

Annexure-A

Technical specification for repair of 5 MVA, 33kV/6.6 KV Transformer

SL.	Head	BHEL Specification	Vendor Remarks
1.0	Introduction	This document details the technical specifications for the repair of 33kV/6.6 kV, 5MVA transformer.	
2.0	Scope for the Vendor	A) Repair of Outdoor, Oil-immersion type, 3-phase, 2-winding with one LV winding and one HV winding, 5000 kVA, 33kV/6.6kV Transformer with accessories and design details as per Annexure-I. Necessary rectification shall be carried out by using existing core, transformer tank, insulating material and MS plates. Vendor shall ensure functionality of all the following components /features: 1) Winding temperature indicator with alarm and trip contacts 2) Oil temperature indicator with alarm and trip contacts 3) Gaskets 4) Buchholz relay with alarm and trip contact 5) Pressure relief valve with alarm and trip contact 6) Magnetic oil level gauge 7) Tap changer 8) diaphragm of explosion vent Please mention the items which can not be repaired and need to be replaced. Vendor shall provide Techno-commercial offer for repair work as per tender. B) E&C of transformer and extending of protection alarm to relay panel.	
3.0	Technical Specifications	Vendor should provide compliance with the specifications given by BHEL. In case of non compliance or deviations, vendor should provide their comments.	
3.1	IP class	Transformer, including the cable and marshalling boxes, shall be maintained of IP55.	
3.2	Type of cooling	ONAN	
3.3	Governing Standard	IS: 2026 -1977 for transformer and IS 335 for Oil.	
3.4	Rating in kVA	5000 kVA	
3.5	No. of phases	3 PHASES	
3.6	Frequency	50 Hz, +/- 3%	
3.7	Vector group	Dyn11	
3.8	HV winding	One 3-phase winding with Delta connection. HV voltage: 33 kV (LL). Specifications of the Conductor are as per Annexure-I	
3.9	LV windings	One 3-phase winding with Star with neutral connection. LV voltage: 6.6 kV (LL). Specifications of the Conductor are as per Annexure-I	
3.10	Winding material	Electrolytic grade Copper for both HV and LV windings with design as per Annexure-1.	
3.11	Winding Insulation	Class A Insulation levels according per IEC 60071(HV terminal – 170 kVp, LV terminal – 60kVp).	

3.12	Neutral on LV side	Neutral terminals of the winding to be brought out separately to facilitate making external connections such as earthing.	
3.13	Termination HV/LV	Bare bushings on HV side /Cable box on LV side shall be maintained.	
3.14	Cable entry on HV side	Over head termination with ACSR conductor shall be maintained.	
3.15	Cable entry on LV side	Bottom entry of cables shall be maintained..	
3.16	Taping on HV winding	ON Load tap changer with auto voltage regulator shall be maintained.	
3.17	Operating flux density	The operating flux density should be below saturation level when HV is sourced with rated supply voltage and tap position is at -5%.	
3.18	Ambient temperature	Max 50 deg C.	
3.19	Temperature rise	For 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	
3.21	Load loss at principal tap at 75 deg. C, with IS tolerance	≤ 37000 +IS shall be maintained. Exact value shall be specified.	
3.22	No Load loss at rated voltage on principal tapping and at rated frequency, with IS tolerance	≤ 5300+IS shall be maintained. Exact value shall be specified.	
3.23	No load current at rated voltage and rated frequency	≤ 1.5% shall be maintained	
3.24	Short circuit capacity	≥ 16 times of rated MVA	
3.25	Efficiency at 75 °C and UPF	≥ 99% at 100%, 75% and 50% Load.	
3.26	Harmonics	The application is to for substation to provide load to BHEL R&D labs.	
3.27	Vibration & noise	Noise level shall be according to NEMA TR-1 2013 standard.	
3.28	Percentage impedance	≤ 6 %+IS	
3.29	Oil quantity required to be filled in transformer (in Litres)	This shall be provided by vendor.	
3.30	Weight of transformer in Kg and Overall dimensions in mm	This shall be provided by vendor	

