 <b>BHEL</b> CBU EPD	<b>PURCHASE SPECIFICATION</b> <b>3 Ph. 11kV / 440 V 50 Hz , 500 kVA</b> <b>DISTRIBUTION TRANSFORMER</b>	Spec. No	EP:PVM:EQS:05
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**TECHNICAL SPECIFICATION**  
**FOR**  
**3 Ph. 11kV / 440 V 50 Hz 500 kVA DISTRIBUTION**  
**TRANSFORMER**

**ELECTROPORCELAINS DIVISION,**  
**BHARAT HEAVY ELECTRICALS LTD.,**  
**IISc POST, BANGALORE, INDIA 560012**

<b>REVISION DETAILS: (00)</b>	<b>PREPARED</b>		<b>DATE</b>
	<b>APPROVED</b>	<b>ISSUED</b>	<b>30.11.2015</b>

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**TECHNICAL SPECIFICATION FOR 11KV/433V, 500 KVA TRANSFORMER FOR BHEL-EPD,**  
**MALLESWARAM COMPLEX, BENGALURU**

- |                                    |   |
|------------------------------------|---|
| 1. Quantity                        | : 4 Nos   |
| 2. Type of cooling                 | : ONAN. Mineral oil filled                          |
| 3. Rating (at all taps)            | : 500 KVA, Distribution Transformer                 |
| 4. Number of phases                | : 3   |
| 5. Voltages primary (L-L)          | : 11000 volts -10% to +10%                          |
| Secondary (L-L):                   | 415 volts   |
| 6. Frequency                       | : 50Hz $\pm$ 3%                                     |
| 7. Combined volt & freq. Variation | : 10% (Absolute sum)                                |
| 8. Number of winding               | : 2   |
| 9. Vector group                    | : DYN11   |
| 10. Impedance / Tolerance          | : 5% on principal tap<br>(Tolerance as per IS 2026) |
| 10a. Voltage/ freq ratio           | : Shall be designed for 1.1 continuous.             |
| 11. Installation                   | : INDOOR  |
| 12. Ambient temp                   | : 50 Degree C                                       |
| 13. Duty                           | : Continuous  |

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14. Temperature rise

(a) Design ambient temp. : 50 Degree C.

(b) Temp. rise of top of oil by thermometer : 50 Degree C.

(c) Temp. rise of wdg. by resistance method : 55 Degree C

15. Class of insulation : Class- "A"

16. Relative Humidity : 100 %

17. Short Ckt. level at 11 kV : 40 KA RMS

18. Suitability to withstand Vacuum breaker switching On primary and secondary sides : Required


19. a) Material of winding : Copper – Electrolytic Grade

b) Core : The Maximum flux density at any part of core and yoke shall not exceed 1.9Wb/m<sup>2</sup> at any tap Position with  $\pm 10\%$  voltage variation from voltage corresponding to the tap. The laminated core shall be of high grade cold rolled grain oriented silicon steel.

c) Tank : Tank shall be of welded construction and Fabricated from tested low carbon steel. It shall be designed for a continuous internal pressure of 0.35 Kg/sq.cm over normal hydrostatic pressure of oil. All bolted connections shall be fitted with weather proof hot oil resistant gasket, in between for complete oil tightness. The gaskets shall give a satisfactory service under the operating conditions and guaranteed temperature rise conditions

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Bi-directional skids, rollers, jacking pads (four nos), Lifting lugs shall be provided.

d) Hardware : All nuts and bolts exposed to weather shall be hot dip Galvanized or cadmium plated or zinc passivated steel.

20. Noise : Not to exceed values specified in NEMA TR-1.

21. Insulating oil : Fresh oil (before pouring into transformer) should be as per IS 335, without inhibitor. 10% extra oil shall be supplied for topping in non-returnable containers in sealed drums.

22. Terminal arrangement : HV Terminal boxes on both primary and secondary side, suitable for termination of HT-XLPE cable with Raychem type heat shrinkable terminating kits.

4mm thick MS blank (undrilled) gland plates to be supplied with primary and secondary sides on the bottom surface and Marshalling boxes.

