NTPC
3 x 660 MW NORTH KARANPURA STPP

VOLUME – II

TECHNICAL SPECIFICATION FOR

OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO : PE-TS-405-302-E001
REV-0

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UTTAR PRADESH, INDIA – 201301

CONTENTS

TOTAL NUMBER OF SHEETS: 81

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION ‘I’

SPECIFIC TECHNICAL REQUIREMENTS

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1.0 SCOPE OF ENQUIRY

1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **BIS certified OIL FILLED SERVICE TRANSFORMERS (BIS Certification** for rating upto 2.5 MVA, 33kV Class as per IS-1180 part-1, however the impedance value, list of tests, fittings shall be as per those mentioned in the specification**)** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.

1.3 Standard technical requirements of the oil filled service transformers are indicated in Section-II. Project specific requirements/changes are listed in Section-I.

1.4 The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

S.No.	***Reference Clause No. of Section-II***	***Specific Requirement/ Change***
1.	2.01.00	The Clause shall be read as The equipment shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed including Indian Electricity Act, Indian Electricity Rules and Bureau of Indian Standards, BEE Guideline & CEA notification.

2.	3.03.00	The Clause shall be read as Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core isolation shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.
3.	3.08.00	The Clause shall be read as Main tank shall be provided with conservator tanks of adequate capacity for expansion of oil from minimum ambient to 100 deg.C. The equipment rated 7.5MVA and above shall be provided with air bag breathing through indicating type cobalt free silica gel breather with transparent enclosure. However conventional type conservator with indicating type cobalt free breather (transparent enclosure) may be offered for transformer below 7.5 MVA.
4.	3.10.00	The Clause shall be read as As per IS: 335. No external inhibitors are permitted. 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.

S.No	Property	Permissible values
1.	Kinematic Viscosity, mm^2/s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C
2.	Flash Point, ° C	≥ 140° C
3.	Pour point, ° C	≤ (-)40 ° C
4.	Appearance	Clear , free from sediment and suspended matter
5.	Density kg/dm^3 at 20 ° C	≤ 0.895
6.	Interfacial Tension N/m at 25° C	≥ 0.04
7.	Neutralisation value, mgKOH/g	≤ 0.01

		8. Corrosive sulphur — Non Corrosive 9. Water content mg/kg — ≤ 30 in bulk supply; ≤ 40 in drum supply 10. Anti oxidants additives — Not detectable 11. Oxidation Stability -Neutralization value, mgKOH/g; -Sludge, % by mass — ≤ 1.2; ≤ 0.8 12. Breakdown voltage As delivered, kV; After treatment, kV — ≥ 30; ≥ 70 13. Dissipation factor, at 90° C And 40 Hz to 60 Hz — ≤ 0.005 14. PCA content — ≤1% 15. Impulse withstand Level, kVp — ≥ 145 16. 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 at site & tested for / Prior to energization at site for following properties & acceptance norms:** 1. BDV — 60 kV (min) — 60 kV (min) 2. Moisture content — 10 ppm (max.) — 10 ppm (max.)
5.	3.12.01	The Clause shall be read as a) Bushing shall be solid porcelain/condenser/oil communicating type. b) No arcing horns to be provided on the bushings. c) LV bushing palms shall be silver/tin plated. The bushings shall conform to the requirements of IS: 2099 and IS: 3347.
6.	3.16.00	The Clause shall be read as Bidder to provide neutral bushing CT as per details given in data sheet – A of section-I, volume-II for

		restricted earth fault protection or standby earth fault protection. CT Shall be of adequate rating for protection as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted. All CT terminals shall be provided as fixed type terminals on the M. Box/CCC/CMB to avoid any hazard due to loose connection leading to CT opening or any other loose connection in power circuit. In no circumstances Plug in type connectors shall be used for CT & Power connection.
7.	3.18.03	The Clause shall be read as 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.
8.	3.22.00	The Clause shall be read as For 33kV, 11kV & 3.3kVwinding, type of winding shall be continuous disc & for 433V/ 420V winding, type of winding shall be spiral type. The conductors shall be of Electrolytic grade copper. Windings are made in dust proof & conditioned atmosphere.
9.	4.01.00- 4.02.00	The Clause shall be read as Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

		a) Conservator for main tank with MOG (with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above rail level) etc. Aircell (for 7.5 MVA & above). b) Buccholz relay, double float type with alarm and trip contacts, along with suitable gas collecting device. c) For 2 MVA & above rating transformer/reactor, minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided. For transformers below 2 MVA, diaphragm type explosion vent shall be provided. d) OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device. (maximum height 1500 mm above rail level) 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) & surge arrestor (as applicable). g) Prismatic/toughened glass oil gauge for transformers. h) Bi-directional wheel & skids, M. Box, OCTC, Bushing CTs, Insulating Oil, Cooling equipment, Valve Schedule Plate. i) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc. j) Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS. k) Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed. 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.

10.	5.00.00	The Clause shall be read as Paint shade shall be finalised to successful bidder during detail engineering as applicable. Adequate quantity of touch up paint shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

PARTS NAME	**TYPE OF PAINT**	**NO.OF COAT**	**TOTAL DFT**
Inside of tank and accessories (except CCC, CMB & M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micro n
External surface of Transformer and accessories including CCC, CMB, M Box (except coolers & radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceious iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	Atleast 100 micron
External Cooler,Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)	Two coats each	Atleast 100 micron
Internal Radiator surface	Hot oil proof, low viscosity varnish and	-	-

				subsequent flushing with transformer oil		
			Internal surface of CCC,CMB & 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
11.	6.03.00	Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out				
12.	New Clause	6.07.00. In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening (i.e. 28.11.2013), he may submit during detailed engineering 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. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor. 6.08.00 Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by purchaser.				

6.09.00 ROUTINE / TYPE TESTS ON TRANSFORMERS:

S.N.	Routine Tests
1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.
2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)
3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)
4.	Vector group and Polarity Check (as per IEC 60076-1)
5.	Magnetic Balance and Magnetising Current Test
6.	Measurement of no load current with 415 V, 50 hz AC supply
7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)
8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps
9.	IR measurement (As per IEC 60076-1)
10.	Measurement of capacitance & tan delta to determine capacitance between winding & earth.
11.	Dielectric tests shall be carried out as per IEC 60076-3.
12.	Separate Source Voltage Withstand Test (as per IEC 60076-3)
13.	Induced overvoltage test (ACSD Test)
14.	Repeat no load current/loss measurement & IR after completion of all electrical test
15.	Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)
16.	Jacking test followed by D.P. test
17.	Marshalling Box/Cable box:It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
18.	IR measurement on wiring of Marshalling Box.

S.N.	Type Tests
1.	Lightning impulse(Full & Chopped Wave) test on windings (as per IEC 60076- 3)
2.	Lightning impulse test on Neutral (*)
3.	Short circuit test (special test) as per IEC 60076-5.

		4. Temperature Rise test at a tap corresponding to maximum losses. 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). Result shall be recorded for future reference. 5. Measurement of acoustic noise level as per NEMA TR-1 (special test) 6. Tank Pressure test (As per CBIP norm) 7. Tank vacuum test (As per CBIP norm) **NOTE:-** i) All the type / special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test. ii) The power factors should not exceed 0.5% (at 20 oC). However in case of deviation from limiting values the same shall be resolved in line with IEEE Std-62. iii) (*) this test is applicable on Transformer neutral earthed thru NGR. 6.10.00 All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer. 6.11.00 **Oil leakage test on assembled transformer (Routine Test):** 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/m2 measured at the base of the tank. The pressure shall be maintained for a period of not less than 6(six) hours during which time no sweating shall occur.

4.0 DOCUMENTATION

4.1 Documents required along with technical offer shall be as per annexure-I.

4.2 Documents required after award of LOI shall be as per annexure -II.

ANNEXURE – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.

b) Schedule of deviations.

c) Schedule of BOQ cum price schedule. (Unpriced)

d) 10% Extra oil price schedule (Unpriced)

e) Schedule of Mandatory spares. (Unpriced)

f) Schedule of Type test. (Unpriced)

DATA SHEET –A

11/0.433 kV, 3.3/0.433kV SERVICE TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	4 & 1000 kVA 2 & 1600 kVA 30 & 2000 kVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	No(s)	03
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 11.0, 3.3 0.433
8.0	No Load transformation ratio		11/0.433 3.3/0.433
9.0	Vector group		Dyn1
10.0	Impedance voltage at rated current and frequency	%	1000 kVA : 6.25% 1600 kVA : 8% 2000 kVA : 10%
11.0	Total range of tapping's and tapping steps		± 5% in steps of 2.5%
12.0	Type of tap changing equipment		Off-Circuit

13.0	Temperature rise		
	a) Top oil by thermometer	deg. C	50 deg. C above ambient of 50 deg.C
	b) Winding by resistance	deg. C	55 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage		
	a) HV Winding	kV	12 kV,3.6kV
	b) LV Winding	V	415V + 10%,
15.0	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV) 10 (3.3kV)
	b) LV Winding	kV	3
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV) 40 (3.3kV)
	b) LV Winding 40 (3.3kV)	kVp	
			-
17.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		
	i) 11KV/0.433KV		Flange throat for TPN non-segregated Al Busduct
	ii) 3.3KV/0.433KV		Cable box (XLPE cables)
	d) LV Neutral		
	i) 11KV/0.433KV		One neutral as part of LV busduct throat and second neutral with

			copper earthing bar for system earthing brought near the base of the transformer.
	ii) 3.3KV/0.433KV		One neutral as part of LV cable box and second neutral with copper earthing bar for system earthing brought near the base of the transformer.
18.0	System Fault Level		
	a) HV Winding	kA	40 kA RMS
	b) LV Winding	kA	50 kA RMS
19.0	Method of System Earthing		
	a) HV System		Low resistance earthed to limit earth fault current to 600A. (Solidly grounded for 2 no. of 2000KVA Transformers)
	b) LV System		Solidly grounded
	c) Through fault withstand time		2 Sec.
20.0	Details of Cooling Equipment		Detachable tank mounted radiators
21.0	Provision/ accommodation of CTs LV Neutral		**2** Core PS CLASS or 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
22.0	Colour Shade : a) Interior (For M. Box)		Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
	b) Exterior		Particulars shall be given to successful bidder during detail

engineering. There shall be no commercial implication to BHEL on this account.

