NTPC
3x800 MW PATRATU STPS EXPANSION PHASE-I

TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO : PE-TS-434-302-E001A
REV-0

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA

CONTENTS

TOTAL NUMBER OF SHEETS: 74

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

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 lightning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightning impulse withstand voltage (kVp)
0.433 KV	3	-	3	-
3.6 kV	10	40	11	40
7.2 kV	20	60	22	60
12 kV	28	75	30	75

SECTION 'I'

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFIC REQUIREMENT

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 (Star-2 losses *(energy efficiency level 3 as per IS 1180)* as per BEE guideline and BIS Certification for rating upto 2.5 MVA 33kV Class, however the impedance value, list of tests, fittings shall be as per those mentioned in the specification & shall also comply with IS-1180)**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 <u>The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.</u>

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.	1.02.01	The Clause shall be read as Terminal points are • HV bushing of transformer • HV cable gland at transformer
2.	1.02.02	The Clause shall be read as Terminal points are • LT Auxiliary transformers (LV voltage 0.433 kV) shall be 3 phase, 4 wire system with additional LVN bushing for equipment earthing. • LV cable gland at transformer (secondary voltage above 0.433 kV) • LV cable lugs & gland at transformer (secondary voltage of 0.433 kV)

3.	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 2003, Indian Electricity Rules and Bureau of Indian Standards, BEE Guideline & CEA notification.
4.	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.
4.	3.06.04	The Clause shall be read as Transformers having LV voltage 0.433 kV shall be provided with four no. (min.) of bi-directional detachable flat rollers & Transformers having LV voltage 3.3 kV & above shall be provided with four no. (min.) of detachable type bi-directional rollers for rail gauge of 1676mm. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.
5.	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.
6.	3.10.00	The Clause shall be read as As per IS: 60296. 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, mm2/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/dm3 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 — ≤ 1.2 -Sludge, % by mass — ≤ 0.8 12. Breakdown voltage As delivered, kV — ≥ 30 After treatment, kV — ≥ 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, mm3/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.)

7.	3.12.01 & 3.12.02	The Clause shall be read as a) The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676. b) Bushings below 52 kV shall with porcelain insulator and shall be of oil communicating / OIP (non-oil communicating type) / epoxy RIP type. All condenser bushings shall be non-communicating type. c) Bushing & fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay. d) No arcing horns to be provided on the bushings. e) LV bushing palms shall be silver/tin plated.
8.	3.12.05	The Clause shall be read as 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.
8.	3.15.00	Following point is added NGR is excluded from bidder scope of supply.

9.	3.16.00	The Clause shall be read as Bidder to provide neutral bushing CTs as per details given in data sheet – A of Section-I, volume-II for protection purpose. CTs 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.
10.	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.
11.	3.20.02	The Clause shall be read as Marshalling Box shall be of stainless steel (SS-316 or better), at least 2.5 mm thick. Also Marshalling Box gland plate shall be atleast 450 mm above ground level.
11.	3.22.00	The Clause shall be read as The conductors shall be of Electrolytic grade copper. All Windings of 66kV and below shall have uniform insulation. Windings are made in dust proof & conditioned atmosphere.
11.	New Clause	Transportation shall be N2/Dry Air/Oil filled.
12.	4.01.00- 4.02.00	The Clause shall be read as Following fittings shall be provided with Transformers covered under this specification. 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. b) Buccholz relay, double float type with alarm and trip contacts, along with suitable gas collecting device. a) For 2 MVA & above rating transformer, minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided. Armored cable be used between PRD to Marshalling box. PRD shall have DOP of IP-67. Plugin type connector shall be provided for proper sealing for terminating cables/ glands.

		c) 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). 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.
13.	5.00.00	The Clause shall be read as Adequate quantity of touch up paint shall also be supplied.

PARTS NAME	TYPE OF PAINT	NO. OF COATS	TOTAL DFT
Inside of tank and accessories (except Marshalling Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
External surface of Transformer and accessories (except 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 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	-	-
14.	6.03.00	The Clause shall be read as The type/ special tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The owner may waive conduction of any test subject to test facility anywhere in the world. The contractor shall obtain the employer's approval for the type/ special test procedure before conducting the type/ special test. The type/ special 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/ special test(s) to be carried out.			
15.	6.06.00	The Clause shall be read as In case the contractor has conducted such specified type/ special test(s) not earlier than ten years as on the date of bid opening, he may submit during detailed engineering the type/ special test reports to the owner for waiver of conductance of such type/ special 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/ special test(s) under this contract. In case type/ special tests are waived, the type/ special test charges shall not be payable to the contractor.			
15.	New Clause	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 / SPECIAL 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 as per IEC 60076-3.
12.	Applied Voltage Withstand Test (as per IEC 60076-3)
13.	Induced overvoltage 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 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/ Special 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/IS-1180 norm)
7.	Tank vacuum test (As per CBIP/IS-1180 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) (*) this test is applicable on Transformer neutral earthed thru NGR (i.e. for transformers having LV voltage 3.45 kV).

iii) ($) The permanent deflection of the plate after the vacuum has been released shall not exceed the values specified below:

Horizontal Length of Flat Plate (in mm)	Permanent deflection(in mm)
Up to and including 750	5.0

		751 to 1250 — 6.5 1251 to 1750 — 8.0 1751 to 2000 — 9.5 2001 to 2250 — 11.0 2251 to 2500 — 12.5 2501 to 3000 — 16.0 Above 3000 — 19.0 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.
16.	7.00.00	This clause stands deleted.

4.0 STANDARD QUALITY PLAN

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	ANNEXURE - A	The Clause shall be read as Follow ANNEXURE-I Standard Quality Plan of Section-I **instead of** ANNEXURE-A Standard Quality Plan of Section-II.