The secondary neutral shall be brought out and be fitted with suitable rated CT in an enclosed chamber on the transformer as per IP 55 protection. The Porcelain Bushing for neutral conductor shall conform to IS 2099 & IS 3347 and shall be covered with suitably slopped plate to protect from rain water.

The minimum length between cable gland plate and cable Lugs should be 550 mm for both primary and secondary sides of cable Boxes. Terminal marking shall be as per IS 2026.  
*Epoxy bushings are not acceptable.*


23. Tap changer : OFF LOAD TAP CHANGER

24. Taps : Taps -10% TO +10% in steps of 5 %

25. Painting : **Grey Shade 631 as per IS: 5 latest revisions** with

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2 coats of primer and 2 coats of paint.

26. Fittings and accessories : As per Annexure-1
27. Standards : IS 2026 latest edition.
28. Inspection and Testing : As per Annexure –2
29. Quality plan : Supplier shall submit his Quality Plan for approval.
30. Testing (Type Test) : Type test certificates to be produced as per Annexure – 3
31. Efficiency at rated current, rated Voltage and Unity power factor at 75C (i.e. at Full load) : **99.00% (Minimum) (without any tolerance)**
32. Over Load capacity : As per IS 6600
33. Information flow : (A) The DATA SHEETS shall be completed filled and all guaranteed figures must be without any tolerance. Supplier must very clearly mention, if any deviation is taken on the specification.
- (B) Following information shall be submitted after placement of order.
- (a) All preliminary drawings for approval.
- (i) Soft Copies in PDF format only.  
(GA, BOM, Data Sheet, Quality Plan, Type Test Procedures etc)

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**(b) All final drawings after approval**

- (i) 2 hard copies of Final Drgs & Data Sheet
- (ii) 2 hard copies of Test certificates and Guarantee certificates
- (iii) 2 hard copies of Instruction & Maintenance Manual
- (iv) All Final Drawings / datasheets / Test Certificates, Instruction & Maintenance Manual in CD- ROM.

34. DATA SHEET

: DATA SHEET is enclosed with this specification. The same is to be filled up and submitted along with the technical offer.

35. Pre-Qualification Criteria

: As per annexure-4

36. Information Reqcd with Offer

: (i) filled up data sheet


(ii) Deviations to this specification.(If there are no deviations, supplier must mention the same explicitly in their technical offer.)

(iii) Work completion /Experience certificates from respective customers along with their contact details for having supplied, installed a minimum of 3 nos. of similar rating transformers in India during the past 5 years and these must be operating satisfactorily.

**Note: The price quoted by the vendor should be inclusive of supervision charges for commissioning.**

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**ANNEXURE - 1**

All accessories shall be provided confirming to IS 3639. The following fittings and accessories shall be provided:

SL.NO	DESCRIPTION	QTY
1.	Oil filling hole with cover on conservator	1
2.	Conservator with sump & drain valves With plug/cover plate. The Breather Shall be mounted at a height less Than1600 mm from the ground.	1
3.	<b>a)</b> Magnetic Oil level gauge(Dial type) With minimum and maximum filling level markings. It should have two Independent electrically insulated low level alarm contacts suitable for 110 V DC. The oil level at 30 deg C Shall be marked on the gauge. The Contacts shall be suitable for 110 V DC.	1
	<b>b)</b> Prismatic oil level gauge	1
4.	Thermometer pockets	1
5.	Air release plug on tank cover	1
6.	Lifting lugs	1 SET
7.	Top filter valve	1
8.	Dehydrating breather with Silica gel and oil seal	1
9.	Rating and terminal marking stainless steel/anodized Aluminium plate, with details etched in MKS & SI units in English	1 No.