23.0 Space/ Layout Limitation if Any

24.1 Cable details (11KV/0.433KV)

a) HV side

i)	Type		XLPE
ii)	Voltage Grade		12kV Unearthed
iii)	Conductor material & size		Stranded Aluminium, after award of contract
iv)	No. of cores & runs		Three core, one run

b) LV side

i)	Type		N.A
ii)	Voltage Grade	kV	N.A
iii)	Conductor material & size		N.A
iv)	No. of cores & runs		N.A

24.1 Cable details (3.3KV/0.433KV)

a) HV side

i)	Type	XLPE
ii)	Voltage Grade	3.6kV Unearthed
iii)	Conductor material & size	Stranded Aluminium, after award of contract
iv)	No. of cores & runs	Three core, one run

b) LV side

i)	Type	XLPE
ii)	Voltage Grade	1.1kV Unearthed
iii)	Conductor material & size	Stranded Aluminium, after award of contract
iv)	No. of cores & runs	Three core, one run

25.0 Penalty for Losses

a) Rates for bid evalution N.A.

	b) 'A' (for no load loss)	Losses not to exceed max. losses as per annexure-B to section-II, vol-II of the specification
	ii) 'B' (for load losses)	- Do-
	c) Rates for penalty	
	i) 'A' (for no load loss)	US $ 3275 per kW
	ii) 'B' (for load loss)	US $ 3275 per kW
26.0	Creepage distance	25mm/kV

DATA SHEET –A

11/3.45kV SERVICE TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	2 & 5.0MVA 2 & 10.0 MVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	No(s)	03
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 11.0 3.45
8.0	No Load transformation ratio		11/3.45
9.0	Vector group		Dyn1
10.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	5.0 MVA : 7% 10.0 MVA : 9%
11.0	Total range of tappings and tapping steps		± 5% in steps of 2.5%
12.0	Type of tap changing equipment		Off-Circuit
13.0	Temperature rise a) Top oil by thermometer b) Winding by resistance	 deg. C deg. C	 50 deg. C above ambient of 50 deg.C 55 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage a) HV Winding b) LV Winding	 kV V	 12.0 kV 3.6 kV

15.0	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV),
	b) LV Winding	kV	10 (3.3 kV)
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV),
	b) LV Winding	kVp	40 (3.3 kV)
17.0	Terminal details		
	a) HV Line	Cable box (XLPE cables)	
	b) HV Neutral		N.A.
	c) LV Line	Flange throat for TPN segregated Al Busduct	
	d) LV Neutral	Cable box (XLPE cables)	
18.0	System Fault Level		
	a) HV Winding	kA	40 kA RMS
	b) LV Winding	kA	40 kA RMS
19.0	Method of System Earthing		
	a) HV System	Low resistance earthed to limit earth fault current to 600A	
	b) LV System	Low resistance earthed to limit earth fault current to 600A	
	c) Through fault withstand time		2 Sec.
20.0	Details of Cooling Equipment	Detachable tank mounted radiators	
21.0	Provision/ accommodation of CTs		
	LV Neutral	**2** Core PS CLASS or 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no	

commercial implication to BHEL on this account.

22.0 Colour Shade :

a) Interior (For M. Box) — Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.

b) Exterior — Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.

23.0 Space/ Layout Limitation if Any

24.0 Cable details

a)	HV side		
i)	Type		XLPE
ii)	Voltage Grade	12kV	Unearthed
iii)	Conductor material & size		Stranded Aluminium, after award of contract
iv)	No. of cores & runs		Three core, one run
a)	LV side		
i)	Type		N.A
ii)	Voltage Grade	kV	N.A
iii)	Conductor material & size		N.A
iv)	No. of cores & runs		N.A
c)	LV Neutral		
i)	Type		XLPE
ii)	Voltage Grade	3.6kV	Unearthed
iii)	Conductor material & size		Stranded Aluminium, after award of contract
iv)	No. of cores & runs		One core, two run

25.0 Penalty for Losses

a) Rates for bid evalution	N.A.
b) i)'A' (for no load loss)	losses not to exceed max losses as per annexure-B to section-II, vol-II of the specification
ii) 'B' (for load losses)	- Do-
b) Rates for penalty	
i) 'A' (for no load loss)	US $ 3275 per kW
ii) 'B' (for load loss)	US $ 3275 per kW

26.0 Creepage distance 25mm/kV

DATA SHEET –A

33/11.5 kV, 33/3.45kV SERVICE TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	2 & 2.0 MVA 2 & 5.0 MVA 2 & 7.5 MVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	No(s)	03
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 33.0 11.5, 3.45
8.0	No Load transformation ratio		33/11.5, 33/3.45
9.0	Vector group		Dyn11
10.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	2.0 MVA : 6% 5.0 MVA : 8% 7.5 MVA : 7%
11.0	Total range of tappings and tapping steps		± 5% in steps of 2.5%
12.0	Type of tap changing equipment		Off-Circuit
13.0	Temperature rise a) Top oil by thermometer	 deg. C	 50 deg. C above ambient of 50 deg.C

	b) Winding by resistance	deg. C	55 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage		
	a) HV Winding	kV	36.0 kV
	b) LV Winding	V	12kV, 3.6 kV
15.0	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	70 (33kV),
	b) LV Winding	kV	28 (11kV) 10 (3.3 kV)
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	170 (33kV)
	b) LV Winding	kVp	75 (11kV) 40 (3.3 kV)
17.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		Cable box (XLPE cables)
	d) LV Neutral		
	i) 33/11.5KV		Neutral with copper earthing bar for system earthing brought near the base of the transformer.
	ii) 33/3.45KV		Cable box (XLPE cables)
18.0	System Fault Level		
	a) HV Winding	kA	12.5 kA RMS
	b) LV Winding	kA	40 kA RMS
19.0	Method of System Earthing		
	a) HV System		Solidly grounded
	b)LV System		

	i) 11KV ii) 3.3KV	Solidly grounded Low resistance earthed to limit earth fault current to 600A
	c) Through fault withstand time	2 Sec.
20.0	Details of Cooling Equipment	Detachable tank mounted radiators
21.0	Provision/ accommodation of CTs LV Neutral	**2** Core PS CLASS or 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
22.0	Colour Shade : a) Interior (For M. Box)	Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
	b) Exterior	Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
23.0	Space/ Layout Limitation if Any	
24.0	Cable details a) HV side	
	i) Type	XLPE
	ii) Voltage Grade	36kV Earthed
	iii) Conductor material & size	Stranded Aluminium, after award of contract
	iv) No. of cores & runs	Single core/phase, one run
	b) LV side	
	i) Type	N.A
	ii) Voltage Grade	12kV Earthed 3.6kV Unearthed

iii)	Conductor material & size	Stranded Aluminium, after award of contract
iv)	No. of cores & runs	After award of contract

25.0 Penalty for Losses

c)	Rates for bid evalution	N.A.
d)	'A' (for no load loss)	Losses not to exceed max. losses as per annex-B to sec-II, vol-II of the specification
ii)	'B' (for load losses)	- Do-
e)	Rates for penalty	
i)	'A' (for no load loss)	US $ 3275 per kW
ii)	'B' (for load loss)	US $ 3275 per kW

26.0 Creepage distance — 25mm/kV

DATA SHEET –B

TECHNICAL PARTICULARS

[*TO BE SUBMITTED ALOGWITH TECHNICAL OFFER*]

FOR 11kV/0.433V

S. No	Description	2.0MVA	1.6MVA	1.0MVA	2.0MVA (Low loss transformer)
1.	Rating				
2.	No Load transformation ratio				
3.	Maximum No- load losses at rated frequency and 100% rated voltage				
4.	Maximum load losses at normal ratio, rated current and 75 deg. C				
5.	Overall Dimensions				
6.	Total weight				
7.	Total oil Quantity				

FOR 3.3kV/0.433V

S. No	Description	1.0MVA
1.	Rating	
2.	No Load transformation ratio	
3.	Maximum No- load losses at rated frequency and 100% rated voltage	
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	

5.	Overall Dimensions	
6.	Total weight	
7.	Total oil Quantity	

FOR 11kV/3.45kV

S. No	Description	10.0MVA	5.0MVA
1.	Rating		
2.	No Load transformation ratio		
3.	Maximum No- load losses at rated frequency and 100% rated voltage		
4.	Maximum load losses at normal ratio, rated current and 75 deg. C		
5.	Overall Dimensions		
6.	Total weight		
7.	Total oil Quantity		

FOR 33kV/3.45kV

S. No	Description	7.5MVA	2.0MVA
1.	Rating		
2.	No Load transformation ratio		
3.	Maximum No- load losses at rated frequency and 100% rated voltage		
4.	Maximum load losses at normal ratio, rated current and 75 deg. C		
5.	Overall Dimensions		
6.	Total weight		
7.	Total oil Quantity		

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FOR 33kV/11.5kV

S. No	Description	5.0MVA
1.	Rating	
2.	No Load transformation ratio	
3.	Maximum No- load losses at rated frequency and 100% rated voltage	
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	
5.	Overall Dimensions	
6.	Total weight	
7.	Total oil Quantity	

DATA SHEET –C

TECHNICAL PARTICULARS

[***TO BE SUBMITTED AFTER AWARD OF CONTRACT***]

Clause No.	Item	(For AUX Transformer)		
1.00.00	Manufacturer's name and address			
1.01.00	Standard Applicable			
1.02.00	Rating (MVA)			
1.03.00	Voltage ratio			
1.04.00	Winding connection			
1.05.00	Vector group			
1.06.00	Number of phases			
1.07.00	Frequency (Hz)			
1.08.00	Type of cooling			
1.09.00	Impedance data Guaranteed positive sequence impedance @ 75 deg. C			
	AUX TR	**HV-LV**	**-**	**-**
(a.)	At Principal Tap			
(b.)	At Maximum Tap			
(c.)	At Minimum Tap			
1.10.00	Guaranteed max. losses in KW at 100 % rated voltage at 75 deg. C at principal tap (1)			
	Iron loss at rated voltage & frequency (2)			
	Copper loss at full load			
	(3) Guaranteed Cooler losses at 100% load			
1.11.00	HV winding DC resistance at 75 deg. C			
	(a) Principal tap			
	(b) Maximum tap			
	(c) Minimum tap			
1.12.00	LV winding DC resistance at 75 deg. C			

	(a)Number of coolers and rating as % of transformer cooling equipment	
	(b)Mounting	
	(c)Fan Motor Data	
	(i)Number per cooler/radiator Cooling requirement (indicate no. of spare fans also)	
	(ii) Type & make	
	(iii) Rating	
	(iv) Speed	
	(v) Locked rotor current	
	(e) Cooler/radiator details	
	(i)Overall dimensions l x b x h (mm)	
	(ii)Type of mounting	
	(iii)Weight with oil (kg)	
	(iv)Weight without oil (kg)	
1.14.00	**Thermal Data**	
	(a) Temperature rise in top oil over an ambient of 50 deg.C	
	(b) Temperature rise in winding by resistance measurement method over an ambient of 50deg. C.	
	(c) Thermal time constant (Hours)	
	(d) Oil temperature at cooler inlet at rated load at max temperature	

	load at max temperature	
	(f) Calculated Hot Spot Temperature (Design value)	
1.15.00	Withstand time for short circuit at terminals (sec.)	
1.16.00	Over excitation withstand time (secs.) for % over excitation of	
	(i) 110%	
	(ii)125%	
	(iii)140%	
	(iv)150%	
	(v)170%	
1.17.00	Bushings	
	a) High voltage	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	
	c) Low voltage	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	

	e) Low voltage (N)	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	
1.18.00		
	Neutral(LV)Bushing CT Parameters	
	CORE-1/2/3	
	(i) Core no.	
	(ii) Service	
	(iii) Ratio	
	(iv) Accuracy class	
	(v) Knee point voltage (V) min	
	(vi) VA Burden	
	(vii) Max. CT resistance	
	(vii) Magnetisation current (max) at Vk/2 (mA)	

	transportation	
	(i). Oil filled or N2 filled	
	(ii). Road Freight/ Rail Freight	
1.20.00	Is vacuum filling required, if so state absolute pressure (mm of Hg)	
1.21.00	Total quantity of oil (liters)	
1.23.00	Insulation level	
	HV Windings	
	(i) (a) Lightning impulse withstand voltage(kVp)	
	(b) CW Impulse withstand voltage (kVp)	
	(ii) Switching surge withstand voltage (kVP)	
	(iii) Power frequency withstand voltage (kV)	
	(iv) HV winding insulation (Graded/ Uniform)	