4.0 DOCUMENTATION

4.1 Documents required along with technical offer shall be as per Annexure-II.

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

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 4 & 1600 kVA 32 & 2500 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	kV	11.0
	b) LV Winding	kV	0.433
8.0	No Load transformation ratio		11/0.433
9.0	Vector group		Dyn1
10.0	Impedance voltage at rated current and frequency	%	1000 kVA: 5% 1600 kVA: 6.25% 2500 kVA: 10%
11.0	Total range of tapping's and tapping steps		$\pm$ 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	40 deg. C above ambient of 50 deg.C
	b) Winding by resistance	deg. C	45 deg. C above ambient of 50 deg.C
14.0	System Highest Voltage		
	a) HV Winding	kV	12 kV
	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)
	b) LV Winding	kV	3
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV)
	b) LV Winding	kVp	-
17.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		Flange throat for TPN non-segregated Al Busduct
	d) LV Neutral		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.
18.0	System Fault Level		
	a) HV Winding	kA	50 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.
	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)	As mentioned in this specification
	b) Exterior	As mentioned in this specification
23.0	Space/ Layout Limitation if Any	
24.0	Cable details (11KV/0.433KV)	(Cable not in bidder scope of supply)
	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
25.0	Penalty for Losses	
	a) Rates for bid evalution	N.A.
	b)	
	i) 'A' (Losses at 50% Load & 75°C)	Losses not to exceed max. losses as per Star-2 of BEE guidelines
	ii) 'B' (Losses at 100% Load & 75°C)	- Do-
26.0	Creepage distance	25mm/kV

DATA SHEET –A

11/3.45kV
AUXILARY TRANSFORMER

S. No.	Description	Unit	Particulars
1.0	Quantity	No. & kVA	4 & 5.0MVA
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	kV	11.0
	b) LV Winding	kV	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	%	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	12.0 kV
	b) LV Winding	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
	b) LV Winding	kV	10
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	75
	b) LV Winding	kVp	40
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)		As mentioned in this specification

	b) Exterior		As mentioned in this specification
23.0	Space/ Layout Limitation if Any		
24.0	Cable details		(Cable not in bidder scope of supply)
	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 evaluation		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

CLAUSE NO.

QUALITY ASSURANCE

AUX. TRANSFORMER **SQE_8**

Items/Components Sub Systems \ Attributes / Characteristics	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT (DPT / RT / 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												Y	
OLTC / Off-Circuit Tap Changer	Y									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.

ANNEXURE-I

STANDARD QUALITY PLAN

एनटीपीसी NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 1 of 8
VALID UPTO: 19.02.2016

REVIEWED BY	APPROVED BY
Banish K. Jha	Approved
H Shekhar	
B D Prasad	I Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
1.00	**RAW MATERIAL**													*A) Supplier's TC for all BOIs shall be maintained by Mfr for NTPC verification.*
1.01	Steel Plate & Pipe	a) Thickness	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:2062 /IS:1239	Mfr Plant Std./ IS:2062 /IS:1239	QC Record		P	V	V	
		b) Surafce defects	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	*B) Make of all BOIs & Raw Material shall be subject to NTPC acceptance and Vendor list for the same sall be submitted as annexure to project/package specific endorsement sheet.*
		c) Chemical Composition	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Mechanical Properties	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Hydraulic Test of Pipes	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	V	
1.02	CRGO Steel	a) Make,Thickness,Finish & Gr	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:3024/IS:649	Mfr Plant Std./ IS:3024/IS:649	QC Record		P	V	V	
		b) Cutting & edge burr	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Waviness & edge camber	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		d) Specific core loss	-do-	-do-	-do-	As per IS/ Plant Std	-do-	-do-	-do-		V	V	V	
		e) Surface resistivity/Insulation resistance of surface coating	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Stacking factor	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Permeability at 800A/m	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Bend Test / Ductility	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.03	Paper Insulated Copper Conductor	a) Dimensions & tolerances (Bare & Insulated)	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:13730/IEC 60554	Plant Std./ IS:13730/IEC 60554	QC Record		P	V	V	
		b) Resistivity/Conductivity	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC	√	V	V	V	
		c) Paper Covering	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Voltage Test betn Strands for bundled conductor	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	For CTC only
		e) Cu Purity	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Elongation	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Tensile Strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.04	Insulating Paper	a) Make,Dimensions & Type	M ajor	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554	QC Record		P	V	V	
		b) Density & substance	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Tensile Strength	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Elongation	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Water Absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Moisture Content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) pH Value & conductivity aqueous extract	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Ash Content	-do-	Test	-do-		-do-	-do-	-do-		V	-	-	
		i) Electrical Strength in Air	-do-	-do-	-do-	As per IS/Plant Std	-do-	-do-	-do-		V	V	V	
		j) Air Permeability	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Tear Index	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		l) Heat Stability	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	

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REVIEWED BY: Banish K. Jha, H Shekhar, B D Prasad
APPROVED BY: Approved, Dt....., T Gowrishankar

Quality Assurance * N.T.P.C., Noida *

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1	2	3	4	5	6		7	8	9		**	10		11
1.05	Press-Board	a) Make, Type, Dimensions	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS-1576	Plant Std./ IS-1576	QC Record		P	V	V	
		b) Compressibility	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Tensile strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) pH Value/Conductivity of Water extract	-do-	-do-	-do-	As per IS/ Plant Std	-do-	-do-	-do-		P	V	V	
		f) Electrical Strength in air and oil	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		g) Shrinkage in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Flexibility/ Elongination	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		i) Ash content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Moisture content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Oil absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Cohesion between plies	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.06	Densified Wood	a) Dimensions & Type	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:3513/IS3400- P-II	Mfr Plant Std./ IS:3513	QC Record		P	-	-	
		b) Surface finish	-do-	Visual	-do-	-do-	-do-	-do-	-do-		P	-	-	
		c) Electrical Strength in air and oil	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	V	
		d) Oil absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Shrinkage in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Moisture content	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Compression strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Crossbreaking strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		i) Tensile strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Specific gravity	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.07	Gasket Syntheic Rubber or Acryo Nitrile Butadine Rubber for Gasket	a) Dimensions, Grade & Type	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:4253-P-I/II	Plant Std./ IS:4253-P-I/II	QC Record		P	-	-	
		b) Hardness	-do-	-do-	-do-	-do-	-do-	-do-	Supplier's TC		V	V	V	
		c) Tensile strength	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Compressibility	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		e) Recovery	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Compression set	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Flexibility	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Ageing in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	
		e) Accelerated ageing	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	
		f) Chloride/Sulphate conte- nt of water extract	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	

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APPROVED BY: Approved, Laxmi Shankar

