Technical specification

For

Outdoor, Oil-immersed, 1250 kVA, 2-winding, 11kV / 433v

Distribution Transformer

REVISION: 00			
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		Indian Electricity Act 2003, BEE Guideline 3 star or better & CEA notifications	
3.5	Rating in KVA	1250 kVA	
3.6	No. of phases	3	
3.7	Frequency	50 Hz, +/- 3%	
3.8	HV winding	One 3-phase winding with **Delta** connection. HV voltage: 11kV±10%	
3.9	LV windings	One 3 phase winding with Y connection with neutral termination.L Voltage 433 Volts	
3.10	Winding material	Electrolytic grade copper for both HV and LV windings	
3.11	Winding Insulation	Class A	
3.12	Vector Group	Dyn11	
3.13	Fault level	H V System: 500MVA	
		LV System: To suit the Impedance with two Transformer connecte parallel.	
3.14	% Impedance	7.25% with IS Tolerance.	
3.15	Termination	HV side : Cable box	LT side: Sandwich Bus duct
3.16	TERMINALS.	- Bottom entry of cables. - Cable size & OD: Shall be provided to vendor at the time manufacturing.	
3.17	TERMINALS.	Sandwich aluminum Bus duct	
3.18	Tapping on HV winding	Off circuit tap changer (OCTC) switch with five tap positions: +5% +2.5%, 0, -5%, -2.5%	
3.19	LV Neutral	Neutral CT to be provided inside the tank and additional neutral bushir should be brought out for earthling(providing external neutral CT in weather proof enclosure outside the transformer is also acceptable) Neutral CT Details; Quantity: 1 No. CT Ratio :2000/1 Class PS V_k.-Knee point Voltage ≥ 200volts	

3.32	LOSSES	As per Energy Losses level 1of IS1180 (part 1)-2014 Maximum total loss@100%load = 10750 watt @75 deg C Maximum total loss@50%load = 3600 watt @75 deg C
3.33	Efficiency at 75^{0}C at UPF	Vendor to indicate value at Full load, 75% load and 50% load.
3.34	Maximum Efficiency (%) and load at which it occurs (kVA)	Vendor to indicate value.
3.35	Overall dimension in mm Length x Breadth x Height	This shall be provided by vendor.
3.36	Oil capacity (in Liters)	This shall be provided by vendor.
3.37	Weight of transformer (kg)	This shall be provided by vendor.
3.38	Regulation at full load, 75 deg C	Value shall be indicated by vendor.

4.0 Constructional features and details of transformer components

4.1	Governing Standard	IS: 2026 and IS: 3639. All materials / components used shall be of best quality and class most suitable for working under the conditions specified.

5.0 Tank

5.1	The transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and cover shall be of welded construction and there should be provision for lifting by crane.
5.2	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.
5.3	The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, preferably of distinct color from the prime and finish coats. The final coat shall be of a glossy, oil and weather resistant non-fading paint of specified shade.
5.4	The interior of the tank shall be cleaned by sand blasting and painted with two coats of heat resistant and oil insoluble paint.
5.5	Steel bolts and nuts exposed to atmosphere shall be galvanized. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets that shall give satisfactory service under the operating conditions for complete life of the transformer, if not opened for maintenance at site.
5.6	The tank together with radiators, conservator, bushings and other fittings shall be designed to withstand the following conditions without permanent distortion: (i) Full vacuum of 760 mm of Hg, for filling with oil by vacuum. Internal gas pressure of 0.35 Kg/cm2 (5 lbs/sq.in) with oil as at operating level. (ii) The transformer shall have conservator tank of adequate capacity to accommodate oil preservation system and volumetric expansion of total transformer oil. The conservator shall be bolted into position so that it can be removed for cleaning purposes.

10.5	Cable boxes shall be provided with suitable gaskets to ensure the specified protection class requirement (IP55). Cable boxes / disconnecting chambers shall be provided with necessary arrangements to prevent entry of rain water into the same.
10.6	**Disconnecting chambers:** (1) Disconnecting chambers shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank. (2) Disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors / links and removable covers. (3) Phase-to-phase and Phase-to-ground clearances within the chamber shall be such as to enable either the transformer or cable to be subject separately to HV tests.