	LV Windings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	HV Bushings	
	(i) (a) Lightning impulse withstand voltage(kVp)	
	(b) CW Impulse withstand voltage (kVp)	
	(ii) Switching surge withstand voltage (kVP)	
	(iii) Power frequency withstand voltage (KV)	
	LV Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	LVN Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
1.24.00	Approximate Dimensions	
	a) Tank (lxbxh) (mm)	
	b) Overall dimensions with coolers (lxbxh) (mm)	
	c) Height for un-tanking (mm)	
	d) Shipping dimensions	
	e) Dimensions of largest package(lxbxh) (mm)	

	a) Core (kg.)	
	b) Windings (kg.)(copper)	
	c) Total cellulose weight (kg)	
	d) Weight of Paper insulation (kg)	
	e) Weight of Press board, frame, barrier, spacer etc (kg)	
	f) Tank and fittings (kg)	
	g) Oil (kg)	
	h) Untanking weight (heaviest piece) (kg)	
	i) Total weight (kg)	
	j) Weight of heaviest pkg. (kg)	
	k) Total shipping weight (kg)	
	l) Parts detached for transport(furnish list)	
1.26.00	Permissible overloading (% of rating and time in minutes)	
1.27.00	(a.)Clearances to tank in oil (mm)	
	(b.) Minimum clearance of HV winding to earth in oil (mm)	
	(c.) Clearance between coils & core(mm)	
	(d.) Clearance between coils (mm)	
	(e.) Clearance between neutral to ground (mm)	
1.28.00	Conservator	
	a) Total volume (Liters)	
	b) Volume between highest and lowest levels (Liters)	
1.29.00	Capacitance Values (pF)	
	b) LV to earth	
	c) HV to LV	
	d) Tap winding to earth	
1.30.00	a) Type of oil preservation	
	b) Material of diaphragm/air cell	
	c) Continuous temperature withstand/ capability of the diaphragm/air cell	

	a) Quality of oil	
	i) Moisture content (ppm)	
	ii) Max. tan-delta value	
	iii) Interfacial tension(N/m)	
	iv) Breakdown strength (kV)	
	b) Total Quantity including 5% extra (liters)	
		Before Energizing
	i) Moisture content (ppm)	
	ii) Max. tan-delta value	
	iii) Interfacial tension(N/m)	
	iv) Breakdown strength (kV)	
	b) Total Quantity including 5% extra (liters)	
	c) Oil flow inside Transformer (Directed/ Forced/ Normal)	
1.32.00	Core	
	a) Type of construction(core/shell)	
	b) Net core area (mm^2)	
	c) Core material and grade used	
	d) Type of joint between core and yoke	
	e) Thickness of stamping (mm)	
	f) Percentage silicon content (%)	
	g) Maximum flux density in core at rated frequency and at	
	i) 90% voltage (wb/m^2)	
	ii) 100% voltage (wb/m^2)	
	iii) 110% voltage (wb/m^2)	
1.33.00	Winding	
	a) Type of winding	
	i) HV	
	iii) LV	
	iv) Tap	
	b) Current density at rated load	
	i) HV (A/mm^2)	

	iii) LV (A/mm^2)	
	iv) Tap	
'	c) Conductor area (mm2)	
	i) HV	
	iii) LV /LV1/LV2	
	iv) Tap	
	d) Magnetizing inrush current(Amps)	
	i) % Component of 2nd harmonic current (max & min)	
	e) No load current (Amps) at rated frequency and at	
	i) 90% voltage	
	ii) 100% voltage	
	iii) 110% voltage	
	f) Magnetising current at rated frequency and at rated voltage	
	g) Leakage reactance	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	h) Resistance	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	i) Air core reactance of HV winding	
1.34.00	Tank	
	a) Tank cover-Conventional/Bell Type	
	b) Approximate thickness of	
	i) Side (mm)	
	ii) Bottom (mm)	
	iii) Cover	
1.35.00	Vacuum withstand capability of	
	a) Main tank	
	b) Coolers and accessories	
1.36.00	Minimum draw bar pull required to move the transformer on level track(kg)	
1.37.00	Size of filter hose	
1.38.00	Fault level	

OUT DOOR TRANSFORMER

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	Y												Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

ANNEXURE-II

DOC REQUIRED AFTER AWARD OF CONTRACT

Sl No	DWG. / DOCUMENT No.	DOCUMENT TITLE	SUBMISSION SCHEDULE
1	PE-V0-405-302-E802	SERVICE TRANSFORMER O & M MANUAL	Within one week after conduction of Type test
2	PE-V0-405-302-E147	1600KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
3	PE-V0-405-302-E149	1600KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
4	PE-V0-405-302-E150	1600KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
5	PE-V0-405-302-E805	SERVICE TRANSFORMER TYPE TEST REPORTS	Within one week after conduction of Type test
6	PE-V0-405-302-E042	1600 KVA SERVICE TRANSFORMER (11/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
7	PE-V0-405-302-E144	1600KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
8	PE-V0-405-302-E145	1600KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
9	PE-V0-405-302-E151	1600KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two weeks from the date of LOI
10	PE-V0-405-302-E152	1600KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
11	PE-V0-405-302-E041	1600 KVA SERVICE TRANSFORMER (11/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
12	PE-V0-405-302-E803	SERVICE TRANSFORMER PAINTING PROCEDURE	Within two weeks from the date of LOI
13	PE-V0-405-302-E043	1600 KVA SERVICE TRANSFORMER (11/0.433KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
14	PE-V0-405-302-E148	1600KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
15	PE-V0-405-302-E146	1600KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
16	PE-V0-405-302-E801	SERVICE TRANSFORMER FIELD QUALITY PLAN	Within two weeks from the date of LOI
17	PE-V0-405-302-E901	QUALITY PLAN FOR SERVICE TRANSFORMERS	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

18	PE-V0-405-302-E155	1600KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
19	PE-V0-405-302-E153	1600KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
20	PE-V0-405-302-E175	2000KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
21	PE-V0-405-302-E168	2000KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
22	PE-V0-405-302-E170	2000KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
23	PE-V0-405-302-E165	2000KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
24	PE-V0-405-302-E166	2000KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
25	PE-V0-405-302-E173	2000KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
26	PE-V0-405-302-E172	2000KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
27	PE-V0-405-302-E164	2000KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
28	PE-V0-405-302-E171	2000KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
29	PE-V0-405-302-E169	2000KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
30	PE-V0-405-302-E167	2000KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
31	PE-V0-405-302-E142	2000 KVA SERVICE TRANSFORMER (11/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
32	PE-V0-405-302-E141	2000 KVA SERVICE TRANSFORMER (11/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

33	PE-V0-405-302-E143	2000 KVA SERVICE TRANSFORMER (11/0.433KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
33	PE-V0-405-302-E275	1000KVA TRANSFORMER (11/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
34	PE-V0-405-302-E268	1000KVA TRANSFORMER (11/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
35	PE-V0-405-302-E270	1000KVA TRANSFORMER (11/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
36	PE-V0-405-302-E265	1000KVA TRANSFORMER (11/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
37	PE-V0-405-302-E266	1000KVA TRANSFORMER (11/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
38	PE-V0-405-302-E273	1000KVA TRANSFORMER (11/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
39	PE-V0-405-302-E272	1000KVA TRANSFORMER (11/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
40	PE-V0-405-302-E264	1000KVA TRANSFORMER (11/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
41	PE-V0-405-302-E271	1000KVA TRANSFORMER (11/0.433KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
42	PE-V0-405-302-E269	1000KVA TRANSFORMER (11/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
43	PE-V0-405-302-E267	1000KVA TRANSFORMER (11/0.433KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
44	PE-V0-405-302-E242	1000 KVA SERVICE TRANSFORMER (11/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
45	PE-V0-405-302-E241	1000 KVA SERVICE TRANSFORMER (11/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
46	PE-V0-405-302-E243	1000 KVA SERVICE TRANSFORMER (11/0.433KV) RATING &	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

		DIAGRAM PLATE	
47	PE-V0-405-302-E375	1000KVA TRANSFORMER (3.3/0.433KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
48	PE-V0-405-302-E368	1000KVA TRANSFORMER (3.3/0.433KV) H.V. BUSHING	Within two weeks from the date of LOI
49	PE-V0-405-302-E370	1000KVA TRANSFORMER (3.3/0.433KV) LVN BUSHING	Within two weeks from the date of LOI
50	PE-V0-405-302-E365	1000KVA TRANSFORMER (3.3/0.433KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
51	PE-V0-405-302-E366	1000KVA TRANSFORMER (3.3/0.433KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
52	PE-V0-405-302-E373	1000KVA TRANSFORMER (3.3/0.433KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
53	PE-V0-405-302-E372	1000KVA TRANSFORMER (3.3/0.433KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
54	PE-V0-405-302-E364	1000KVA TRANSFORMER (3.3/0.433KV) FOUNDATION PLAN	Within two weeks from the date of LOI
55	PE-V0-405-302-E371	1000KVA TRANSFORMER (3.3/0.433KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
56	PE-V0-405-302-E369	1000KVA TRANSFORMER (3.3/0.433KV) L.V. BUSHING	Within two weeks from the date of LOI
57	PE-V0-405-302-E367	1000KVA TRANSFORMER (3.3/0.433KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
58	PE-V0-405-302-E342	1000 KVA SERVICE TRANSFORMER (3.3/0.433KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
59	PE-V0-405-302-E341	1000 KVA SERVICE TRANSFORMER (3.3/0.433KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
60	PE-V0-405-302-E343	1000 KVA SERVICE TRANSFORMER (3.3/0.433KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

61	PE-V0-405-302-E475	5000KVA TRANSFORMER (33/11.5KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
62	PE-V0-405-302-E468	5000KVA TRANSFORMER (33/11.5KV) H.V. BUSHING	Within two weeks from the date of LOI
63	PE-V0-405-302-E470	5000KVA TRANSFORMER (33/11.5KV) LVN BUSHING	Within two weeks from the date of LOI
64	PE-V0-405-302-E465	5000KVA TRANSFORMER (33/11.5KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
65	PE-V0-405-302-E466	5000KVA TRANSFORMER (33/11.5KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
66	PE-V0-405-302-E473	5000KVA TRANSFORMER (33/11.5KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
67	PE-V0-405-302-E472	5000KVA TRANSFORMER (33/11.5KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
68	PE-V0-405-302-E464	5000KVA TRANSFORMER (33/11.5KV) FOUNDATION PLAN	Within two weeks from the date of LOI
69	PE-V0-405-302-E471	5000KVA TRANSFORMER (33/11.5KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
70	PE-V0-405-302-E469	5000KVA TRANSFORMER (33/11.5KV) L.V. BUSHING	Within two weeks from the date of LOI
71	PE-V0-405-302-E467	5000KVA TRANSFORMER (33/11.5KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
72	PE-V0-405-302-E442	5000 KVA SERVICE TRANSFORMER (33/11.5KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
73	PE-V0-405-302-E441	5000 KVA SERVICE TRANSFORMER (33/11.5KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
74	PE-V0-405-302-E443	5000 KVA SERVICE TRANSFORMER (33/11.5KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
75	PE-V0-405-302-E575	2000KVA TRANSFORMER (33/3.45KV) DESIGN CALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