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SL.NO	DESCRIPTION	QTY
10.	Earthing terminals without lugs suitable for connecting 50x6 mm galvanized mild steel flat.	2
11.	Diagram plate	1
12.	Drain cum bottom filter valve <u>(A sampling device or sampling facility on drain valve)</u>	1
13.	Base channel with towing holes/lugs	2
14.	Double diaphragm explosion vent with Sight glasses and equalizer pipe Connection to conservator.	1
15.	Four Jacking Pads to enable transformer with oil to be raised or lowered using Hydraulic or screw jacks.	1 SET
16.	Manufacture's name plate (stainless steel)	1
17.	Bi-directional rollers + Bi-directional skids	1 SET
18.	Detachable radiator with bottom drain Plug, top air release plug and top & bottom Shut off valve.	1 SET
19.	Buchholz relay ( Oil and gas )should be of double float type with testing & sampling cocks, alarm and trip contacts and one isolating valve on conservator side	1
20.	150mm dial type oil temp. Indicator and winding temp. Indicators with max. pointer with alarm and trip contacts. Contacts suitable for 110V DC. with adjustable alarm and trip points. Full scale temp. 240 deg C. Least count 2 deg C.Oil / Winding temp. Indicators should be provided with resetting device.	1 SET

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SL.NO	DESCRIPTION	QTY
21.	Pressure Relief Valve on Tank side wall With Alarm and Trip contacts.(Location of this valve will be such that the hot oil discharge shall not fall on the Transformer or any of its parts.)	2 Nos.
22.	Marshalling box (protection class IP55 and IS 2147) epoxy painted. Should be vermin, weather, dust proof. Terminal connector of control cable should be of reputed make.20% extra spare terminals reqd. All TBs to be complete with insulating barriers, clip on type terminals suitable to 2.5 sq mm stranded copper wire. The marshaling box and temperature indicators shall not be mounted at a height greater than1600 mm from the ground level. The box shall be tank mounted with sloping roof. All incoming cables shall enter from bottom sheet steel to be 1.6 mm thick. Thermostatically Controlled space heaters shall be provided.	1 No
23.	Inspection openings on tank with handle	2 Nos
24.	Winding temperature indicator with alarm & trip	1 SET

**NOTE:**

1. Contacts of all temp indicators, Buchholz relays and auxiliary devices shall be suitable for 110 V dc supply. All alarm and trip contacts shall also be suitable for 110 V dc circuits. External power Supply will not be provided.
2. Nuts and bolts exposed to weather to be hot dipped galvanized or cadmium plated or zinc passivated steel.
3. Control wiring to be done with 1100 V grade PVC wire, 2.5 mm stranded copper wire.
4. Cable glands and lugs shall be supplied loose along with transformer. Cable glands shall be double compression nickel plated brass. Cable lugs will be installed with fixing hardware in the cable box.

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## ANNEXURE - 2

A comprehensive Quality Assurance plan (QAP) for the transformer and bought out/sub contracted items to be submitted and got approved by M/S BHEL after placement of order.


### A) Final testing of the finished Transformer

The following tests shall be conducted on the transformers. Also please note that all routine tests shall be as per **approved quality plan only**.

- All Routine tests in accordance with the latest issue/ amendments of IS 2026 shall be done on Transformer.
- Jacking test.
- **Oil leakage test**  
All tanks and oil filled compartment shall be tested for oil tightness by completely filling with air, or oil of a viscosity not greater than that of insulating oil, at an ambient temp of 50 deg C, and subjected to a pressure equal to the normal pressure plus 0.35 Kg/cm<sup>2</sup> measured at the base of the tank. The pressure shall be maintained for a period not less than 24 hours for fluid and 1 hour for air, during which time no leakage shall occur.
- All auxiliary equipment shall be tested as per the relevant IS and Test certificates shall be submitted for bought out items. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.
- BDV test on oil samples before start and after finish of all Routine tests.
- Magnetic Balance Test
- Repeat of no load test after all electrical tests.

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**Annexure-3**

The following type tests shall be done on the Transformer and the quoted price should be inclusive.


The Type tests shall be in accordance with latest issue / amendments of IS: 2026 in presence of M/s BHEL officials.

1. Measurement of zero sequence impedance.
2. Measurement of capacitance and tan delta of all Transformer windings.
3. Measurement of acoustic noise level. This shall conform to NEMA standard publication TR-1
4. Temperature rise test
5. Measurement of harmonic current in no-load current.