11.0 Neutral Bushings

The neutrals of the star-connected LV windings shall be brought out to separate bushing terminals. The neutral bushings shall be provided on the tank at such a location that facilitates connecting earth conductor down to the ground level.

Tank-mounted pin-type support insulators shall be provided for supporting the neutral earthling bar of specified section, along its run from the neutral bushing to ground level.

12.0 Marshalling box

12.1	Marshalling box shall be tank mounted, outdoor and weather/vermin/dust proof (protection class IP55), sheet-steel (2mm thick minimum) enclosure, with hinged door having padlocking facility and painted. Marshalling box shall have proper lighting and thermostatically controlled space heaters. All doors, covers and plates shall be fitted with neoprene gaskets. Bottom shall be at least 450 mm above floor level and provided with gland plate and cable glands as required. Top surface shall be sloped to drain off water falling on the box.
12.2	It shall be in the vendor scope to provide the interconnection control cabling between the marshalling box and all the accessory devices of transformer by either PVC insulated un armored cables routed through GI conduit (or) PVC insulated, armored cables with metallic casing. Cables used should be UV protected type.
12.3	Necessary cable glands shall be provided at the marshalling box for the above mentioned cables as well as for terminating the incoming cables from remote panels.
12.4	One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. 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.

13.0 Transformer oil

13.1	Transformers shall be supplied complete with transformer oil. The new insulating oil before pouring into the transformer shall conform to the requirement of IS: 335. No inhibitors shall be used in the oil. The oil samples taken from the transformer at site shall conform to requirements of IS: 1866.
13.2	10% extra oil, in non-returnable sealed containers, shall be sent along with main consignment to avoid any shortage of oil at the time of topping up of oil at the site. This oil quantity shall be over and above the specified spares requirement.

14.18	Oil temperature indicator, 150 mm dial type, with alarm and trip contacts, maximum reading pointer & resetting device. Oil temperature range: 0-150 deg C (resolution 1 deg C) Oil temperature accuracy: +/- 2 deg C RTD PT-100 temperature sensor for OTI (IEC 751). Two analog outputs of 4-20mA for remote indication of OTI. Maximum height 1500mm above ground level	1 set
14.19	Winding temperature indicator, 150-mm dial type, with alarm and trip contacts, maximum reading pointer & resetting device. Winding temperature range: 0-200 deg C (resolution 1 deg C) Winding temperature accuracy: +/- 2 deg C Two analog outputs of 4-20mA for remote indication of WTI. WTI shall be provided for all windings Maximum height 1500mm above ground level	3 Nos (1HV+ 2LV)
14.20	Marshalling box (IP55) shall be provided with removable gland plates and glands for cable entry from bottom side. Marshalling box shall be provided with OTI, WTI, transmitters (for 4-20mA output of OTI and WTI), space heater, thermostat, lamp, MCBs, power socket, switch for WTI, terminal connectors and all other attachments that are necessary to meet its functional aspects. Terminal connectors for the following signals / connections shall be made available. Number of terminal connectors for each case shall be as per connection requirements: 1) 4-20mA output for WTI 2) WTI CT secondary 3) Alarm contact of WTI 4) Trip contact of WTI 5) Alarm contact of OTI 6) Trip contact of OTI 7) Buchholz relay alarm 8) Buchholz relay trip 9) Magnetic oil level gauge alarm 10) Pressure relief valve alarm 11) 240V AC supply (external source) 12) Spare connectors: Eight terminals **Note:** Alarm and trip contacts shall be rated for 110 / 220V DC	1 set
14.21	Inspection window with cover	1 set
14.22	Cover lifting lugs / eyes	2 Nos
14.23	Core and winding lifting lugs / eyes	2 Nos

7. Measurement of no-load losses and current at 90%, 100% and 110% of rated voltage
8. Measurement of impedance voltage / short-circuit impedance, load loss on principal and extreme taps
9. Measurement of insulation resistance
10. Dielectric tests - Separate source voltage withstand test
11. Repeating the no-load current, no-load loss and IR measurements after completion of all the dielectric tests
12. Oil leakage test on completely assembled transformer along with unit coolers / radiators:
    All tank and 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 and 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. This test shall be repeated as pre-commissioning test at site with test duration of 24 hours.
13. Jacking test followed by DP test
14. Frequency Response Analysis test
15. Marshalling box / Cable box: IP Class test (IP55): It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
16. IR measurement on wiring of Marshalling Box.
17. BDV test on oil as per IS:335-1993:
    Test certificate shall be submitted to BHEL.
18. Capacitance and tan delta test