76	PE-V0-405-302-E568	2000KVA TRANSFORMER (33/3.45KV) H.V. BUSHING	Within two weeks from the date of LOI
77	PE-V0-405-302-E570	2000KVA TRANSFORMER (33/3.45KV) LVN BUSHING	Within two weeks from the date of LOI
78	PE-V0-405-302-E565	2000KVA TRANSFORMER (33/3.45KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
79	PE-V0-405-302-E566	2000KVA TRANSFORMER (33/3.45KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
80	PE-V0-405-302-E573	2000KVA TRANSFORMER (33/3.45KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
81	PE-V0-405-302-E572	2000KVA TRANSFORMER (33/3.45KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
82	PE-V0-405-302-E564	2000KVA TRANSFORMER (33/3.45KV) FOUNDATION PLAN	Within two weeks from the date of LOI
83	PE-V0-405-302-E571	2000KVA TRANSFORMER (33/3.45KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
84	PE-V0-405-302-E569	2000KVA TRANSFORMER (33/3.45KV) L.V. BUSHING	Within two weeks from the date of LOI
85	PE-V0-405-302-E567	2000KVA TRANSFORMER (33/3.45KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
86	PE-V0-405-302-E542	2000 KVA SERVICE TRANSFORMER (33/3.45KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
87	PE-V0-405-302-E541	2000 KVA SERVICE TRANSFORMER (33/3.45KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
88	PE-V0-405-302-E543	2000 KVA SERVICE TRANSFORMER (33/3.45KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
89	PE-V0-405-302-E675	7500KVA TRANSFORMER (33/3.45KC96:C110ALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
90	PE-V0-405-302-E668	7500KVA TRANSFORMER (33/3.45KV) H.V. BUSHING	Within two weeks from the date of LOI
91	PE-V0-405-302-E670	7500KVA TRANSFORMER (33/3.45KV) LVN BUSHING	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

92	PE-V0-405-302-E665	7500KVA TRANSFORMER (33/3.45KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
93	PE-V0-405-302-E666	7500KVA TRANSFORMER (33/3.45KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI
94	PE-V0-405-302-E673	7500KVA TRANSFORMER (33/3.45KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
95	PE-V0-405-302-E672	7500KVA TRANSFORMER (33/3.45KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
96	PE-V0-405-302-E664	7500KVA TRANSFORMER (33/3.45KV) FOUNDATION PLAN	Within two weeks from the date of LOI
97	PE-V0-405-302-E671	7500KVA TRANSFORMER (33/3.45KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
98	PE-V0-405-302-E669	7500KVA TRANSFORMER (33/3.45KV) L.V. BUSHING	Within two weeks from the date of LOI
99	PE-V0-405-302-E667	7500KVA TRANSFORMER (33/3.45KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
100	PE-V0-405-302-E642	7500 KVA SERVICE TRANSFORMER (33/3.45KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
101	PE-V0-405-302-E641	7500 KVA SERVICE TRANSFORMER (33/3.45KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
102	PE-V0-405-302-E643	7500 KVA SERVICE TRANSFORMER (33/3.45KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
103	PE-V0-405-302-E775	5000KVA TRANSFORMER (11/3.45KC96:C110ALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
104	PE-V0-405-302-E768	5000KVA TRANSFORMER (11/3.45KV) H.V. BUSHING	Within two weeks from the date of LOI
105	PE-V0-405-302-E770	5000KVA TRANSFORMER (11/3.45KV) LVN BUSHING	Within two weeks from the date of LOI
106	PE-V0-405-302-E765	5000KVA TRANSFORMER (11/3.45KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
107	PE-V0-405-302-E766	5000KVA TRANSFORMER (11/3.45KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

108	PE-V0-405-302-E773	5000KVA TRANSFORMER (11/3.45KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
109	PE-V0-405-302-E772	5000KVA TRANSFORMER (11/3.45KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
110	PE-V0-405-302-E764	5000KVA TRANSFORMER (11/3.45KV) FOUNDATION PLAN	Within two weeks from the date of LOI
111	PE-V0-405-302-E771	5000KVA TRANSFORMER (11/3.45KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
112	PE-V0-405-302-E769	5000KVA TRANSFORMER (11/3.45KV) L.V. BUSHING	Within two weeks from the date of LOI
113	PE-V0-405-302-E767	5000KVA TRANSFORMER (11/3.45KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
114	PE-V0-405-302-E742	5000 KVA SERVICE TRANSFORMER (11/3.45KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
115	PE-V0-405-302-E741	5000 KVA SERVICE TRANSFORMER (11/3.45KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
116	PE-V0-405-302-E743	5000 KVA SERVICE TRANSFORMER (11/3.45KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI
117	PE-V0-405-302-E875	10000KVA TRANSFORMER (11/3.45KC96:C110ALCULATIONS FOR SHORT CIRCUIT CAPABILITY	Within two weeks from the date of LOI
118	PE-V0-405-302-E868	10000KVA TRANSFORMER (11/3.45KV) H.V. BUSHING	Within two weeks from the date of LOI
119	PE-V0-405-302-E870	10000KVA TRANSFORMER (11/3.45KV) LVN BUSHING	Within two weeks from the date of LOI
120	PE-V0-405-302-E865	10000KVA TRANSFORMER (11/3.45KV) GENERAL ARRANGEMENT OF MARSHALLING BOX	Within two weeks from the date of LOI
121	PE-V0-405-302-E866	10000KVA TRANSFORMER (11/3.45KV) HV CABLE BOX ARRANGEMENT DRAWING	Within two weeks from the date of LOI

ANNEXURE-II
DOC REQUIRED AFTER AWARD OF CONTRACT

122	PE-V0-405-302-E873	10000KVA TRANSFORMER (11/3.45KV) TRANSPORTATION DETAILS	Within two weeks from the date of LOI
123	PE-V0-405-302-E872	10000KVA TRANSFORMER (11/3.45KV) WIRING DIAGRAM FOR MARSHALLING BOX	Within two weeks from the date of LOI
124	PE-V0-405-302-E864	10000KVA TRANSFORMER (11/3.45KV) FOUNDATION PLAN	Within two weeks from the date of LOI
125	PE-V0-405-302-E871	10000KVA TRANSFORMER (11/3.45KV) VALVE SCHEDULE PLATE	Within two week from date of LOI
126	PE-V0-405-302-E869	10000KVA TRANSFORMER (11/3.45KV) L.V. BUSHING	Within two weeks from the date of LOI
127	PE-V0-405-302-E867	10000KVA TRANSFORMER (11/3.45KV) LV BUS DUCT TRUNKING DRAWING	Within two weeks from the date of LOI
128	PE-V0-405-302-E842	10000 KVA SERVICE TRANSFORMER (11/3.45KV) OUTLINE GENERAL ARRANGEMENT DRAWING [OGA]	Within two weeks from the date of LOI
129	PE-V0-405-302-E841	10000 KVA SERVICE TRANSFORMER (11/3.45KV) TECHNICAL DATA SHEET	Within two weeks from the date of LOI
130	PE-V0-405-302-E843	10000 KVA SERVICE TRANSFORMER (11/3.45KV) RATING & DIAGRAM PLATE	Within two weeks from the date of LOI

6.00.00 **INSULATION LEVEL**

The insulation level for the transformer windings and bushings shall be as follows :

	WINDING		**BUSHING**	
Highest System Voltage	Rated Power Freq. withstand Voltage (kVrms)	Rated lightlning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightling impulse withstand voltage (kVp)
0.433 KV	3	-	3	-
3.6 kV	10	40	10	40
7.2 kV	20	60	20	60
12 kV	28	75	28	75
17.5 kV	38	95	38	95
24kV	50	125	50	125
36kV	70	170	70	170
72.5 kV	140	325	140	325
145kV	275/38*	650	275	650
245 kV	395/38*	950/1050**	460	1050/1050**
420 kV	630/38*	1425/1570**	750	1550/1570***

* In case of non-uniformly insulated. **** Chopped wave BIL.**

*** Suitable for chopped wave impulse test on transformers.

SECTION ‘II’

STANDARD TECHNICAL SPECIFICATION

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1.00.00 SCOPE

1.01.00 This specification covers the design, manufacture, inspection & testing, packing at manufacturer's works and delivery to site of mineral oil filled service Transformers complete with all fittings & accessories for satisfactory operation at site.

1.02.00 **TERMINAL POINTS**

1.02.01 HV bushings with terminal connector for bus duct/ cable glands & lugs in case of cable connection.

1.02.02 LV bushings with terminal connector (3 Phase + 1 Neutral) for bus duct/ cable glands & lugs in case of cable connection.

1.02.03 For HV Earthing : (Applicable in case of star connection of HV) - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection.

1.02.04 For LV Earthing : - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection

1.02.05 Transformer earthing pads.

1.02.06 Terminals of marshalling box for external connection to equipment supplied by the purchaser.

2.00.00 CODES AND STANDARDS

S.NO.	STANDARD NUMBER	STANDARD TITLE
1	IS:2026 IEC: 60076	POWER TRANSFORMERS
2	IS:1180	OUTDOOR TYPE OIL IMMERSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 kVA, 33kV - SPECIFICATION
2	IS:6600	GUIDE FOR LOADING OF OIL IMMERSED TRANSFORMER
3	IS: 3639	FITTINGS & ACCESSORIES FOR POWER TRANSFORMER
4	IS: 335 IEC: 60296	NEW INSULATING OILS
5	IS: 2099 IEC: 60137	Bushing for alternative voltage above 1000 volts
6	IS: 3347	Dimension for porcelain transformer bushings
7	IS: 2705 IEC: 60185	Current transformers
8	IS: 3637	Gas operated relays
9	IS:1271 IEC: 60216	Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service
10	IS/IEC: 60529	Classification of degrees of protection provided by enclosures of electrical equipment
11	IS: 2071 IEC: 60060	Method of high voltage testing
12	IS: 5	Colours for ready mixed paints & enamels
13	NEMA, STANDARD-TR1	Noise level
14	CBIP Publication (latest edition)	Manual on transformers

2.01.00 The equipment shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed including Indian Electricity Act, Indian Electricity Rules and Bureau of Indian Standards.

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3.00.00 TECHNICAL REQUIREMENTS

3.01.00 Technical particulars of transformers are specified in Data Sheet –A of section-I, volume-II.

3.02.00 All windings shall be fully insulated. Material of the windings shall be electrolytic grade copper, free from scales and burrs. Winding shall be uniformly insulated.

3.03.00 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.

3.04.00 Internal design of transformer shall ensure that air is not trapped in any location.

3.05.00 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts

3.06.00 **Tank**

3.06.01 Under base of tank shall be fixed type.

3.06.02 Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. Tank shields, if provided, shall not resonate at natural frequency of equipment.

3.06.03 All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish.

3.06.04 Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.

3.06.05 At least two adequately sized inspection openings, one at the each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.

3.06.06 The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum.

3.06.07 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/m2 measured at the base of the tank.

3.07.00 **Tank mounting**

Tank shall also be provided with lifting lugs and minimum four jacking pads. Rollers shall be provided with holding clamp plates (04 nos), required hardware and foundation bolts etc. for each transformer.