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3.31	Constructional features	Transformer shall be constructed as per BHEL approved design drawing (Annexure-1) and shall be tested as detailed in 5.1 and 5.2 of this specification. All materials used shall be of best quality and of the class most suitable for working under the conditions specified. These shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion or deterioration, without development of stresses in any part and also without affecting the strength and suitability of the various parts for the work that they have to perform. Tank : Existing tank only shall be used. Core: Existing core shall be used and modifications shall be done as specified by BHEL Windings: Windings shall be made of electrolytic grade copper. Windings shall be modified as specified in Annexure-I 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. Termination: Transformers shall be fitted either with cable boxes / cable box with disconnection chambers Existing Bushings shall be used and tested along with transformer.
3.32	Constructional features (Contd...)	Oil: 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.
4.0	Fittings and accessories (Reference standard: IS 3639)	Following fittings on transformer shall be maintained, and their functionality shall be ensured. Vendor shall indicate compliance (Confirmed/ Not Confirmed) for each line item. 1) Oil conservator with equalizer pipe. 2) HV bare bushings. 3) Transformer primary, secondary and neutral Bushings Current Transformers (preferably ring type CT's) for the Transformer Differential Protection to protect transformer from inter-tern faults & winding faults. 4) LV cable box. 5) LV disconnecting chamber. 6) On Load tap changer. 7) Neutral bushings for earthing of LV windings 8) Earthing terminals with hardware suitable for connecting earth strip. Separate terminals shall be provided for cable boxes, tank, etc. 9) Radiators with drain, air plug, top & bottom shut-off valves, lifting lugs. 10) Buchholz relay with alarm and trip contact. 11) Provision for collecting gas and oil from Buchholz relay. 12) Silica gel dehydrating breather with oil cup.

		13) Magnetic oil level gauge (dial type) with alarm contact, minimum and maximum filling level markings.	
		14) Prismatic oil level gauge with min and max markings	
		15) Pressure relief valve with alarm contacts. Location of this valve shall be such that the hot oil discharge shall not fall on the transformer or any of its parts.	
		16) Explosion vent (double diaphragm) with sight glasses and equalizing pipe connection to conservator.	
		17) Thermometer pocket for OTI.	
		18) Temperature sensor for OTI.	
		19) Thermometer pocket for WTI.	
		20) OTI and WTI indicators with alarm and trip contacts (with annunciation signal to breaker). Alarm and trip contacts shall be suitable for (240) 230/115 V ac and contacts shall be of potential free digital status output.	
		21) Marshalling box (IP55) provided with removable gland plates and glands for cable entry from bottom side.	
4.0	Fittings and accessories	22) Inspection window with cover.	
	(Contd..)	23) Cover lifting lugs.	
		24) Core and winding lifting lugs / eyes.	
		25) Tank lifting lugs for the entire transformer.	
		26) Jacking pad with hauling eyes, to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	
		27) Bi-directional flat rollers.	
		28) Base channel with towing holes / lugs.	
		29) Air release hole with plug.	
		30) Oil filling hole with cap.	
		31) Top filter valve with blanking plug.	
		32) Bottom drain valve with filter (top of the tank).	
		33) Shut-off valves for conservator.	
		34) Sampling valve, with blanking plug.	
		35) Drain valve for conservator, with blanking plug.	
		36) Shut-off valves for radiators, with open and close markings.	
		37) Required quantity of Transformer oil for fulfilling the tank.	

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5.0	Inspection and testing of transformer at vendor works	Vendor shall provide inspection call to BHEL for routine tests. Vendor shall offer stage inspections during the repairs of above power transformer, in addition to the final testing and the inspection reports shall be submitted to BHEL. Final Inspection (Test) reports shall be submitted duly entering minutes of meeting indicating the tests conducted, comments on test results and any balance works to be attended. Without the above MOM with the inspecting officer, the test reports will not be considered for approval and issue of dispatch instructions.	
5.1	Routine tests as per IS 2026/1180 as applicable	Following tests shall be carried out on 100% basis. BHEL will witness the tests. 1) Measurement of winding resistance. 2) Measurement of voltage ratio. 3) Vector group check. 4) Magnetic balance test. 5) Measurement of no-load loss and current. 6) Measurement of impedance voltage / short-circuit: impedance, load loss. 7) Measurement of insulation resistance. 8) Dielectric tests. a. Separate source voltage withstand test. b. Induced overvoltage withstand test. 9) Tank oil leakage/pressure test. 10) Pressure relief valve test.	
5.2	Additional tests	Additional tests Before and after HV dielectric tests 1. Magnetic balance 2. Magnetising current 3. Oil break down voltage	
6.0	Documents to be submitted along with the repaired transformer	Following documents shall be submitted to BHEL at the time of delivery of the consignment. (1) Dimensional report of transformer as per BHEL approved design (2) Routine test reports on transformer as per 5.1 and 5.2	
7.0	Delivery	Delivery period shall be preferably 4 to 8 weeks and shall be specified.	
8.0	Warranty	Vendor shall give warranty for the transformer for a total period of 24 months of service from the date of commissioning of the repaired transformer. In case, the transformer fails within 24 months of warranty period as mentioned above, the repaired transformer should be warranted for a period of 24 months from the date of commissioning after repairs and performance bank guarantee shall be extended for the fresh guarantee period plus 6 months of claim period. To & fro transportation and repair cost of failed transformer during warranty period has to be borne by the vendor.	