16.0 Type Tests shall be offered as per list below:

#	Type test
16.1	Temperature rise test as per IS: 2026 (Type test to be done on One transformer) This test shall be performed as a type test on one transformer. This is a mandatory test and shall be witnessed by BHEL and this test shall be performed at no additional cost to BHEL. This temperature rise test shall be carried out at a tap corresponding to maximum losses as per IS: 2026. Gas chromatography shall be conducted, as per relevant standard, on oil sample taken before and immediately after temperature rise test. Test report shall be furnished to BHEL.
16.2	**Other type tests** List of other type tests is are follows. In case the vendor has conducted the type test(s) on distribution duty transformer of similar rating and type within last 5 years as on the date of technical bid opening, report(s) of the type test(s) shall be submitted to BHEL for waiver of conducting those particular type tests. Such report(s) shall be for the test(s) conducted on transformer that is similar to this present specification. Also, the test(s) should have been conducted at an independent NABL accredited laboratory of repute.

18.3	Warranty Vendor shall provide warranty for **12 months** from the date of commissioning or **18 months** from the date of supply, whichever is earlier. Vendor shall enclose, along with technical bid, the complete scope, terms and conditions of the warranty. During the warranty period, whenever a technical problem is encountered with transformers, BHEL will report the same to the vendor. Vendor shall ensure that the problem is attended to by their service engineer with in from the time of reporting.

19.0 Documents to be submitted along with offer

19.1	Following documents shall be submitted to BHEL along with technical offer: (1) Filled in values/details wherever the same is asked for in BHEL technical specifications (2) Confirmation of NIL deviation to BHEL Purchase Spec. In case any deviation is taken, vendor shall indicate the clause number. BHEL requirement as per the subject clause and the deviation taken.

20.0 Documents to be submitted after receipt of purchase order

20.1	Following documents shall be submitted for BHEL approval within 7 days from date of purchase order. (a) Overall General Arrangement (plan, elevation, end view) with overall dimensions and bill of accessories. (b) Rating plate details (c) Valve schedule plate details with elevation and side view showing valve positions (d) HV cable box with disconnecting chamber, bushings, gland plate, cable termination details etc. (e) LV cable box with disconnecting chamber, bushings, gland plate, cable termination details etc. (f) Marshalling box GA (front view, side view, bill of items) and wiring diagram (g) Foundation plan (h) Bill of material of transformer (i) Gross weight of the transformer (j) Unthanking details (removal of core and assembly from tank) (3) Guaranteed technical specification of transformer in line with Appendix-B (schedule of technical particulars to be furnished by manufacturer) of IS: 2026 (part-1)-1977. (4) Quality assurance plan (routine tests, type tests, test certificates) covering incoming materials, stage-wise inspection during manufacturing, finished goods, packing and forwarding. Witness by BHEL shall be included for stage inspection / final inspection as required. (5) Detailed Test Procedure for all routine, type and special tests and type test report already conducted on similar rating transformer to be submitted. (6) Manufacturing clearance shall be subject to approval of the above documents by BHEL.

	(Each set shall represent complete qty of different types of valves used in one transformer. Total list of valves shall be indicated by vendor during detailed engg)	
4	Pressure Relief Device with trip contacts	1 Nos
5	Winding temperature indicator with alarm & trip contacts	1 No.
6	Oil temperature indicator with alarm & trip contacts	1 No.
7	Buchholz Relay (complete unit)	1 No.
8	Magnetic Oil Level Gauge (MOG)	1 No.
9	Set of Gaskets (Each set shall represent complete qty of different types of gaskets used in one transformer. Total list of gaskets shall be indicated by vendor during detailed engg.)	1 set
10	Silica gel breather with charge	2 Nos
12	Oil in sealed drums – for top up	200 liters

Notes:

a) Vendor shall express compliance for the list of spares and shall provide a complete list of spares showing item-wise unit price, quantity and total price.

b) Make and Quality of spare items shall be in line with corresponding to main supply items.

c) BHEL reserves the right in selection and inclusion of the spares in the scope of supply during technical evaluation stage.

d) Makes of BOI items is subject to BHEL approval during technical evaluation stage.