3.08.00 **Oil preservation**

Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C shall be provided. The transformers rated 6.3MVA and above shall be provided with air bag breathing through silica gel breather. For lower rating transformers with conventional conservator with dry air filling of the space above oil and connected to silica gel breather shall be provided.

3.09.00 **Radiators**

The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank.

3.10.00 **Insulating Oil**

As per IS: 335. No external inhibitors are permitted.

3.11.00 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A of section-I, volume-II.

3.12.00 **Bushings/ Insulators**

3.12.01 The bushings shall conform to the requirements of IS: 2099 and IS: 3347 and shall be of porcelain and above 3150A for the LV bushing Epoxy bushing shall also be acceptable.

3.12.02 For 33kV windings 36kV bushing shall be provided. For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.

3.12.03 The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.

3.12.04 Clamps and fittings of steel or malleable cast iron shall be galvanised.

3.12.05 Where bushing current transformer is provided, the bushing shall be mounted so that it can be removed and replaced without disturbing the current transformers. CTs shall be cast resin type & suitable for operation at ambient temperature existing at its location on the transformer.

3.12.06 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.12.07 Minimum rated current for bushings shall be as under. However, same shall comply with IS-2099 and HV/LV system fault current mentioned in Clause No. 20.00 of Datasheet A of section-I, volume-II:

1) H V Bushing for 33kV
   7.5 MVA = 250A
   5.0 MVA = 100A
   2.0 MVA = 100A

2) H V Bushing for 11kV & 6.6kV
   10.0MVA= 1000A
   8.0MVA = 1000A
   7.5MVA = 800A
   6.3MVA = 800A
   5.0MVA = 630A
   3.5MVA = 250A
   2.5 MVA = 250A

2.0 MVA = 250A
1.6 MVA = 250A
1.0 MVA = 100A
630 kVA = 100A

2) H V Bushing for 3.3kV
2.5 MVA = 630A
2.0 MVA = 500A
1.6 MVA = 400A
1.0 MVA = 250A
630 kVA = 250A

3) L V Bushing for 11kV, 6.6kV & 3.3kV

10.0MVA= 2500A
8.0MVA = 2000A
7.5MVA = 1600A
6.3MVA = 1600A
5.0MVA = 1250A
3.5MVA= 1250A

4) L V Bushing for 433V/420V
2.5 MVA = 4000A
2.0 MVA = 4000A
1.6 MVA = 3150A
1.0 MVA = 2000A
630 kVA = 1000A

3.13.00 **Cable Box**

3.13.01 A dust tight air insulated type cable box with D.O.P. of IP: 55 shall be provided for terminating the cables directly of size and type specified in Data sheet-A of section-I, volume-II. The cable box shall also be provided with a suitable canopy. Suitable cable glands (double compression type) and lugs shall be provided for cable termination.

3.13.02 Dimensions of cable box shall be subject to purchaser's approval.

3.13.03 Inspection cover for fixed portion of cable box shall be provided. Handles for lifting cable box shall be provided.

3.13.04 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.13.05 Provision shall be made for earthing the body of each cable box. Separate earthing pads shall be provided for this purpose, suitable for bolted connection to galvanised mild steel flat of size to be specified during contract engineering stage.

3.13.06 Gland plate for single core cable termination shall be of Aluminium.

3.13.07 Cable box(es) shall be provided with suitable air-insulated disconnecting chamber so that if required, transformer can be removed from its position without disconnecting the cables in the cable box(es). Independent supporting arrangement shall be provided for cable box(es) for this purpose. Supporting arrangement shall be supplied along with required hardware & foundation bolts etc.

3.14.00 **Busduct Termination**

If LV terminals are specified to be connected by means of a busduct, a flanged throat or equivalent connection shall be provided to suit purchaser's busducts. The winding termination shall be on outdoor type of bushing. Necessary flexibles shall be provided by purchaser to connect the bushing terminals to the busbars of the busduct. Details of busduct shall be furnished during detail engineering stage. Degree of protection of LV busduct flange enclosure shall be IP:55.

3.15.00 **Neutral Terminals**

Two (2) nos. neutral terminals shall be provided on LV side. One neutral terminal shall be part of phase connection arrangement busduct throat/ LV cable-box (as applicable). Other neutral terminal shall be in a separate box and brought to tank bottom by means of earthing bar of 50x6 mm of copper, supported on porcelain insulators mounted on transformer tank. The neutral earthing bar brought to the tank bottom for connection to station earth shall be provided with holes and suitable connecting hardware. This earthing bar shall have fork type arrangement at the end. However neutral may be connected to NGR as per system requirement.

3.16.00 **Neutral CT**

Bidder to provide neutral bushing CT as per details given in data sheet – A of section-I, volume-II for restricted earth fault protection or standby earth fault protection. In case neutral CT is tank mounted, CT box shall be weather proof having D.O.P. IP: 55. The Neutral CT box shall also be provided with a suitable canopy. CTs shall be cast resin type.
All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

3.17.00 **Valves**

3.17.01 All valves upto 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 with gun metal fittings.

3.17.02 Sampling & drain valves should have zero leakage rate.

3.18.00 **Gaskets**

3.18.01 Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork.

3.18.02 If gasket is compressible, metallic stops shall be provided to prevent over compression.

3.18.03 The gaskets shall not deteriorate during the life of transformer/shunt reactor 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.

3.19.00 **Voltage control (off circuit type)**

3.19.01 Off circuit tap-changing switch shall be three phase, hand operated, for simultaneous switching of similar taps on all the three phases by operating an external handle/ hand wheel. The position of off-circuit tap switch handle/hand wheel provided outside the transformer tank should be such as to enable an operator standing on ground to operate the same with ease. A caution plate indicating that switch shall be operated only when the transformer is de-energised shall be fitted near tap switch.

3.19.02 Operating mechanism of tap changer shall be suitably labelled to show the direction of operation for raising secondary voltage & vice versa. Position markings shall be provided.

3.19.03 Arrangement shall be made for securing and padlocking the tap-changing switch at any working position. It shall not be possible to set and padlock in any intermediate position.

3.19.04 Tap position indicator and mechanical stops to prevent over-cranking of the mechanism shall be provided.

3.20.00 **Marshalling box**

3.20.01 Tank mounted vermin and dust proof marshalling box shall be provided to accommodate indication circuits and temperature indicators etc. and provided with proper lighting and thermostatically controlled space heaters.

3.20.02 The marshalling box shall be fabricated using sheet steel of at least 2.5mm thickness. The marshalling box shall have domed or sloping roof.

3.20.03 Marshalling box shall be complete with all internal wiring and identification ferrules, cables, conduits required for wiring between marshalling box and instruments on transformer. Wiring shall be by 1100 V grade, copper cable of size 2.5mm^2.

3.20.04 The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 stranded copper wire. 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.

3.20.05 The marshalling box shall have IP: 55 degree of protection.

3.20.06 CT terminals shall be with shorting and disconnecting facility. TB shall be stud type for all CT & power connection.

3.20.07 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. Refer annexure-C for standard terminal block numbering.

3.21.00 **Flux density**

Flux density in any part of the core & yoke on any tap position with ±10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 Wb/m^2.
Transformer shall also withstand following conditions due to combined voltage and frequency variations:

Continuous operation for 110% flux density
At least 1 minute operation for 125% flux density
At least 5 sec. operation for 140% flux density

3.22.00 **Winding**

For 33kV, 11kV & 3.3kVwinding, type of winding shall be continuous disc & for 433V/ 420V winding, type of winding shall be spiral type. The conductors shall be of Electrolytic grade copper.

3.23.00 **Noise & Vibration**

The design and manufacture of transformer, fittings and accessories shall be such as to reduce noise & vibration. Noise level shall not be more than as specified in NEMA Standard Publication TR-1, when measured with transformer energised at normal voltage and frequency.

3.24.00 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds.

3.25.00 Maximum Transformer losses including tolerances shall be as per annexure – B, of section-I, volume-II.

3.26.00 **LOADING CAPABILITY**

Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of $\pm$ 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IS:6600 / IEC60076-7.

4.00.00 **Fittings & accessories**

4.01.00 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

4.01.01 Conventional type conservator with drain valve and oil filling hole.

4.01.02 Magnetic oil level gauge with low-level alarm contact.

4.01.03 Prismatic & toughened glass oil level gauge.

4.01.04 Gaskets

4.01.05 Gasket protection covers.

4.01.06 Silica gel breather with oil seal.

4.01.07 Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.

4.01.08 Diaphragm type explosion vent for transformers of rating less than 2MVA

4.01.09 Pocket on tank cover for thermometer.

4.01.10 Protected type mercury in glass thermometer.

4.01.11 Dial type (150 mm) Oil temperature indicator (OTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The OTI shall be provided with anti-vibration mounting. OTI shall have maximum reading pointer along with resetting device. For remote oil temperature metering, an independent 4-20 mA should be made available.

4.01.12 Dial type (150 mm) Winding temperature indicator (WTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The WTI shall be provided with anti-vibration mounting. WTI shall have maximum reading position along with resetting devices. For remote winding temperature metering, an independent 4-20 mA should be made available.

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4.01.13 Drain Valves.

4.01.14 Sampling devices.

4.01.15 Filter valves.

4.01.16 Earthing terminals – 2 Nos.

4.01.17 Rating & Diagram plates.

4.01.18 Valve schedule plate.

4.01.19 Two sets of lifting lugs (one for transformer with oil and other for tank cover).

4.01.20 Jacking pads.

4.01.21 Skids and pulling eyes on both sides.

4.01.22 Air release devices.

4.01.23 Inspection cover.

4.01.24 Oil filling hole and cap.

4.01.25 Tank mounted marshalling box.

4.01.26 Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.

4.01.27 Clamping arrangement for rollers.

4.01.28 Ground support for cable box.

4.01.29 Neutral CT secondary box.

4.01.30 Haulage facilities.

4.01.31 Two nos. spring operated pressure relief devices with extension pipe to bring oil to plinth level along with electrically insulated contact for alarm and tripping for transformer rating 2 MVA and above.

4.01.32 Gas collection device along with all accessories**.**

4.02.00 Breather shall be fitted at a height not exceeding 1.5 M.

4.03.00 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level.

4.04.00 The WTI and OTI shall have accuracy class of $\pm$ 2 deg. C or better.

4.05.00 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering. Such plates shall be bi- lingual (requirement will be finalised during detailed engineering) with Hindi inscription first, followed by English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

5.00.00 **PAINTING**

Paint shade shall be informed to successful bidder during detail engineering as applicable for specific project. Adequate quantity of touch up paint shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

6.00.00 **QUALITY ASSURANCE, TESTING & INSPECTION**

6.01.00 BHEL's Standard QP (PE-QP-999-302-E001 Rev. 0) is enclosed as per Annexure-A of section-II, volume-II for reference. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of QP approval.

6.02.00 All materials, components and accessories of the transformers shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

6.03.00 Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out.

6.04.00 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers.

6.05.00 Successful bidder shall furnish List of sub-vendors/ makes of items for BHEL/ customer approval at contract stage. This shall not have any commercial implication to BHEL.