Other Type test certificates for the similar rating transformer in accordance with latest issue / amendments of IS: 2026 shall be submitted.

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#### Annexure-4

##### Pre-Qualification Criteria:

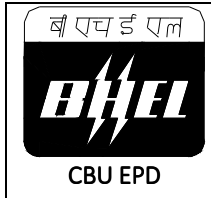
1. The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers along with an authorization letter can submit offers. An authorized Representative/Dealer cannot quote for the same equipment from more than one OEM.
2. Offer shall be for new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.
3. The vendor should have already supplied and installed a minimum of 10 nos. of similar rating transformers in India during the past 3 years and these must be operating satisfactorily. The details of the customers with contact details, transformers installed, date of installations etc. to be provided. BHEL reserves the right for independent verification of the references provided.
4. The vendor or their authorized service representatives shall have trained engineers for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for our installations.
5. The vendor shall be in a position to provide service support for the equipment supplied, after the expiry of the warranty/ guarantee period either directly or through a service representative.
6. The vendor shall furnish a comprehensive warranty for at least 12 months from the date of commissioning.

##### **Note:**

1. Pre-qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre-qualification criteria are mandatory requirements and the technical bids will be evaluated only when the Pre-Qualification criteria are met.

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**DISTRIBUTION TRANSFORMER**

Spec.  
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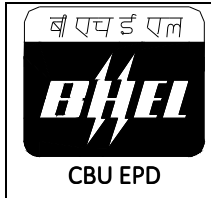
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**DATA SHEET**

SI No	Details	Vendor Confirmation / Response
1	Manufacturer's Name and address	
	Are you Original Equipment Manufacturer or authorized Dealer?	
	Is authorization letter from OEM enclosed if you are a dealer?	Yes/No
2	Service Class / KVA rating	
3	Rated Voltage	
	a) Primary Winding KV	
	b) Secondary Winding KV	
4	Rated frequency	
5	Number of phases	
6	Connections	
	a) Primary Winding	
	b) Secondary Winding	
7	Connection symbol	
8	Type of cooling	
9	Insulation level	
	a) Separate source power frequency voltage withstand	
	i) Between Windings(KV rms)	
	ii) To Earth (KV rms)	
	iii) Between adjacent contacts(KV rms)	
	iv) Between first and last contact (KV rms)	
	b) Switch impulse withstand voltage	
	i) Between Windings(KV Peak)	
	ii) To Earth (KV Peak)	
	iii) Between adjacent contacts(KV Peak)	
	iv) Between first and last contact (KV Peak)	
10	Guaranteed positive sequence impedance at 75 deg C with 100% rating at	
	i) at Principal tap	

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Sl No	Details	Vendor Specifications
	ii)Maximum tap (Approx)	
	iii)Minimum tap (Approx)	
11	Temp. rise over an ambient of 50 deg C	
	a) Top oil in deg C	
	b) Winding (by resistance measurement method in degC )	
12	Guaranteed losses at rated voltage on principal Tap and at rated current, rated frequency:	
	a) No load loss (KW)	
	b) Copper loss at full load and 75 deg C (KW)	
	c) Total Losses(KW)	
13	Withstand time for three phases Short circuit at terminals (sec.)	
14	No load current at rated voltage and rated Frequency (Amps) (Approx)	
15	Insulation level	
	a) Separate source power frequency voltage withstand	
	i) Primary Winding (KV rms)	
	ii)Secondary Winding (KV rms)	
	iii) Neutral Bushing	
	b) Induced over voltage withstand	
	i) Primary Winding (KV rms)	
	ii) Secondary Winding (KV rms)	
	c) Full wave lightning impulse withstand	
	i) Primary Winding (KV)	
	ii) Secondary Winding (KV)	
	iii) Neutral Bushing	
	d) Switch impulse withstand voltage	
	i) Primary Winding (KV)	
	ii) Secondary Winding (KV rms)	
16	Regulation at full load at 75 deg C	
	i)At unity power factor (percent)	
	ii)At 0.8 power factor lagging (percent)	
17	Terminal arrangement	
	i) Primary Voltage	
	ii) Secondary voltage	