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1	2	3	4	5	6		7	8	9		**	10		11
1.08	Insulating Oil	a) Make, Appearance of oil	Major	Visual	As per IEC/IS	As per IEC/IS	NTPC Specification/ IEC-296/IS-335	NTPC Specification	Supplier's TC	√	V	V	V	
		b) Density,Resistivity	-do-	Test	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		c) Kinematic Viscosity	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		d) Interfacial Tension	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		e) Flash & pour point	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		f) Neutralisation value	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		g) Corrosive Sulfer Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		h) Water contnet	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		i) Anti Oxidants Additives	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		j) Oxidation Stability, Neuralisation Value in mgKOH/g and Sludge %	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		k) Breakdown Voltage (As delivered and after treatment)	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		l) Dissipation factor	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		m) PCA Content	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		n) Impulse withstand Level	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		o) Gassing tendency	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		q) Ageing characteristics at 115^0 C for 96 hours	-do-	-do-	-do-	-do-	IS-335-1993	IS-335-1993	-do-	√	V	V	V	*For reference only*
		r) S.K.Value	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
2.00	FITTING AND ACCESSORIES													
2.01	Porcelain Busings	a) Make , Rating,Dimensions	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	IS:2099/IS:3347/ IS:12676/NTPC Spec.	IS:2099/IS:3347/ IS:12676/NTPC Spec.	QC Record		P	-	-	
		b) Visual Defects	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Routine testing	-do-	Testing	-do-	-do-	-do-	-do-	Supplier's TC	√	V	V	V	
2.02	Bucholz Relay	a) Type, Size & Make	Major	Visual	As per IS/ Plant Std	As per IS/ Plant Std	Plant Std./ IS:3637	Plant Std./ IS:3637	QC Record		P	V	V	
		b) Continuity for alarm & trip (Performance)	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	-	
		c) Porosity Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		d) High Voltage & IR Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		e) Element Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		f) Gas Voulme Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		g) Loss of Oil & Surge Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
2.03	Pressure Relief Device (if applicable)	a) Type, Size & Make	Major	Visual	10%	As per IS/ Plant Std	Mfr Plant Std./ IS:3637	Plant Std./ IS:3637	QC Record		P	V	-	
		b) Operation (Pressure & flag indication)	-do-	Test	-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Switch Contact Operation	-do-	-do-	-	-	-do-	-do-	-do-		V	-	-	
		d) HV Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	

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1	2	3	4	5	6		7	8	9		10			11
2.04	Magnetic Oil Level Gauge	a) Type, Size & Make	Major	Visual	10%	-	NTPC Spec/ Plant Std/Mfrr Drg	NTPC Spec/ Plant Std/Mfrr Drg	QC Record		P	-	-	
		b) Dial Marking	-do-	-do-	-do-		-do-	-do-	Supplier's TC		V	-	-	
		c) Switch Continuity	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Leak Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) HV Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Operational test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
2.05	Off-Circuit Tap Changer (if applicable)	a) Dimensions, Alignment of padlocking arrangement	Major	Measure	10%	As per IS / Plant Std	Mfrr Drg. /Mfr Plant Std	Mfrr Drg. /Mfr Plant Std	QC Record		P	V	-	
		b) Physical condition	-do-	Visual	100%	-	-do-	-do-	-do-		P	-	-	
		c) Operation of Switch	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Insulation Resistance Test	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		e) Leak Test of Handle Stuffing Box	-do-	-do-	-do-	100%	-do-	-do-	-do-		V	V	V	
2.06	On Load Tap (if applicable)	a) Visual Check,make,type	Major	Visual	100%	-	IS: 2026/IS:8468	IS: 2026/IS:8468	QC Record		P	V	-	
		b) Dimensional check	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Mechanical operation on Diverter & selector switch	-do-	verify	-do-	100%	-do-	-do-	Supplier's TC		P	V	-	
		d) HV test on auxiliary circuit	-do-	Test	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
2.07	Valves (Gate/Globe/ Butterfly)	a) Dimensional check	Major	Measre	10%	-	Mfr Drg/Plant Std/ IS:778-P-I	Mfr Drg/Plant Std/ IS:778-P-I	QC Record		P	-	-	Drain and Sample Vlave should have zero leakage rate
		b) Type, Size & Make	-do-	Visual	-do-	-	-do-	-do-	-do-		P	V	-	
		c) Hydraulic/Leakage Test (for Body & Seat)	-do-	Test	As per IS/ Plant Std	As per IS/ Plant Std	IS:778-P-I	IS:778-P-I	Supplier's TC		V	V	V	
									-do-		V	-	-	
		d) Operational Test (Smooth Close & Open)	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
2.08	Marshalling Kiosk & Remote Tap Control (RTCC)	a) Dimensional/Visual checks, makes of MB & mountings	Major	Visual	100%	100%	NTPC Appd Drgs	NTPC Appd Drgs	QC Record		W	W	V	At Marshalling Kiosk's mnaufactuer's works.
		b) 2 kV insulation test on auxiliary wiring	-do-	Test	-do-	-do-	-do-	Should withstand for one minute	Test Report	√	W	W	V	
		c) IP-55 Degree of protection by thin paper insertion	Major	Test	-do-	-do-	IS:13947-1993	IS:13947-1993	-do-		P	W	V	
		d) Check for paint, shade & thickness	-do-	Measure/ Test	On random basis	On random basis	NTPC Specn./ IS:101-P-IV-Sec-2	NTPC Specn./ IS:101-P-IV-Sec-2	-do-		W	W	V	
2.09	OTI & WTI	a) Type, Size & Make	Major	Visual	As per IS/ Plant Std	As per IS/ Plant Std	NTPC Specs/Apvd drgs/ Mfr Std/ IS:11222/IS:2848	NTPC Specs/Apvd drgs/ Mfr Std/ IS:11222/IS:2848	QC Record		P	V	V	
		b) HV Test	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	-	
		c) Temperature Calibration	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		d) Switch setting & switch deferential	-do-	-do-	-do-	-do-	Mfr Std / IS 2848	Mfr Std / IS 2848	-do-		V	V	V	
		e) Calibration & operation of Switch	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	