1.0 INTRODUCTION

Bharat Heavy Electricals Limited (BHEL), Electroporcelin Division, Bangalore is requiring distribution transformer for their operations at EPD Bangalore. The plant propose to install outdoor, oil-immersed type, ONAN, 3-phase, 2-winding transformers to step down the HV voltage of 11 KV to 433 Volts. This document details the technical specifications, supply conditions, erection and commissioning and post-commissioning requirements.

2.0 Scope for Vendor

2.1	**Outdoor Oil-immersed type, ONAN, 3-phase,Distribution Duty Transformer - Rating 1250 KVA, Dyn11, 11kV / 433 V** **1) HV Voltage: 11kV ± 10%** **2) LV voltage 433 V** **3) Vector group: Dyn11**	**2 nos (Vendor shall quote unit price) Note: These two transformers are operated in parallel all the time.**

3.0 Technical specification

#	Technical parameter	BHEL specification	
3.1	Transformer type	Out door, oil-immersed type ONAN type.	
3.2	IP class	Transformer, including the cable box and marshalling box shall be of IP55.	
3.3	Application	Distribution transformer for manufacturing plant operation.	
3.4	Governing Standards	Power Transformer	IS: 2026, IS: 6600 IEC: 60076, CBIP. IS.1180 PART1 2014
		Fittings and Accessories	IS: 3639
		Insulating Oil	IS:335
		Bushings	IS: 2099, IS: 7421
		Bushing CTs	IS:2705
		Degree of protection	IS: 2147
		Tests and tolerance of guaranteed particulars	IS: 2147
		Buchholz relay	IS: 3637
		Electrical insulation classified by thermal stability	IS: 1271
		Climate proofing	IS: 3202

		Im-Magnetising Current ≤ 30mA at $V_{kl}/2$ RCT = CT Secondary resistance ≤ 6 ohms 4 Nos of Similar CTs will be installed in main LT panel and these 4 CTs and 1 neutral CT will be connected in parallel and wired to REF relay. These 4 numbers of CTS will be included in the scope of LT panel supplier and will be mounted in the LT panel.
3.20	Over load Capability	Transformer should be designed for 125% loading for 2 Hours.in a cycle of 24 Hours operation.
3.21	Ambient temperature	Max 50 deg C
3.22	Temperature rise	For top oil: Max.50 deg C by thermometer method. For winding: Max. 55 deg C by resistance method. Both rises shall be over an ambient temperature of 50 deg C irrespective of tap position.
3.23	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 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 Vendor shall furnish over-fluxing characteristics up to 150% during detailed engineering.
3.24	Air Clearances	As per CBIP
3.25	Noise level	As per NEMA TR-1 standard
3.26	Highest system voltage	LV side: 1.1kV HV side: 12 kV
3.27	Insulation Class (Winding and bushing)	As per relevant IS / IEC standard
3.28	Insulation levels Rated Lightning Impulse withstand voltage / Short duration power frequency withstand voltage	Values to be provided by the vendor..
3.29	Painting	Light Grey Shade 631 of IS:5
3.30	Constructional features	As per clause 5.0 of this specification
3.31	Fittings and accessories	As per clause 6.0 of this specification

	(iii) The conservator shall be of single compartment type. 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. (iv) The tank cover shall be suitably sloped so that it does not retain rain water. The material used for gaskets shall be cork, neoprene or approved equivalent.

6.0 Core

6.1	The magnetic circuit shall be of core type. The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations (CRGOS) to suit the losses mentioned in point 33 . The manufacturers test certificate for the CRGOS shall be provided at the time of pre-dispatch inspection, indicating the traceability.
6.2	The insulation structure of the core to clamp plates shall be such that it withstands a voltage of 2kV (RMS) for one minute in air.
6.3	Adequate lifting lugs will be provided to enable the core & windings to be lifted.

7.0 Windings

7.1	Windings shall be of electrolytic grade copper free from scales and burrs.
7.2	Windings shall have uniform insulation.
7.3	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
7.4	The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.
7.5	Windings shall be made in dust proof and conditioned atmosphere.