6.06.00 For acceptance of short circuit reports for tests carried out earlier on similar transformers, successful bidder shall furnish the following documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL

6.06.01 Calculations and design considerations to prove ability to withstand the dynamic effects of short circuit.

6.06.02 Short circuit test report of previously tested similar transformer for validation by comparison. Criteria for similarity of transformer for acceptance of Short circuit test report shall be as given in the Annexure-B of IEC-60076-5.

7.00.00 COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES

7.01.00 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer as per annexure-IV of section-I, volume-II.

7.02.00 The bidder shall supply with the equipment, one unused complete set of all special tools & tackles required for the erection, assembly, disassembly and proper maintenance of the equipment. A list of such tools & tackles (price deemed to be included in the total bid price) shall be submitted by the bidder along with the offer as per annexure-V of section-I, volume-II.

7.03.00 O & M spares are those which are required for satisfactory & trouble free operation of equipment. List of O & M spares is enclosed as per Annexure-D of section-II, volume-II. O & M spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.

8.00.00 O & M MANUALS

8.01.00 O & M manuals for the installation, operation and maintenance of transformers shall be furnished at least three months before despatch of equipment.

8.02.00 Draft manual should first be submitted for purchaser's approval. The manual should contain minimum following details:

8.02.01 General description of equipment.

8.02.02 Approved Technical Data Sheet

8.02.03 All drawings

8.02.04 Salient constructional features.

8.02.05 Technical leaflets of fittings/ important parts.

8.02.06 Type and routine test certificates.

8.02.07 Instructions to be followed on receipt of equipment at site & for storage.

8.02.08 Instructions for foundation arrangement.

8.02.09 Erection procedures and checks.

8.02.10 Pre-commissioning checks.

8.02.11 Commissioning procedures.

8.02.12 Withdrawal arrangement/ material handling instructions.

8.02.13 Operation instructions.

8.02.14 Maintenance instructions.

8.02.15 Trouble-shooting.

8.02.16 Safety instructions.

ANNEXURE - A

STANDARD QUALITY PLAN

BHEL	**QUALITY PLAN**	CUSTOMER :	PROJECT TITLE :		SPECIFICATION NO. :
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:
	SHEET 1 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER		DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**											
1.1	Mild Steel plate, MS Pipe, Channels, MS Angles	a) Thickness	Major	MEASURE	10%			QC Record.	3/2		1	
		b) Surface defects	Major	VISUAL	100%			QC Record.	3/2		2	
		c) Chemical composition	Major	TEST	-			Supplier's TC	3/2		-	
		d) Mechanical Properties	Major	TEST	-	'MANFUF. STD /	'MANFUF. STD /	Supplier's TC	3/2		2	
		e) Hydraulic test of pipes	Major	TEST	-	IS:2062 / IS:1239	IS:2062 / IS:1239	Supplier's TC	3/2		2	
1.2	CRGO Steel	a) Thickness Dimension & Finish	Major	MEASURE	10%	DRG/DATA SHEET/	DRG/DATA SHEET/	QC Record.	2		1	
		b) Grade of CRGO	Major	MEASURE	-	'MANFUF. STD /	'MANFUF. STD /	TC	3/2		2	
		c) Cutting & burr	Major	MEASURE	10%	IS:3024 / IS:649	IS:3024 / IS:649	QC Record.	2		-	
		d) Scratches, surface finish	Major	VISUAL	10%			QC Record.	3/2		-	
		e) Waviness & edge camber	Major	MEASURE	10%			QC Record.	2		1	
		f) Specific core loss	Major	TEST	-			Supplier's TC	3/2		2	
		g) Surface resistivity	Major	TEST	-			Supplier's TC	3/2		2	
		h) Stacking factor	Major	TEST	-			Supplier's TC	3/2		2	
		i) Permeability	Major	TEST	-			Supplier's TC	3/2		2	
		j) Bend test/ Ductility	Major	MEASURE	-			Supplier's TC	3/2		2	
1.3	Paper Insulated Copper Conductor	a) Dimensions	Major	MEASURE	100%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Resistivity/Conductivity	Major	TEST	10%	IS:13730-P-27/IEC	IS:13730-P-27/IEC	Supplier's TC	3/2		1	
		c) Elongation	Major	TEST	-	60554	60554	Supplier's TC	3/2		2	
		d) Tensile Strength	Major	TEST	-			Supplier's TC	3/2		2	
		e) Proof stress if applicable	Major	TEST	-			Supplier's TC	3/2		2	
		f) Insulation test between strands for bunched conductors	Major	TEST	-			Supplier's TC	3/2		2	
		g) Cu purity of CC rod	Major	TEST	-			Supplier's TC	3/2		2	
		h) Chemical composition	Major	TEST	-			Supplier's TC	3/2		2	
		i) Surface Finish	Major	VISUAL	100%	Free from sharp edge,burr,scretch, cuts etc.	Free from sharp edge,burr,scretch, cuts etc.	QC Record.	2		2	
1.4	Insulating Paper	a) Dimensions	Major	MEASURE	10%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Density & substance	Major	TEST	-	IS:9335-P-2/IS:9335-	IS:9335-P-2/IS:9335-	Supplier's TC	3/2		2	
		c) Tensile Strength	Major	TEST	-	P-III/IEC 60554	P-III/IEC 60554	Supplier's TC	3/2		2	
		d) Elongation	Major	TEST	-			Supplier's TC	3/2		2	
		e) Water absorption	Major	TEST	-			Supplier's TC	3/2		2	
		f) Moisture content	Major	TEST	-			Supplier's TC	3/2		2	
		g) pH value & conductivity aqueous extract	Major	TEST	-			Supplier's TC	3/2		2	
		h) Ash content	Major	TEST	-			Supplier's TC	3/2		2	
		i) Electrical strength	Major	TEST	-			Supplier's TC	3/2		2	
		j) Air permeability	Major	TEST	-			Supplier's TC	3/2		2	
		k)Tear index	Major	TEST	-			Supplier's TC	3/2		2	
		l) Heat stability	Major	TEST	-			Supplier's TC	3/2		2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:
	SHEET 2 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	Insulation & Press-	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:1576	'MANFUF. STD / IS:1576	QC Record.	2		1	
	Board moulding	b) Compressibility	Major	Test	-			Supplier's TC	3/2		2	
	(stock items)	c) Density	Major	Test	-			Supplier's TC	3/2		2	
		d) Tensile strength	Major	Test	-			Supplier's TC	3/2		2	
		e) pH value/Conductivity of water extract	Major	Test	-			Supplier's TC	3/2		2	
		f) Electrical strength in air & oil	Major	Test	-			Supplier's TC	3/2		2	
		g) Shrinkage in air	Major	Test	-			Supplier's TC	3/2		2	
		h) Flexibility	Major	Test	-			Supplier's TC	3/2		2	
		i) Ash content	Major	Test	-			Supplier's TC	3/2		2	
		j) Moisture content	Major	Test	-			Supplier's TC	3/2		2	
		k) Cohesion between plies	Major	Test	-			Supplier's TC	3/2		2	
		l) Elongation	Major	Test	-			Supplier's TC	3/2		2	
		m) Oil absorption	Major	Test	-			Supplier's TC	3/2		2	
1.6	Densified wood	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:3513	'MANFUF. STD / IS:3513	QC Record.	2		1	
		b) Surface finish	Major	Visual	10%			QC Record.	2		-	
		c) Electrical strength in oil	Major	Test	-			Supplier's TC	3/2		1	
		d) Oil absorption	Major	Test	-			Supplier's TC	3/2		-	
		e) Moisture content	Major	Test	-			Supplier's TC	3/2		-	
		f) Compression strength	Major	Test	-			Supplier's TC	3/2		-	
		g) Crossbreaking strength	Major	Test	-			Supplier's TC	3/2		-	
		h) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
		i) Specific gravity/ Density	Major	Test	-			Supplier's TC	3/2		-	
1.7	Gasket(Rubber	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	QC Record.	2		-	
	Bonded Cork sheet	b) Hardness	Major	Test	-			Supplier's TC	3/2		1	
	(if applicable)	c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
		d) Compressibility	Major	Test	-			Supplier's TC	3/2		1	
		e) Recovery	Major	Test	-			Supplier's TC	3/2		-	
		f) Compression set	Major	Test	-			Supplier's TC	3/2		-	
		g) Flexibility	Major	Test	-			Supplier's TC	3/2		-	
		h) Fluid resistence test	Major	Test	-			Supplier's TC	3/2		-	
		i) Chloride/Sulphate content of water extract	Major	Test	-			Supplier's TC	3/2		-	
		j) Density	Major	Test	-			Supplier's TC	3/2		-	
1.8	Nitrile Rubber	a) Dimension	Major	MEASURE	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	Supplier's TC	2		-	
	Cord and "0"	b) Shore Hardness	Major	Test	-			Supplier's TC	3/2		-	
	Ring	c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
	(if applicable)	d) Elongation at break	Major	Test	-			Supplier's TC	3/2		-	
		e) Compression set	Major	Test	-			Supplier's TC	3/2		-	
		f) Accelerated Ageing in oil	Major	Test	-			Supplier's TC	3/2		-	

	PARTICULARS	BIDDER/VENDOR
BHEL	NAME	
	SIGNATURE	
	DATE	

BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE :			SPECIFICATION NO. :					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 3 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
1.9	Insulating Oil	a) Appearance of oil	Major	Visual				Supplier's TC	3/2		2,1		
		b) Density at 29.5 deg C	Major	Test				Supplier's TC			2,1		
		c) Kinematic viscosity at 27 & 40 deg C	Major	Test				Supplier's TC			2,1		
		d) Interfacial tension at 27 deg C	Major	Test				Supplier's TC			2,1		
		e) Flash point	Major	Test				Supplier's TC			2,1		
		f) Pour point	Major	Test				Supplier's TC			2,1		
		g) Neutralization value	Major	Test				Supplier's TC			2,1		
		h) Corrosive sulphur	Major	Test				Supplier's TC			2,1		
		i) Dielectric dissipation factor	Major	Test				Supplier's TC			2,1		
		j) Specific resistance (resistivity)	Major	Test	One sample	MANUF. STD / IS:335	MANUF. STD / IS:335	Supplier's TC			2,1		
		k) Ageing characteristics after accelerated ageing	Major	Test				Supplier's TC			2,1		
		l) Oxidation stability	Major	Test				Supplier's TC			2,1		
		m) Presence of oxidation inhibitor	Major	Test				Supplier's TC			2,1		
		n) Electric strength(BDV, Tan-delta) i) As delivered ii) After treatment	Major	Test				Supplier's TC			2,1		
		o) Water content	Major	Test				Supplier's TC			2,1		
		p) S.K.value	Major	Test				Supplier's TC			2,1		
1.10	Paint &Varnish	Shelf Life	Major	VISUAL	100%	MANF.STD	MANF.STD	Supplier's TC	3/2		2,1		
2	**FITTING AND ACCESSORIES (MAKE SHALL BE AS PER ANNEXURE-1)**												
2.1	Porcelain Bushing (if applicable)	a) Dimension	Major	MEASURE	100%	IS:2099/IS:8603	IS:2099/IS:8603	QC records	2		-		
		b) Visual defects	Major	Visual	100%			QC records	2		-		
		c) routine testing	Major	Test	100%			Supplier's TC	3/2		2,1		
2.2	Condenser Bushing (if applicable)	a) Type, size & model	Major	Visual	100%	IS:2099 / IS:8603 / IEC 60137	IS:2099 / IS:8603 / IEC 60137	QC records	2		1		
		b) Dimensional check	Major	Measure	100%			QC records	2		1		
		c) Dry power frequency voltage withstand test	Major	Test	-			Supplier's TC	3/2		2,1		
		d) HV Test for test tap	Major	Test	-			Supplier's TC	3/2		2,1		
		e) Tan delta & capacitance test	Major	Test	-			Supplier's TC	3/2		2,1		
		f) Nitrogen Pressure Test	Major	Test	-			Supplier's TC	3/2		2,1		
		g) Routine Test	Major	Test	-			Supplier's TC	3/2		2,1		
				PARTICULARS	**BIDDER/VENDOR**								
	BHEL			**NAME**									
				SIGNATURE									
				DATE								BIDDER'S/VENDORS COMPANY SEAL	