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2.10	Bushing CT	a) Make & rating	Major	Visual	100%	10%	Mfr Drg/IS:2705	Mfr Drg/IS:2705	QC Record		V	V	V	
		b) Dimensions/Visual check	Major	Measure	As per IS	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Routine Test	-do-	Test	100%	100%	-do-	-do-	-do-		V	V	V	
2.11	Radiator	a) Type, Model, Rating, make	Major	Visual	100%	100%	NTPC Specs/Apvd drgs/ Mfr Std	NTPC Specs/Apvd drgs/ Mfr Std	QC Record		P	V	V	
		b) Dimensions & No. of elements	-do-	Measure	-do-	-do-	-do-	-do-	-do-		W	V	-	
		c) Paint, Shade, Finish & thickness	-do-	Visual / Measure	-do-	-do-	-do-	-do-	-do-		W	V	V	
		d) Pressure test	-do-	Test	-do-	1samp/des./lot	-do-	-do-	Supplier's TC	√	W	V	V	
		e) Adhesion Test on paint	-do-	-do-	-do-	As per IS	IS:101	IS:101	-do-		W	V	V	
2.12	Terminal Connector	a) Dimensional check	Major	Measure	10%	-	Mfrs Drg'/IS:5561	Mfrs Drg'/IS:5561	QC Record		P	-	-	
		b) Surface Finish	-do-	Visual	As per IS	-	-do-	-do-	-do-		V	-	-	
		c) Acceptance Test	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
2.13	Silicagel Breather	a) Type, Size, Model	Major	Visual	10%	-	Mfr Plant Std.	Mfr Plant Std.	QC Record		P	-	-	
		b) Pressure/Breathing Leakage Test	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Colour of Silica gel	-do-	Viusal	-do-	-	-do-	-do-	-do-		V	-	-	
3.00	**IN-PROCESS**													
3.01	Fabrication of Tank, Cover, Conservator and welding requirement	a) Welding Procedure Spececification	Major	Verify	100%	100%	ASME-Sec-IX	Approved WPS/ ASME-Sec-IX	QW-482		V	V	V	
		b) Process Qualification Records	-do-	Test	-do-	-do-	-do-	-do-	QW-483		W	V/W†	V/W†	†-WPS approval, Welders & PQR qualification shall be done as per following :-
		c) Welders Qualification	-do-	-do-	-do-	-do-	-do-	-do-	QW-484		W	V/W†	V/W†	A) Upto 2 MVA - by Transformer Mfrr
		d) Welding Electrodes	-do-	-do-	As per IS	-	As per WPS/IS:814	As per WPS/IS:814	Supplier's TC		V	-	-	B) 2-5 MVA - by Main Contractor
		e) Fitup for Butt weld joints of tank and cover	-do-	Visual	-do-	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		V	-	-	
		f) Visual check on weldment	-do-	Visual	100%	-	-do-	-do-	-do-		V	-	-	
		g) Dimensional check after welding	-do-	Measure	-do-	-	-do-	-do-	-do-		V	-	-	
		h) DP Test on welded joints of load bearing member	-do-	Test	-do-	100%	Mfr Drg/Plant Std/ IS:3658	Mfr Drg/Plant Std/ IS:3658	-do-		W	V	V	
		i) Check for flatness of gasket surface	-do-	Visual	-do-	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	-do-		W	-	-	
		j) Rim flatness	-do-	Measure	10%	-	-do-	-do-	-do-		W	-	-	
		k) Surface cleaning by sand/ shot blasting	-do-	Visual	100%	100%	-do-	-do-	-do-		V	V	-	
		l) Primer coating, Paint shade, thickness inside and outside	Major	Measure	100%	10%	IS:101/ NTPC Specification	IS:101/ NTPC Specification	-do-		W	V	V	
		m) Paint adhesion test	-do-	Test	-do-	5%	IS:101	IS:101	-do-		W	V	V	
3.02	Core Stamping	a) Burr & Bow	Major	Visual	Plant Std	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Dimensional check	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
3.03	Core Building	a) Dimensional check	Major	Measure	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Assembly of limb insulation and limb plates	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Rectangularity of core assembly	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	

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एनटीपीसी NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 6 of 8
VALID UPTO: 19.02.2016

REVIEWED BY: Banish K. Jha, H Shekhar, B D Prasad
APPROVED BY: T Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		d) Freedom from overlaps & air gap at joints.	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Core verticality	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Limb & stack thikcness	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Limb clamping & binding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		h) Core Diameter	-do-	-do-	-do-	100%	-do-	-do-	-do-		P	V	V	
		i) Earthing of Core	-do-	-do-	-do-	-do-	-do-	-do-	-do-		P	V	V	
3.04	Test on core	a) Dimensional check	Major	Measure	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Pre-core Loss measurement	-do-	-do-	Plant Std.	-	-do-	-do-	-do-		P	-	-	
3.05	Winding	a) Brazing procedure , PQR & Brazer qualification	Major	Review	100%	100%	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	V	V	
		b) Conductor size	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Radial Depth of winding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Anchoring & Binding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	At start & finish
		e) No of turns.	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Transposition & cross overs	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Dimensional checks	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	OD, ID & axial length
		h) Insulation arrangement & alignment	Major	Measure	100%	-	-do-	-do-	-do-		P	-	-	
		i) Winding length	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		j) Brazed joints	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Lead & Coil identification and marking	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Free from damages	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Continuity test for leads	-do-	Test	-do-	100%	-do-	-do-	-do-		P	V	V	
		h) IR Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		P	V	V	
3.06	Core coil assembly	a) Cleanliness of core	Major	Visual	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Alignment of spacers /blocks	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Cleaning of Core before Core Coil Assembly	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		d) Arrangement of Top & Bottom Insulation and Pressure rings.	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		e) Resting of Common Blocks on Active Part	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		f) Isoaltion Test of Core, if applicable	-do-	-do-	-do-	100%	-do-	NTPC Spec.	-do-		P	V	V	
		g) Earthing of core	-do-	-do-	-do-	100%	-do-	Mfr Drg/Plant Std	-do-		P	V	V	
3.07	Connection and tap switch assembly	a) Ratio Test on all taps	Major	Test	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Lead disposition	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Brazing of joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Crimping of joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Insulation over joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Vector group	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	