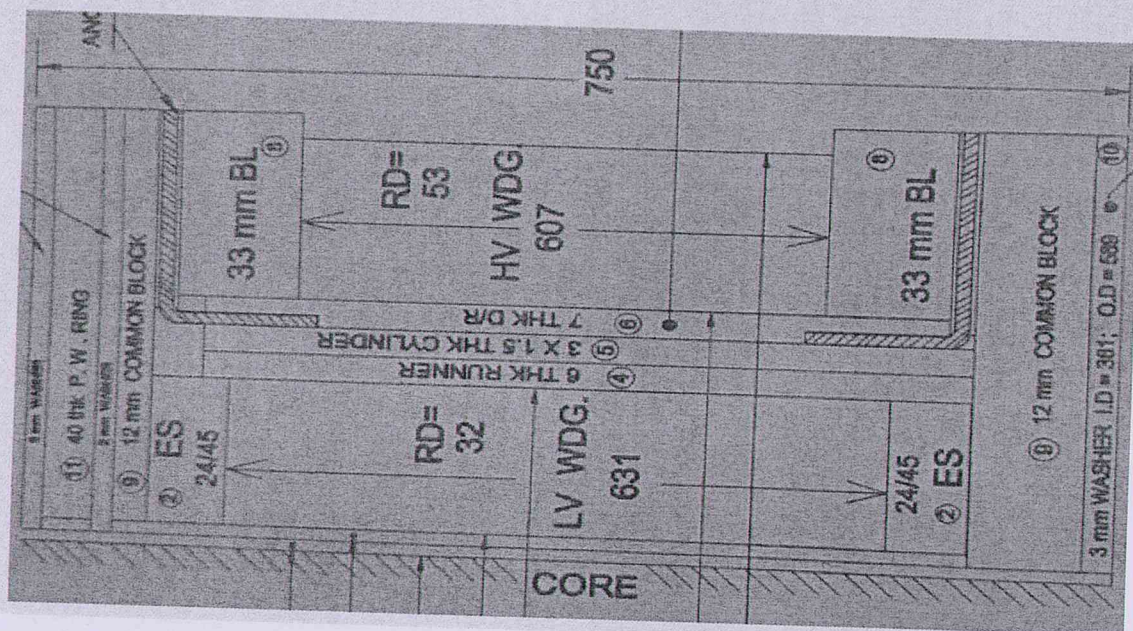
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9.0	E&C	Vendor has to depute their authorized person/engineer at the time of erection to ascertain any shortages of oil or short supply of materials or unattended works, which are to be rectified at the place of allotment within one week of intimation. All the Vendor to bring all tools and tackles required for E&C is in Vendor's scope.	
10.0	Freight & Insurance	Shifting of transformer including transport, loading, unloading and all other costs, to and fro from BHEL R&D to Supplier's Works and insurance during above/on site warranty will be in supplier's scope.	
11.0	Visit to site(Optional)	The supplier may visit the site (BHEL R&D) to access the requirement before submitting the tender. For visit Sh. Munnuru Srinivas (040-23882365) may be contacted.	