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE :			SPECIFICATION NO. :					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 4 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
2.3	Bucholz Relay	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1		
		b) Continuity for alarm &	Major	Test	-	IS:3637	IS:3637	Supplier's TC	3/2		2		
		trip (Performance)	Major	Test	-								
		c) Porosity test	Major	Test	-			Supplier's TC	3/2		2		
		d) High voltage & IR test	Major	Test	-			Supplier's TC	3/2		2		
		e) Element test	Major	Test	-			Supplier's TC	3/2		2		
		f) Gas volume test	Major	Test	-			Supplier's TC	3/2		2,1		
		g) Loss of oil & surge test	Major	Test	-			Supplier's TC	3/2		2,1		
2.4	Pressure	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1		
	Relief Device	b) Operation (Pressure &	Major	Test	-	IS:3637	IS:3637	Supplier's TC	3/2		2,1		
		flag indication)	Major	Test	-								
		c) HV Test	Major	Test	-			Supplier's TC	3/2		2,1		
		d) Switch contact operation	Major	Test	-			Supplier's TC	3/2		2		
2.5	Magnetic Oil	a) Type, size & make	Major	Visual	100%	MANFUF. STD'	MANFUF. STD.'	QC records	2		1		
	Lavel Gauge	b) Dial marking	Major	Visual	-			Supplier's TC	3/2		2		
	(MOG)	c) Switch continuity	Major	Test	-			Supplier's TC	3/2		2		
		d) HV test	Major	Test	-			Supplier's TC	3/2		2		
		e) Operation test	Major	Test	-			Supplier's TC	3/2		2		
2.6	Off-Circuit Tap	a) Dimensions	Major	Measure	100%	MANFUF. STD'	MANFUF. STD'	QC records	2		-		
	Changer/Switch	b) Physical condition	Major	Visual	100%			QC records	2		-		
	(if applicable)	c) operation of switch	Major	Test	-			QC records	2		-		
		d) Insulation resistance test	Major	Test	-			Supplier's TC	3/2		2		
		e) Leak test of handle stuffing box	Major	Test	-			Supplier's TC	3/2		2		
		f) Milli volt drop test	Major	Test	-			Supplier's TC	3/2		2		
2.7	On load Tap	a) Visual check	Major	Visual	100%	IS:8468/IEC 60214	IS:8468/IEC 60214	QC records	2		-		
	Changer	b) Dimensional check	Major	Measure	100%			Supplier's TC	2		-		
	(if applicable)	c) Mechanical operation on	Major	Verify	-			Supplier's TC	3/2		2		
		Diverter & Selector switch,											
		4000 switching oper. (Min)											
		d) HV test on Auxiliary circuit	Major	Test	-			Supplier's TC	3/2		2,1		
		e) Sequence test	Major	Test	-			Supplier's TC	3/2		2,1		
		f) Pressuure test of diverter	Major	Test	-			Supplier's TC	3/2		2,1		
		switch compartment with oil											
		g) Mechanical test of Tap	Major	Test	-			Supplier's TC	3/2		2,1		
		selector with motor drive											
		500 satisfactory opm(in all)											
		from one extreme position											
		to the other in air											
		h) Opm test of complete	Major	Test	-			Supplier's TC	3/2		2,1		
		tapchanger											
		i) Aux. ckt. HV test at 2 KV for 1 min.	Major	Test	-			Supplier's TC	3/2		2,1		

	PARTICULARS	**BIDDER/VENDOR**	
BHEL	**NAME**		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :	
		BIDDER/ : VENDOR	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:	
	SHEET 5 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :	

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.8	Gun Metal / Cast Iron Valves Gate/globe/ Butterfly)	a) Dimensional check	Major	Measure	100%	Manf. Std./IS:778 Class 1	Manf. Std./IS:778 Class 1	QC Record	2		-	
		b) Type, size & make	Major	Visual	100%			QC Record	2		-	
		c) Leakage test(Hydraulic test	Major	Test	-			Supplier's TC	3/2		2,1	
		for Body & Seat)	Major	Test	-							
		d) Operational test (close & open)	Major	Test	-			Supplier's TC	3/2		2	
2.9	Bushing CT	a) Visual check/Dimensional check	Major	Measure/Visual test	100%	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	2		-	
		b) Routin test	Major	Test	-	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	3/2		2,1	
2.10	Marshaling box/RTCC	a) Visual check for wiring	Major	Test	100%	Drg./Manf. Std./IS:5/IS:13947	Drg./Manf. Std./IS:5/IS:13947	Supplier's TC	3/2	2	-	
		b) Dimensional check	Major	Measure/Test	100%			Supplier's TC	3/2	2	-	
		c) Check for make of components	Major	Measure/Test	100%			Supplier's TC	3/2	2	-	
		d) 2 kV insulation test on auxiliary wiring	Major	Measure/Test	100%			Supplier's TC	3/2	2	-	
		e) Check for paint, shade & thickness	Major	Measure/Test	100%			Supplier's TC	3/2	2	-	
		f) Degree of Prot. By paper insertion	Major	Measure/Test	100%			Supplier's TC	3/2	2	-	
2.11	OTI&WTI	a)Type size & make	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		1	
		b) HV test	Major	Test	-			Supplier's TC	3/2		2,1	
		C) Temperature calibration	Major	Test	-			Supplier's TC	3/2		2,1	
		d) Switch setting & switch deferential	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Calibration & operation of switch	Major	Test	-			Supplier's TC	3/2		2,1	
2.12	Radiator	a) Type, Model, Rating	Major	Visual	100%	Drg./Manf. Std./IS:101	Drg./Manf. Std./IS:101	QC records	3/2	2	1	
		b) Dimensions & No. of elements	Major	Measure	100%			QC records	3/2	2	-	
		c) Paint shade, Finish & film thickness	Major	Measure/test	100%			QC records	3/2	2	-	
		d) Pressure test	Major	Test	100%			Supplier's TC	3/2	2	1	
		e) Adhesion test on paint	Major	Test	100%							
		f) Welding quality	Major	Visual/ DPTest	100%	Relevant code	Relevant code	Supplier's TC	3/2	2	1	
2.13	Hardware	a) Dimensional check	Major	Measure	100%	Manf. Std.	Manf. Std.	QC records	2		-	
		b) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	

	PARTICULARS	BIDDER/VENDOR
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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE :			SPECIFICATION NO. :				
		BIDDER/ : VENDOR			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:				
	SHEET 6 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :				

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.14	Oil Pump Motor set (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Hv test at 2 kV for one minute	Major	Test	-			Supplier's TC	3/2		2,1	
		d) Input power taken by pump	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Performance test (I/P,O/P,DISCH, NO LOAD, Locked Rotor te)	Major	Test	-			Supplier's TC	3/2		2,1	
2.15	Cooling Fan (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Approved drgs/docs/spec./ IS:2312	Approved drgs/docs/spec./ IS:2312	QC records	2		-	
		b) Dimensional check	Major	Measure	-			QC records	2		-	
		c) HV test at 2 KV for	Major	Test	-			Supplier's TC	3/2		2,1	
		one minute	Major	Test	-						-	
		d) IR test	Major	Test	-			Supplier's TC	3/2		-	
		e) Power consumption & RPM	Major	Test	-			Supplier's TC	3/2		2,1	
2.16	Roller Assembly	a)Dimensions	Major	Measure	100%	Manf. Drg./docs	Manf. Drg./docs	QC records	2		-	
		b) Mechanical & Chemical properties of Raw material used for Shaft & Roller	Major	Measure	-			Supplier's TC	3/2		2	
2.17	Terminal Connector (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/IS:5561	Manf. Drg./docs/IS:5561	QC records	2		-	
		b) Surface finish	Major	Visual	-			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	-			Supplier's TC	3/2		2,1	
2.18	Air Cell for Conservator (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/PO	Manf. Drg./docs/PO	QC records	2		-	
		b) Surface finish	Major	Visual	100%			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	100%			Supplier's TC	3/2		2,1	
2.19	Oil Flow Indicator (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Functional test	Major	Test	-			Supplier's TC	3/2		2,1	
2.20	Silicagel Breather	a) Type, Size, Model	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Pressure/ Leakage test	Major	Test	-			Supplier's TC	3/2		2	
		c) Colour of silica gel	Major	Visual	-			Supplier's TC	3/2		2,1	

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LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:
	SHEET 7 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3	**IN-PROCESS**											
3.1	Fabrication of Tank, Conservator,Radiator, HV&LV CABLE BOX and welding requirement	a) Welding procedure specification	Major	Verify/Review	100%			QC Records	3/2		2	
		b) Process qualification record	Major	Verify/Review	100%			QC Records	3/2		2	
		c) Weider qualification	Major	Verify/Review	100%			QC Records	3/2		2	
		d) Welding electrodes-Me-chanical Properties	Major	Verify/Review	100%			QC Records	3/2		2	
		e) Fitup for butt weld joints of tank and cover	Major	Visual	100%			QC Records	3/2		2	
		f) Visual check on weldment & any foregin particle in the entire tank with conservator, pipes etc.and blanking of ends with bolted plates	Major	Visual	100%			QC Records	3/2		2	
		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	3/2		2	
		h) DP test on welded joints	Major	Test	100%			QC Records	3/2		2,1	
		i) Check for flatness gasket surface	Major	Visual	100%			QC Records	3/2		2,1	
		J) Rim flatness	Major	Measure	100%			QC Records	3/2		2,1	
		k) Surface cleaning by sand/ shot blasting	Major	Visual	100%			QC Records	3/2		2,1	
		l) Primer coating, paint shade thickness inside & outside	Major	Measure	100%			QC Records	3/2		2,1	
		m) Paint film adhesion test	Major	Test	100%			QC Records	3/2		2,1	
		n) Vacuum Test (Tank)	CR	Vacuum test	1 unit each type	Appd. Doc./BHEL	Appd. Doc./BHEL	QC formate	3/2	1		
		o) Pressure test (Tank)	CR	Pressure test	1 unit each type	SPEC./CBIP	SPEC./CBIP	QC formate	3/2	1		
3.2	Core Stamping	a) Burr & Bow	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		b) Dimensional check	Major	Measure	100%			QC Records	2		-	
3.3	Core Building	a) Dimensional check	Major	Measure	100%			QC Records	2		-	
		b) Assembly of limb insulation and limb plates.	Major	Visual	100%			QC Records	2		-	
		c) Rectangularity of core assembly	Major	Visual	100%			QC Records	2		-	
		d) Freedom from overlaps & air gap at joints	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		e) Leaning of cor(i.e core verticality)	Major	Visual	100%			QC Records	2		-	
		f) Limb & stack thickness	Major	Visual	100%			QC Records	2		-	
		g) Limb clamping & binding	Major	Visual	100%			QC Records	2		-	
		h) Core diameter	Major	Visual	100%			QC Records	2		1	
		i) Earthing of core	Major	Visual	100%			QC Records	2		1	