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CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)	**STANDARD QUALITY PLAN** **CONFORMING TO CODE :** **NTPC TECHNICAL SPECIFICATION / IEC:60076**	**QP No: 0000-999-QOE-S-036, Rev No: 0** **Date: 20.02.2013** **Page:** 7 of 8 **VALID UPTO: 19.02.2016**	REVIEWED BY Banish K. Jha H Shekhar B D Prasad	APPROVED BY Approved T.G.Krishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		**	10		11
3.08	Ovening and	a) Cleanliness of tank	Major	Visual	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Drying	-do-	Physical	-do-	-	-do-	-do-			P	-	-	
		c) Check tightness of clamped blocks and measurments of winding height	-do-	Measure	-do-	-	-do-	-do-	-do-	√	P	-	-	
		d) Electrical Clearances	-do-	-do-	-do-	100%	-do-	-do-	-do-	√	P	V	V	
		e) Tightning of Coil & Spacers; Locking of tie rods & fastners	-do-	-do-	-do-	-	-do-	-do-	-do-	√	P			
		g) Check Paint shade,thickness & Adhesion	-do-	Visual/ Phys.	-do-	-	-do-	-do-	-do-	√	P	-	-	
		h) Oil filling and air release	-do-	Physical	-do-	-	-do-	-do-	-do-		P	-	-	
4.00	Type & Special Test	a) Review of Type test & Special test report												NTPC RIO to verify type test clearance from NTPC Engg for complete transformer including bushings, MB, transformer tank (eg: Pressure & Vacuum tests), terminal connector, OLTC, etc, as per specs. / LOA.
		b) Review of all previous stage of inspection as per QP	Major	Verify	100%	100%	NTPC Specs/ Apvd Drg/DS	CHP Reports/ Protocols	TC / TR		V	V	V	
5.00	Routine Test	a) Dimensional check	Critical	Measure	100%	1Sample /Lot/Rating	NTPC Spec/ Apvd Drgs/ DS/IS:2026 / IEC-60076	NTPC Spec/ Apvd Drgs/ DS/IS:2026 / IEC-60076	QC Record	√	P	W	W	Each transformer shall be assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by NTPC.
		b) Measurement of winding resistance of HV at normal, extreme taps & LV winding	-do-	-do-	-do-	100%	-do-	-do-	-do-	√	P	W	W	
		c) Measurement of voltage ratio at all taps, polarity & vector group	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		d) Magnetic balance test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		e) Measurement of No-Load Losses & magnetising current at 90%, 100% & 110% voltage at 50 Hz.	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		f) Measurement of No Load Current with 415 Volt/50 Hz AC Supply	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		g) Measurement of impedance & short circuit impedance at normal & extreme taps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		h) Measurement of load loss	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		i) Measurement of insulation resistance of winding	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	

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एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**	**STANDARD QUALITY PLAN** **CONFORMING TO CODE :** **NTPC TECHNICAL SPECIFICATION / IEC:60076**	**QP No: 0000-999-QOE-S-036, Rev No: 0** **Date: 20.02.2013** **Page: 8 of 8** **VALID UPTO: 19.02.2016**	**REVIEWED BY** Banish K. Jha H Shekhar B D Prasad	**APPROVED BY** Approved J Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		**	10		11
		j) Dielectric Test												
		1) Separate source AC withstand voltage test of HV & LV	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		2) Induced over voltage test on HV & LV terminals	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		k) Repeat no load current/loss measurement & IR measurement after completion of dielectric tests	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		l) Measurement of Capacitance & tan delta for winding to earth	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		m) BDV of oil before and after dielectric test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		n) Jacking test on oil filled transformer followed by DP Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		o) Oil Leakage test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		p) IP-55 Degree of protection by thin paper insertion on MB	Major	Test	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		q) Functional/Continuity checking of wiring, IR, & HV on MB	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		r) Functional / Continuity checking of WTI, OTI, PRV, Buchholtz Relay	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		s) Paint, Shade, Thickness, Adhesion	Critical	-do-	Random basis	Random basis	-do-	-do-	-do-	√	P	W	W	
6.00	**PRE-DESPATCH**	a) Packing of loose items and main unit	Major	Physical	100%	-	Mfr Std/Packing List /Chalan	Mfr Std/Packing List /Chalan	QC Record	√	P	-	-	Accessories to be segregated unitwise
		b) Blanking of openings & valves after adjustment/drainage of oil	-do-	-do-	-do-	-	-do-	-do-		√	P	-	-	

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CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

ANNEXURE – II

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 –B

TECHNICAL PARTICULARS

[*TO BE SUBMITTED ALOGWITH TECHNICAL OFFER*]

FOR 11kV/0.433V

S. No	Description	Unit	Requirement	To be filled by bidder
1.	Rating	MVA	#	
2.	No Load transformation ratio	kV	11/0.433	
3.	Losses at 50% Load & 75°C (Watts)	W	Star-2 as per BEE guidelines	
4.	Losses at 100% Load & 75°C (Watts)	W		
5.	Overall Dimensions	mm x mm x mm		
6.	Total weight	kg		
7.	Total oil Quantity	kg		

To be separately filled for each rating transformers i.e. 630 KVA, 1 MVA, 1.6 MVA, 2.0 MVA & 2.5 MVA

FOR 11kV/3.45kV

S. No	Description	Unit	Requirement	To be filled by bidder
1.	Rating	MVA	5	
2.	No Load transformation ratio	kV	11/3.45	
3.	Maximum No- load losses at rated frequency and 100% rated voltage	kW	5.5 (Max.)	
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	kW	36 (Max.)	
5.	Overall Dimensions	mm x mm x mm		
6.	Total weight	kg		
7.	Total oil Quantity	kg		