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Annexure-I

Existing Design Layout



LV Winding: ID-375, OD-439, Ht-679
 Conductor: 2.6x6.8 0.2tk radial paper (3.0x7.2), parallel 2-rad x 3-axial
 Turns: 110 (27.5 turns x 4 layers - spiral)
 Duct: Nil

Transposition: In-Out transposition at middle

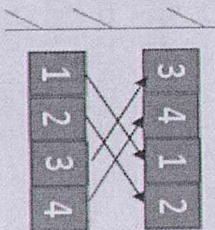
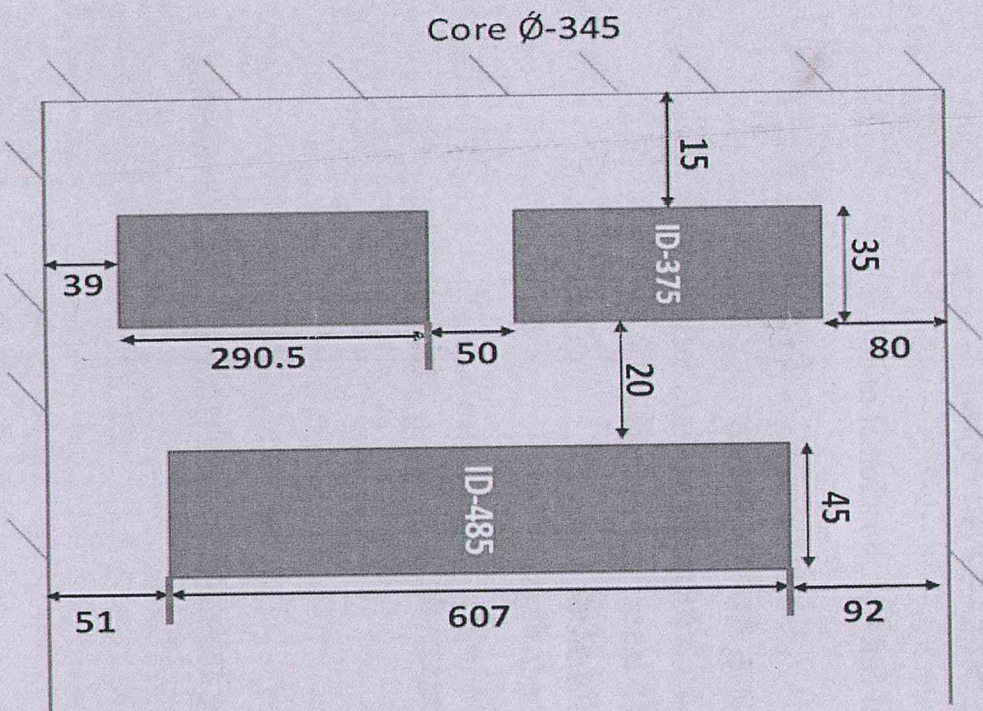
HV Winding: ID-475, OD-581, Ht-610
 Conductor: 2.9x4.7 0.3tk radial paper (3.5x5.3)
 Turns: 1001. (64 Main+8 Tap) 72 discs
 Main: 64*14.15t/d = 905
 Duct: 3mm between discs
 Tap: 8*12t/d = 96
 Duct: 4.5mm between discs

Note:

Top pressing ring: 40mm Pressboard (10mm chipped for winding adjustment)

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Proposed Modifications



LV Winding: ID-375, OD-445, Ht-631

Conductor: 3.65x8.0 0.3tk radial paper (4.25x8.6), 4 parallel radially

Turns: 112 (56 discs x 2 turns/disc)

Duct: 2mm between discs and 50mm at middle

Transposition: Block transposition between discs 28&29

HV Winding: ID-485, OD-577, Ht-607

Conductor: 2.4x5.65 0.3tk radial paper (3.0x6.25)

Turns: 1019. (56 Main+16 Tap) 72 discs

Main: $41 \times 15t/d + 15 \times 14t/d = 825$. (Disc no's with 14 turns)

Duct: 2mm between discs

Tap: $14 \times 12t/d + 2 \times 13t/d = 194$. (Disc no's with 13 t/d – 33 & 40)

Duct: 4mm between discs

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Proposed modifications:

- The LV winding will be having disc configuration with 4 conductors (strands) in parallel (radially) and 2 turns per disc. 2mm radial ducts to be provided between the discs.
- The HV winding will have similar disc configuration with proposed changes in conductor dimensions and interleaving to be provided as per existing practise.
- The top pressing ring will comprise of 20mm tk MS ring + 30mm tk Pressboard ring.
- Yoke clamping has to be arranged with Tie rods (2 no's per yoke) above yokes and clamped to end-frames suitably with required insulation.

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