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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

BHEL	QUALITY PLAN	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:
	SHEET 8 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.4	Test on Core	a) Dimensional check	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		b) Flux density measurement	Major	Measure	100%			QC Records	2		-	
		c) Isolation test between(core to core clamps)	Major	Test	100%			QC Records	2		-	
		d)Torque Tightness	Major	Measure	100%			QC Records	2		-	
		e) Core Insulation	Major	Electrical	100%			QC Records	2		-	
		f) Core Loss	Major	Electrical with dummy coil	100%			QC Records	2		1	
		g)Visual checks of core verticality	Major	Visual	100%			QC Records	2		-	
3.5	Winding	a) Brazing procedure & Brazer qualification	Major	Review	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Conductor size.	Major	Measure	100%			QC Records	2		-	
		c) Redial depth of winding	Major	Measure	100%			QC Records	2		-	
		d) Anchoring & binding at start & finish	Major	Measure	100%			QC Records	2		-	
		e) No. of turns	Major	Measure	100%			QC Records	2		-	
		f) Transposition of cross-overs	Major	Measure	100%			QC Records	2		-	
		g) Dimensional check (0D,ID & axial length)	Major	Measure	100%			QC Records	2		-	
		h) Insulation arrangement & alignmt.	Major	Measure	100%			QC Records	2		-	
		i) Winding length	Major	Measure	100%			QC Records	2		-	
		j) Brazed joints	Major	Measure	100%			QC Records	2		-	
		k) Lead & coil identification and marking	Major	Measure	100%			QC Records	2		-	
		l) Free from damages	Major	Measure	100%			QC Records	2		-	
		m) Continuity test for leads	Major	Measure	100%			QC Records	2		-	
		n) Turn to Turn Insulation	Major	Measure	100%			QC Records	2		1	
		o) Measure. Of Resistance	Major	Measure	100%			QC Records	2		1	
3.6	Core coil assembly	a) Cleanliness of core	Major	Visual	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Alignment of spacers/blocks	Major	Visual	100%			QC Records	2		-	
		c) Elect. Clearance & Insp. Of core & coil assly after completion of terminal gear	Major	Visual/measure	100%			QC Records	2		-	
		d) Check provision of core frame earthing	Major	Visual	100%			QC Records	2		-	
3.7	Connection and Tap switch assembly	a) Ratio test on all taps	Major	Test	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		1	
		b) Lead disposition.	Major	Visual	100%			QC Records	2		-	
		c) Brazing of joints	Major	Visual	100%			QC Records	2		-	
		d) Crimping of joints	Major	Visual	100%			QC Records	2		-	
		e) Insulation over joints	Major	Visual	100%			QC Records	2		-	
		f) Vector group	Major	Test	100%			QC Records	2		1	
3.8	Ovening and Tanking	a) Cleanliness of tank	Major	Visual	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Drawing	Major	Physical	100%			QC Records	2		1	
		c) Check tightness of clamped blocks and measurements of winding height	Major	Measure	100%			QC Records	2		1	
		d) Electrical clearances	Major	Measure	100%			QC Records	2		1	
		e) Oil filling and air release	Major	Physical	100%			QC Records	2		-	
		f) Dryness (Tan-delta & I.R)	Major	Measure	100%			QC Records	2		-	

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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

BHEL	**QUALITY PLAN**	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :	
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:	
	SHEET 9 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :	

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
4	Type & Special Test on Transformer	a)Review of type test & special test report b) Review of all previous stage of insp. As per QR prior to final testing	Major	Verify	100%	Reports			2	1	-	Type test as per enclosed annexure-1 to be conducted.
5	ROUTINE TEST Each Transformer Shall be completely assembled with all fittings and accessoriesmeant for particular transformerbefore offering for inspection & Test	a) Verification of completeness / Dimensional check	Major	Measure	100%				2	1		
		b) Measurement of Voltage Ratio at all taps,polarity & vector group verification	Major	Measure	100%				2	1		
		c) Measurement of winding resistance on HV & LV on all the Taps.	Major	Measure	100%				2	1		
		d) Vector group and polarity check	Major	Measure	100%				2	1		
		e) Magnetic balance Test	Major	Measure	100%				2	1		
		f) Induced overvoltage	Major	Measure	100%				2			
		g) Sepatate Source Voltage Withstand test	Major	Measure	100%				2	1		
		h)Measurementof capacitance & Tan delta to determine capacitance between winding & earth,	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026	As per APPROVED DATA SHEET/IS:2026	Manf. Test Records/QC Formats	2	1		
		i) Measurement of No-load losses & current at 90)%, 100% & 110% rated voltage.	Major	Measure	100%				2	1		
		j) .2 kV core Isolation (If Applicable),	Major	Measure	100%				2	1		
		k) Measurement of no load current with 415 V, 50 hZ AC supply.	Major	Measure	100%				2	1		
		l) IR & measurement of Insulation power factor & capacitance between winding and earth	Major	Measure	100%				2	1		
		m) Load loss & short circuit Impedence measurement on principal & extreme taps.	Major	Measure	100%				2	1		
		n) Repeat no load currents/loss measurement after completion of all dielectric test.	Major	Measure	100%				2	1		
		o) Test on OLTC/OCTC.	Major	Measure	100%				2	1		

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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE :	SPECIFICATION NO. :	
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:	
	SHEET 10 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :	

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
		p) Verification of oil leakage test with all fitting & accessories at normal presure plus 35KPA for 24 hours.	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	Manf. Test Records/QC Formats	2	1		
		q) Jacking Test followed by D.P. Test	Major	Measure	100%				2	1		
		r) Paint shade & adhession test	Major	Measure	100%				2	1		
		s) Protection on M. Box by paper insertion	Major	Measure	100%				2	1		
		t) 2 KV test on M.Box wiring & functional check for component of MB	Major	Measure	100%				2	1		
		u) Slope and alignment of Buchhoz relay	Major	visual	100%				2	1		
		v) DFT of paint	Major	Measure	100%				2	1		
6	Pre **Shipment** check &Despatch	a) Transformer- verification of final transportion.							2			
		b) Dew points measurement of N2/Dry gas tightness/ Pr reading (Only applicable for transformers dispatched with Gas Filling)							2			
		c) Packing of loose items							2			

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	SIGNATURE	
	DATE	

BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

ANNEXURE - B

TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers 2.0MVA & above and voltage ratio 33kV/6.9kV, 33kV/3.5kV, 11kV/6.9kV, 11kV/3.5kV, 6.6kV/3.5kV are given below:

Ratings	Maximum No-Load losses at rated frequency and 100%voltage	Maximum Load losses at normal ratio, rated current and 75 deg. C
10.0 MVA	9.0kW	72.0kW
8.0MVA	7.5 kW	57.0kW
7.5 MVA	7.2 kW	50.0kW
6.3MVA	6.5kW	45.0kW
5.0MVA	5.5kW	36.0kW
3.5MVA	4.5kW	32.0kW
2.5 MVA	2.8kW	30.0kW
2.0MVA	2.4 kW	24.0kW

The above indicated maximum No-Load and Load losses are inclusive of permissible tolerance as per IS-2026. Further tolerance on maximum losses is not permissible.

2. Transformers of rating 2.5MVA & below and voltage ratio 33kV/433V, 11kV/433V, 6.6kV/433V, 3.3kV/433V shall have Energy Efficiency Level 1 as per IS-1180. However, percent impedance shall be as per Data Sheet-A of section-I, volume-II of technical specification.

ANNEXURE – C

Terminal No.	Description	Remarks
T-01	230V, Single Phase, 50Hz, AC Supply	
T-02		
T-03	MOG (Oil Level) Alarm	
T-04		
T-05	Buchholz Relay Alarm	
T-06		
T-07	Buchholz Relay Trip	
Dummy		
T-08		
T-09	PRV-1 Alarm	If applicable
T-10		
T-11	PRV-1 Trip	
Dummy		
T-12		
T-13	PRV-2 Alarm	
T-14		
T-15	PRV-2 Trip	
Dummy		
T-16		
T-17	OTI Alarm	
T-18		
T-19	OTI Trip	
Dummy		
T-20		
T-21	WTI-1 Alarm	
T-22		
T-23	WTI -1 Trip	
Dummy		
T-24		
T-25 to T-28	SPARE	If applicable
T-29	4-20 mA for OTI (DDCMIS)	If applicable
T-30		
T-31	4-20 mA for OTI (SCADA)	
T-32		
T-33	4-20 mA for WTI-HV (DDCMIS)	
T-34		
T-35	4-20 mA for WTI-HV (SCADA)	
T-36		
T-37 to T-50	SPARE	
T-51	WTI 1-CT	If applicable
T-52		
T-53	CT Shorting Terminal	
T-54	WTI 2-CT	
T-55		
T-56	CT Shorting Terminal	
T-57	LV Neutral CT (REF Protection)	If applicable
T-58		
T-59	CT Shorting Terminal	
T-60	LV Neutral CT (E/F Protection)	If applicable
T-61		
T-62	CT Shorting Terminal	
T-63	HV Neutral CT (REF Protection)	
T-64		
T-65	CT Shorting Terminal	
T-66	HV U-PHASE CT	
T-67		
T-68	CT Shorting Terminal	
T-69	HV V-PHASE CT	
T-70		
T-71	CT Shorting Terminal	
T-72	HV W-PHASE CT	
T-73		
T-74	CT Shorting Terminal	
T-75 to T-80	SPARE TBs (for CT)	

Notes:

1). The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (ONAN cooling).

2). The Terminals which are not used for a particular Transformer shall be left as spare. e.g. in case there is only one WTI alarm & trip, then terminals T-25 to T-28 & T-38 to T-40 shall be left as spare terminals.

3). Provide 20% spare TBs.

ANNEXURE – D

LIST OF O & M SPARES

S. NO.	DESCRIPTION	QTY
1	HV bushing with metal parts & gaskets	1 no. for each rating
2	LV bushing with metal parts & gaskets	1 no. for each rating
3	WTI with alarm & trip contacts	1 no.
4	OTI with alarm & trip contacts	1 no.
5	Magnetic oil level gauge	1 no.
6	Diaphragm of explosion vent	1 no.
7	Buchholz relay	1 no.
8	Silica gel charge	Three charge
9	Floats with contacts for Buchholz relay	1 set
10	Set of gaskets	2 sets
11	Set of valves (1 no. of each size & Type)	1 set
12	Set of windings for one limb in a suitable oil container (container shall be completely filled with transformer oil)	1 no. of each rating & type of transformer.
13	Contact for tap changer	1 set
14	Pressure relief device for 2MVA & above transformers	1 no.
15	Hydraulic/screw Jacks	4 no.
16	Any other item considered essential by the bidder	

Note:

1) Wherever set is indicated above, it means the total parts/ accessories required to replace the particular item for a given equipment

2) O & M spares shall be supplied along with transformers and packed separately with proper inscription.