ANNEXURE -III

DOCUMENTS REQUIRED AFTER AWARD OF LOI

Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval: -

Sl. No.	BHEL Drawings/ Document Number	NTPC Drawings/ Document Number	Drawings/ Document Description	Drawings/ Document Type	First Submision	Resubmission
1	PE-V0-434-302-E011	9585-001-215-PVE-B-110	2500 KVA SERVICE TRANSFORMER (11/0.433 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
2	PE-V0-434-302-E012	9585-001-215-PVE-B-111	LOADING GAUGE DRG/ (TRANSPORTATION DRG/) & TWIN BIDIRECTIONAL ROLLER--2500 KVA, 11/0.433 KV	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
3	PE-V0-434-302-E013	9585-001-215-PVE-B-112	2500KVA TRANSFORMER (11/0.433 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
4	PE-V0-434-302-E014	9585-001-215-PVE-B-114	2500 KVA SERVICE TRANSFORMER (11/0.433 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
5	PE-V0-434-302-E015	9585-001-215-PVE-B-115	2500KVA TRANSFORMER (11/0.433 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
6	PE-V0-434-302-E016	9585-001-215-PVE-L-008	2500KVA TRANSFORMER (11/0.433 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
7	PE-V0-434-302-E017	9585-001-215-PVE-V-008	2500KVA TRANSFORMER (11/0.433 KV) FOUNDATION DRAWING	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
8	PE-V0-434-302-E018	9585-001-215-PVE-Y-022	2500 KVA SERVICE TRANSFORMER (11/0.433 KV) TECHNICAL DATA SHEET	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
9	PE-V0-434-302-E019		2500 KVA SERVICE TRANSFORMER (11/0.433 KV) VALVE SCHEDULE PLATE	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
10	PE-V0-434-302-E020	9585-001-215-PVE-W-031	2500KVA TRANSFORMER (11/0.433 KV) TYPE/ SPECIAL TEST REPORT	Secondary	Within one week after conduction of Type test	Within 10 days of BHEL comments
11	PE-V0-434-302-E211	9585-001-215-PVE-B-078	1600 KVA SERVICE TRANSFORMER (11/0.433 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
12	PE-V0-434-302-E212	9585-001-215-PVE-B-079	LOADING GAUGE DRG/ (TRANSPORTATION DRG/) & TWIN BIDIRECTIONAL ROLLER--1600 KVA, 11/0.433 KV	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
13	PE-V0-434-302-E213	9585-001-215-PVE-B-080	1600KVA TRANSFORMER (11/0.433 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
14	PE-V0-434-302-E214	9585-001-215-PVE-B-081	1600 KVA SERVICE TRANSFORMER (11/0.433 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
15	PE-V0-434-302-E215	9585-001-215-PVE-B-082	1600KVA TRANSFORMER (11/0.433 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
16	PE-V0-434-302-E216	9585-001-215-PVE-L-005	1600KVA TRANSFORMER (11/0.433 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
17	PE-V0-434-302-E217	9585-001-215-PVE-V-005	1600KVA TRANSFORMER (11/0.433 KV) FOUNDATION DRAWING	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
18	PE-V0-434-302-E218	9585-001-215-PVE-Y-019	1600 KVA SERVICE TRANSFORMER (11/0.433 KV) TECHNICAL DATA SHEET	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
19	PE-V0-434-302-E219		1600 KVA SERVICE TRANSFORMER (11/0.433 KV) VALVE SCHEDULE PLATE	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments

20	PE-V0-434-302-E220	9585-001-215-PVE-W-025	1600KVA TRANSFORMER (11/0.433 KV) TYPE/ SPECIAL TEST REPORT	Secondary	Within one week after conduction of Type test	Within 10 days of BHEL comments
21	PE-V0-434-302-E311	9585-001-215-PVE-B-083	1000 KVA SERVICE TRANSFORMER (11/0.433 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
22	PE-V0-434-302-E312	9585-001-215-PVE-B-084	LOADING GAUGE DRG/ (TRANSPORTATION DRG/) & TWIN BIDIRECTIONAL ROLLER--1000 KVA, 11/0.433 KV	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
23	PE-V0-434-302-E313	9585-001-215-PVE-B-085	1000KVA TRANSFORMER (11/0.433 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
24	PE-V0-434-302-E314	9585-001-215-PVE-B-086	1000 KVA SERVICE TRANSFORMER (11/0.433 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
25	PE-V0-434-302-E315	9585-001-215-PVE-B-087	1000KVA TRANSFORMER (11/0.433 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
26	PE-V0-434-302-E316	9585-001-215-PVE-L-006	1000KVA TRANSFORMER (11/0.433 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
27	PE-V0-434-302-E317	9585-001-215-PVE-V-006	1000KVA TRANSFORMER (11/0.433 KV) FOUNDATION DRAWING	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
28	PE-V0-434-302-E318	9585-001-215-PVE-Y-020	1000 KVA SERVICE TRANSFORMER (11/0.433 KV) TECHNICAL DATA SHEET	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
29	PE-V0-434-302-E319		1000 KVA SERVICE TRANSFORMER (11/0.433 KV) VALVE SCHEDULE PLATE	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
30	PE-V0-434-302-E320	9585-001-215-PVE-W-026	1000KVA TRANSFORMER (11/0.433 KV) TYPE/ SPECIAL TEST REPORT	Secondary	Within one week after conduction of Type test	Within 10 days of BHEL comments
31	PE-V0-434-302-E511		5000 KVA SERVICE TRANSFORMER (11/3.45 KV) OUTLINE GENERAL ARRANGEMENT DRAWING (OGA) AND LIST OF FITTINGS/ACCESSORIES	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
32	PE-V0-434-302-E512		LOADING GAUGE DRG/ (TRANSPORTATION DRG/) & TWIN BIDIRECTIONAL ROLLER--5000 KVA, 11/3.45 KV	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
33	PE-V0-434-302-E513		5000KVA TRANSFORMER (11/3.45 KV) HV CABLE BOX & LV BUSDUCT/CABLE TERMINATION ARRANGEMENT DRAWING	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
34	PE-V0-434-302-E514		5000 KVA SERVICE TRANSFORMER (11/3.45 KV) BILINGUAL RATING & DIAGRAM PLATE	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
35	PE-V0-434-302-E515		5000KVA TRANSFORMER (11/3.45 KV) GA BUSHING DRG/(H/V, LV & NEUTRAL)	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
36	PE-V0-434-302-E516		5000KVA TRANSFORMER (11/3.45 KV) GENERAL ARRANGEMENT AND WIRING DIAGRAM OF MARSHALLING BOX	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
37	PE-V0-434-302-E517		5000KVA TRANSFORMER (11/3.45 KV) FOUNDATION DRAWING	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
38	PE-V0-434-302-E518		5000 KVA SERVICE TRANSFORMER (11/3.45 KV) TECHNICAL DATA SHEET	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
39	PE-V0-434-302-E519		5000 KVA SERVICE TRANSFORMER (11/3.45 KV) VALVE SCHEDULE PLATE	Primary	Within four weeks from the date of LOI	Within 10 days of BHEL comments
40	PE-V0-434-302-E520		5000KVA TRANSFORMER (11/3.45 KV) TYPE/ SPECIAL TEST REPORT	Secondary	Within one week after conduction of Type test	Within 10 days of BHEL comments