8.0 Internal earthling

8.1	The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.

9.0 Bushings

9.1	Bushings shall be designed and tested to comply with the applicable standards. If type test certificates are not available, these tests shall also be carried out in addition to the routine tests. Bushings shall have non-ferrous flanges and hardware. Bushings shall be supplied with terminal connector clamp suitable for connecting the cables.

10.0 Cables boxes and disconnecting chambers

10.1	Cable boxes shall be supplied with gland plates having holes to suit BHEL supplied cables.
10.2	Cable boxes / disconnecting chambers shall be provided with body earth terminals.
10.3	LV boxes shall be provided with necessary bus bars, bus bar supports for making Busduct terminations.
10.4	HV cable boxes shall be provided with necessary HV bushings and terminals for making cable terminations.

14.0 Fittings and accessories

Following fittings per transformer shall be provided. Vendor shall indicate compliance (Yes / No) for each line item. In case of non-compliance or deviation, vendor shall indicate and provide comments.

#	Nomenclature of fitting / accessory	Qty
14.1	Oil conservator with equalizer pipe	1 set
14.2	HV cable box	1 set
14.3	LV box Suitable for Bus duct.	1 sets
14.4	Off circuit tap changing switch (OCTC) with operating knob, tap position marking and locking facility, with warning plate "Tap switch to be operated only with the transformer de-energized".	1 set
14.5	Neutral Bushings and Neutral CT.	1 set.
14.6	Earthling terminals with hardware suitable for connecting 50x6 GI earth strips. Separate terminals shall be provided for cable boxes, tank etc.	1 set
14.7	Radiators (detachable type) with drain value at the bottom, relief valve at the top, air plug, shut-off valves at every point of connection to the tank and lifting lugs.	4 sets
14.8	Double float Buchholz relay with alarm and trip contact. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. Buchholz relay shall be provided with 2 nos. shut-off valve (on conservator side and tank side) of size 50 mm.	1 set
14.9	Provision for collecting gas and oil from Buchholz relay	1 set
14.10	Silica gel dehydrating breather with oil cup; indicating type cobalt free silica gel breather in transparent enclosure. (maximum height 1400 mm above ground level)	1 set
14.11	Magnetic oil level gauge (MOG), dial type, with alarm contact, minimum and maximum filling level markings. Contact shall be suitable for 110V/220V DC. The oil level at 30 deg C shall be marked on the gauge.	1 set
14.12	Prismatic / toughened glass oil level gauge for transformer and tap changer chamber with min and max markings.	1 set
14.13	Spring operated Pressure relief valve with alarm/trip contacts. Location of this valve shall be such that the hot oil discharge shall not fall on the transformer or any of its parts. This shall include all necessary arrangements to facilitate proper discharge of PRV through discharge pipes away from the transformer.	1 set
14.14	Thermometer pocket for OTI	1 No
14.15	Temperature sensor for OTI	1 No
14.16	Thermometer pocket for WTI	1 No
14.17	CT for WTI	1 No

14.24	Tank lifting lugs / eyes for the entire transformer	4 Nos
14.25	Jacking pad with hauling eyes, to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	4 sets
14.26	LV cable box supports with mounting plates	1 sets
14.27	HV cable box supports with mounting plates	1 sets
14.28	Bi-directional flat rollers	4 sets
14.29	Base channel with towing holes / lugs	2 sets
14.30	Air release hole with plug	1 No
14.31	Oil filling hole with cap	1 No
14.32	Top filter cum sampling valve with threaded male adapter (blanking plug)	1 No
14.33	Bottom filter valve with threaded male adapter (blanking plug)	1 No
14.34	Drain valve for conservator, with blanking plug	1 No
14.35	Shut-off valves for conservator	2 Nos
14.36	Bottom Sampling valve, with blanking plug	1 No
14.37	Shut-off valves for radiators, with open and close markings	8 Nos
14.38	Drain / Sludge valve at bottom most point of tank to be provided for easy flush out / removal of sludge during maintenance	1 No
14.39	Valve schedule plate made of stainless steel or aluminum (anodized)	1 No
14.40	Rating and diagram plates made of stainless steel or anodized aluminum (Hindi and English)	2 Nos
14.41	Terminal marking plates	1 Set
14.42	Core to frame earthling hood (2kV isolation)	1 No
14.43	Earthling pads	2 Nos
14.44	Rain hoods on Buchholz, MOG and PRD with entry points of wires suitably sealed	1 set
14.45	Bolts & nuts - Galvanized steel / S.S	1 set