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Sl No	Details	Vendor Specifications
	ii) Neutral Secondary	
18	Over excitation withstand time (sec)	
	a) 120%	
	b) 150%	
19	Neutral Bushing	
	i) Manufacturer	
	ii) Type	
	iii) Minimum creepage distance (mm)	
20	Proposed method of transformer shipment	
21	Total quantity of oil (litres) required for first filling	
22	Is vacuum filling required, if so, state absolute pressure	
23	Efficiency at 75 deg C at unity power factor	
	a) At full load ( percent )	
	b) At 3/4 full load (percent)	
	c) At 1/2 full load (percent)	
	d) Maximum efficiency of the transformer (%)	
	e) Load at which max. efficiency occurs in KVA	
24	Approximate dimensions	
	i) Tank enclosure (mm) (L x B x H)	
	ii) overall L x B x H (mm)	
25	Untanking height (mm)	
26	Approximate weight	
	i) Core and winding(Kg)	
	ii) Tank cover (Kg)	
	iii) Tank fitting (Kg)	
	iv) Oil (Kg)	
	v) Total weight (Kg)	
27	Dispatch details (Kg)	
	a) Approximate mass of heaviest package (Kg)	
	b) Approximate dimensions of largest package L x B x H (mm)	
28	Reference standards for Transformer	
29	Type of Construction (Core/Shell)	
30	Thermal time constant (Hours)	
31	Magnetizing inrush current (Amps)	

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Sl No	Details	Vendor Specifications
32	No load current at rated Frequency and at(Approx)	
	i) 90% voltage (Amps)	
	ii) 100% voltage (Amps)	
	iii) 110% voltage (Amps)	
33	Power factor of no load current	
34	Zero sequence impedance at principle tap	
35	Capacitance between winding and to Earth (micro farads)	
36	Percentage reactance at rated Current and frequency and at	
	i)Principal Tap	
	ii) Maximum tap	
	iii) Minimum tap	
37	Radiator(nos)	
	i) Overall dimensions lxbxh (mm)	
	ii) Total weight with oil (Kg)	
	iii) Total weight without oil (Kg)	
	iv) Type of mounting	
	v) Thickness of Radiator tube radiator sheet steel (approx)	
38	Size of filter hose (mm)	
39	Core	
	a) Form of core	
	b) Net core area (mm <sup>2</sup> )	
	c) Type of joint between core and yoke	
	d) Thickness of stamping (mm)	
	e) Percentage silicon content (percent)	
	f) Maximum flux density in core at	
	rated frequency and at	
	i)90% voltage (Wb/m <sup>2</sup> )	
	ii) 100% voltage (Wb/m <sup>2</sup> )	
	iii) 110% voltage (Wb/m <sup>2</sup> )	
	g) Type of core binding	
40	Winding	
	a) Type of winding	
	b) Current density at rated load	
	i) HV (A/mm <sup>2</sup> )	

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Sl No	Details	Vendor Specifications
	ii) LV (A/mm <sup>2</sup> )	
	c) Conductor area	
	i) HV (A/mm <sup>2</sup> )	
	ii) LV (A/mm <sup>2</sup> )	
	d) Maximum current density under short circuit	
	i) HV (A/mm <sup>2</sup> )	
	ii) LV (A/mm <sup>2</sup> )	
41	Clearance	
	a) Minimum clearance between phase	
	i) In oil (mm)	
	ii) In air (mm)	
	b) Minimum clearance of HV winding to tank/enclosure (in oil, if applicable),(mm)	
	c) Minimum clearance of HV winding to earth (In oil, if applicable),(mm)	
	d) Clearance between core and coil (mm)	
	e) Clearance between coils (mm)	
42	Tank/enclosure details	
	i) Side (mm)	
	ii) Bottom (mm)	
	iii) Cover (mm)	
43	Bushings	
	i) Type	
	ii) Rated Voltage	
	iii) Lightning Impulse	
	iv) Creepage distance (minimum)	
	v) Power Frequency	
44	Magnetic Oil Level Gauge (Dial type) Size	
45	List of deviations ( if any )	
	If yes, please mention deviations here.	

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