41	PE-V0-434-302-E901		MQP FOR OIL FILLED SERVICE TRANSFORMERS (Up to 5 MVA, 33 kV)	Primary	Within two weeks from the date of LOI	Within 10 days of BHEL comments
42	PE-V0-434-302-E902		O&M MANUAL/FQP FOR OIL FILLED SERVICE TRANSFORMERS (Up to 5 MVA, 11 kV)	Secondary	Within two weeks after all drawing/ document approval	Within 10 days of BHEL comments
43	PE-V0-434-302-E903		BOM (BILL OF MATERIAL) FOR OIL FILLED TRANSFORMERS (Up to 5 MVA, 11 kV)	Secondary	Within two weeks after all drawing/ document approval	Within 10 days of BHEL comments

Note:

1. Missing NTPC drawing/ document nos. shall be provided to successful bidder.
2. Drawing/ document nos. provided are tentative & may change, there shall be no commercial/ delivery implication to BHEL on this account.
3. Vendor shall submit the dates for drawing/document submission/BHEL comments/resubmission after approval of documents.
4. In BOM each of the item to be uniquely identified with item code no. or item Sl. no. Supplier to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM.Supplier to give following undertaking in BOM: " The BOM provided here completes the scope (in content and intent) of material supply under PO no. ---- dtd ----- Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."
5. BHEL shall furnish comments / approval on each submission within 18 days from receipt.
6. If Vendor has already TYPE/ SPECIAL test report of any or all rating transformer, vendor shall submit TYPE/ SPECIAL test report along with other coresponding drawings of same rating.

DATA SHEET –C

TECHNICAL PARTICULARS

[*TO BE SUBMITTED AFTER AWARD OF CONTRACT*]

CLAUSE NO.	Bidder's Name ……..

1.00.00 TECHNICAL DATA REQUIREMENTS

Clause No.	Item	(For AUX Transformer) (Mark appropriately)		
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**	**-**	**-**
	(Specify Base)	**HV-LV1**	**HV-LV2**	**LV1-LV2**
(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 & MV winding DC resistance at 75 deg. C			
	(a) Principal tap			
	(b) Maximum tap			
	(c) Minimum tap			
1.12.00	LV (LV1 / LV2) winding DC resistance at 75 deg. C			
1.13.00	**Cooling Equipment Details**			

CLAUSE NO.	Bidder's Name ……..	
	(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	
	(d) Oil Pump Motor Data	
	(i) Number per cooler and rating as % of Cooling requirement (indicate no. of spare pumps also)	
	(ii) Type	
	(iii) Rating	
	(iv) 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)	
	(f) Type of oil pump & motor	
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	
	(e) Oil temperature at cooler outlet at rated	

CLAUSE NO.	Bidder's Name ……..	
	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	
	b) Medium 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	
	d) High voltage (N)	
	(i) Manufacturer	

CLAUSE NO.	Bidder's Name ……..	
	(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	Proposed method of transformer transportation	
	(i). Oil filled or N2 filled	
	(ii). Road Freight/ Rail Freight	
1.19.00	Is vacuum filling required, if so state absolute pressure (mm of Hg)	
1.20.00	Total quantity of oil (liters)	
1.21.00	Tap changing equipment	
	(a) Make	
	(b) Type & model	
	(c) Voltage class & current	
	(d) Number of steps	
	(e) Range	
	(f) Step voltage	
	(g) Rated Short circuit current	
	(i) Dynamic	
	(ii) Thermal	
	(h) Withstand time for Short circuit (sec.)	
	(i) Dynamic	
	(ii) Thermal	
	(i)No. of revolution to complete One step	
	(j)Insulation level of the connecting leads	

CLAUSE NO.	Bidder's Name ……..	
	between tap changer & transformer winding	
	(k) Total quantity of oil	
	(l)Whether On load Type or Off load Type	
1.22.00	Insulation level	
	HV/MV 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)	
	MV Windings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	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)	
	MV Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	LV Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	HVN Bushings	
	(i) Lightning impulse withstand voltage (kVp)	

CLAUSE NO.	Bidder's Name ……..	
	(ii) Power frequency withstand voltage (kV)	
	LVN Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
1.23.00	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)	
1.24.00	Weights of Transformer Components	
	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)	
1.25.00	Permissible overloading (% of rating and time in minutes)	
1.26.00	(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)	
1.27.00	Conservator	
	a) Total volume (Liters)	

CLAUSE NO.	Bidder's Name ……..	
	b) Volume between highest and lowest levels (Liters)	
1.28.00	Capacitance Values (pF)	
	b) LV /LV1/LV2 to earth	
	c) HV to LV/LV1/LV2	
	d) HV to MV	
	e) MV to LV	
	d) Tap winding to earth	
1.29.00	a) Type of oil preservation	
	b) Material of diaphragm/air cell	
	c) Continuous temperature withstand/ capability of the diaphragm/air cell	
1.30.00	Oil	**Before filling in main tank**
	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)	
1.31.00	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 (%)	

CLAUSE NO.	Bidder's Name ……..	
	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)	
1.32.00	Winding	
	a) Type of winding	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	iv) Tap	
	b) Current density at rated load	
	i) HV (A/mm^2)	
	ii) MV	
	iii) LV/LV1/LV2 (A/mm^2)	
	iv) Tap	
'	c) Conductor area (mm2)	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	iv) Tap	
	d) Magnetizing inrush current(Amps)	
	i) % Component of 2^{nd} 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	
1.33.00	Tank	

CLAUSE NO.	Bidder's Name ……..	
	a) Tank cover-Conventional/Bell Type	
	b) Approximate thickness of	
	i) Side (mm)	
	ii) Bottom (mm)	
	iii) Cover	
1.34.00	Vacuum withstand capability of	
	a) Main tank	
	b) Coolers and accessories	
1.35.00	Minimum draw bar pull required to move the transformer on level track(kg)	
1.36.00	Size of filter hose	
1.37.00	Fault level	

SECTION ‘II’

STANDARD TECHNICAL SPECIFICATION

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **2** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **3** of **30**

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 India n Electricity Act , Indian Electricity Rules and Bureau of Indian Standards.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **4** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **5** of **30**

3.06.07 All tank and oil filled compartment shall be tested for oil tightness by being completely filled wit h oil of visc osity n ot greater than th at of specified oi l at the ambient temperature and a pplying pre ssure eq ual to t he normal press ure pl us 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 sha ll be p rovided. Th e tra nsformers ra ted 6. 3MVA and above s hall b e provided with air ba g bre athing through s ilica gel br eather. For lo wer rating transformers with conventional con servator 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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **6** of **30**

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

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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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **8** of **30**

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 bus duct 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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **9** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **10** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **11** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **12** of **30**

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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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **13** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **14** of **30**

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 . Su ch plates sh all b e b i- lingu al (requ irement will be finalised d uring de tailed e ngineering) w ith Hindi inscription first, followed b y English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

5.00.00 **PAINTING**

Paint s hade shal l be informed to su ccessful bi dder during det ail e ngineering as applicable for s pecific pr oject. Adequate q uantity of touch u p pa int 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 m aterials, com ponents a nd accessories of th e tra nsformers shall be p rocured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **15** of **30**

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 bi dder s hall fur nish Li st of s ub-vendors/ m akes of it ems f or BHE L/ customer approval at contract stage. This shall not have any commercial implication to BHEL.