15.0 Routine tests

15.1	All routine tests as per IS 2026 shall be carried out on 100% basis. These tests shall also necessarily include the tests listed below (if not already included under Routine Tests of IS 2026): 1. Measurement of voltage ratio and phase displacement 2. Measurement of winding resistance on all the taps 3. Vector group check 4. Polarity check 5. Magnetic balance and magnetizing current test 6. Measurement of no-load current with 415V, 50Hz AC supply

	In case the vendor is not able to submit report(s) of the type test(s) conducted within last 5 years from the date of technical bid opening (or) in case the type test reports are not found to be meeting the specification requirements, the vendor shall conduct the type test(s) on one no. of transformer as per applicable standards at no additional cost to BHEL and the type test reports shall be submitted to BHEL for approval.
16.3	Tank vacuum and pressure test as per CBIP norms.
16.4	Zero sequence impedance measurement test
16.5	Measurement of harmonics of no load current
16.6	Measurement of acoustic noise level as per NEMA TR-1
16.7	Lightning impulse (full & chopped wave) test on HV & LV windings

Note: BHEL shall witness the tests indicated above at vendor works.

17.0 Inspection and testing of transformers at vendor works

17.1	Vendor shall provide inspection call to BHEL for the type and routine tests. Prior to the call, vendor shall submit the detailed quality plan for approval. Inspection shall be carried out by BHEL.

18.0 Installation and commissioning support for the transformers at site:

18.1BHEL scope of activities at site for installation and commissioning:

(1) Movement and positioning of transformers on their respective foundation: .BHEL shall arrange all necessary material handling Equipment.
(2) Erecting / assembly of transformer fittings and accessories: BHEL shall arrange all necessary material handling Equipment

18.2 Vendor scope of activities at site for commissioning:

(1) Supervision of erection / assembly of transformer fittings and accessories including marshaling box wiring.
(2) All the electrical pre-commissioning checks prior to charging of the transformer at site (on 100% basis). This shall include IR on LV/HV, vector group, magnetic balance, magnetizing current, winding resistance on LV/HV at different tap positions. Consolidated test report shall be submitted to BHEL.

(3) Commissioning / service engineer(s) shall be available at site at the time of commissioning. All necessary guidance / support in overcoming technical problems (if any) related to the transformers

21.0 Documents to be submitted during pre-dispatch inspection and along with consignment

21.1	Following documents shall be submitted to BHEL at the time of pre-dispatch inspection and delivery of the consignment: (1) As built drawings of transformer (2) Routine test reports on transformer (3) Type test reports on transformer (4) Test certificate for pressure & vacuum test on tank (5) Test certificate for transformer oil (6) Operations and Maintenance manual of transformer - 4 hard copies along with a soft copy (7) Technical datasheets of transformer accessories such as Buchholz relay, Magnetic oil level gauge, Pressure release valve, OTI, WTI, Temperature sensor (PT-100), Explosion vent with diaphragm, Breather with silica gel, HV / LV Bushings, CT for WTI and other brought out items.

22.0 Support from vendor during document approval phase

22.1	During the phase of approval of design / engineering / quality documents (GA, DS, BOM, MQP, Test report etc.), it will be required to hold in-depth discussions with BHEL to provide clarifications through clear understanding of technical queries. Accordingly, when needed, vendor shall hold direct (across-the-table) discussions with BHEL (Bangalore office) to eliminate undue time delays.
22.2	Site support: Vendor shall ensure that any problem/ failure of transformer at site is attended to within a period of 48 hours from the date of reporting of the problem by BHEL to vendor. Transformer shall be rectified and made functional within this period.

2.3.0 **Spares shall be offered as per list below:**

#	Spares	Qty
1	HV Bushings with metal parts and gaskets	1 set (3 Nos)
2	LV Bushings with metal parts and gaskets	1 set (3 Nos)
3	Set of valves	1 set