6.06.00 For a cceptance of sho rt c ircuit repo rts fo r te sts c arried out earli er on simil ar transformers, successful bi dder s hall furnish the fo llowing documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL

6.06.01 Calculations an d d esign considerations t o prove ab ility to withstand t he 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 b idder shall sup ply with the equ ipment, one unused com plete set of all special tools & tackles required for the erection, a ssembly, disa ssembly and pr oper maintenance of the e quipment. A li st of such tools & tackles (price deem ed 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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **16** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR** **OIL FILLED SERVICE TRANSFORMERS**	**PE-SS-999-302-E001** VOLUME NO. : **II** SECTION : II REV NO. : **00** DATE : 30/06/2016 SHEET : **17** of **30**

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

BHEL	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
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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 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	MANFUF. STD / IS:335	MANFUF. 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	Major	Test				Supplier's TC			2,1	
		ii) After treatment										
		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	
			Major	Test	-							
		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	

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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 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 Relief Device	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1	
		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 Lavel Gauge (MOG)	a) Type, size & make	Major	Visual	100%	MANFUF. STD'	MANFUF. STD.'	QC records	2		1	
		b) Dial marking	Major	Visual	-			Supplier's TC	3/2		2	
		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 Changer/Switch (if applicable)	a) Dimensions	Major	Measure	100%	MANFUF. STD'	MANFUF. STD'	QC records	2		-	
		b) Physical condition	Major	Visual	100%			QC records	2		-	
		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 Changer (if applicable)	a) Visual check	Major	Visual	100%	IS:8468/IEC 60214	IS:8468/IEC 60214	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			Supplier's TC	2		-	
		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
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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 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	Manf. Std./IS:778	QC Record	2		-		
		b) Type, size & make	Major	Visual	100%	Class 1	Class 1	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.	Drg./Manf.	Supplier's TC	3/2	2	-		
		b) Dimensional check	Major	Measure/Test	100%	Std./IS:5/IS:13947	Std./IS:5/IS:13947	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.	Drg./Manf.	QC records	3/2	2	1		
		b) Dimensions & No. of elements	Major	Measure	100%	Std./IS:101	Std./IS:101	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		-		

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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 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		
			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

BHEL	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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	SIGNATURE		
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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 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		-		
			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

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			

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

BHEL	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			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			

	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

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	TITLE :	SPECIFICATION NO.
BHEL	STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	PE-SS-999-302-E001 VOLUME NO. : II SECTION : II REV NO. : 00 DATE : 30/06/2016 SHEET : 28 of 30

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **29** of **30**

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.

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	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **30** of **30**

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 co mpletely 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.

BHEL PEM-ELECTRICAL

PRE-QUALIFYING REQUIREMENTS FOR OIL FILLED SERVICE TRANSFORMER

PROJECT: 3X800 MW PATRATU STPS EXPANSION PHASE-I

1. The Bidder should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11 kV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years before the date of **07.09.2018**.

2. Bidder should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).

3. 16 MVA, 11 kV Class or higher rated oil filled transformer manufactured by Bidder should have been successfully short circuit tested.

4. Availability of type test certificates (including short circuit test) conducted at independent Lab or witnessed by third party for at least one design for LV oil filled service transformers: (500-2500 KVA, HV Wdg - 66/33/11/6.6/3.3 kV & LV Wdg - 415/433 V) and one design for MV oil filled service transformers: (2-16 MVA, HV Wdg - 66/33/11/6.6 kV & LV Wdg - 3.3 kV & above).

5. Minimum No. of transformers supplied in the last 10 years from the date of techno-commercial bid opening:
   - 50 nos. in LV oil filled service transformers: (500-2500 KVA, HV Wdg - 66/33/11/6.6/3.3 kV & LV Wdg - 415/433 V) with at least 20 nos. in range of 1000 to 2500 kVA
   - 20 nos. in MV oil filled service transformers: (2-16 MVA, HV Wdg - 66/33/11/6.6 kV & LV Wdg - 3.3 kV & above).

6. Minimum two (2) nos. purchase orders for LV oil filled service transformers (500-2500 KVA, HV Wdg - 66/33/11/6.6/3.3 kV & LV Wdg - 415/433 V) and Minimum two (2) nos. purchase orders for MV oil filled service transformers: (2-16 MVA, HV Wdg - 66/33/11/6.6 kV & LV Wdg - 3.3 kV & above) shall be submitted which should not be more than five (5) years old from the date of techno- commercial bid opening for establishing continuity in business.

Notes:

(i) Two different installations mean two different project sites or two different contracts.

(ii) Equipment designed by the Bidder itself or through its collaborator/associate for reference plant, shall also be considered meeting the requirement of design.

SURYA DEV
Digitally signed by SURYA DEV
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Date: 2021.11.11 10:34:13 +05'30'

[Dealing Engineer]

NARENDRA NATH JAJWARE
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[Controlling Officer]

PRAVEEN DUTTA
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[Section Head]

DEBASISA RATH
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Date: 2021.11.11 15:42:16 +05'30'

[DH-Electrical]

3X800 MW PATRATU STPS EXPANSION PHASE-I
OIL FILLED AUXILIARY SERVICE TRANSFORMERS
PRICE SCHEDULE

Sr. No.	Item code	Item Description	Unit	Quantity	Unit Ex-Works Price (INR)
1.0	302-11007-A	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=5.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	4	
2.0	302-11008-A	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	4	
3.0	302-11010-A	2500kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	32	
4.0	302-11013-A	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	NO.	4	
5.0	302-11000-B	OIL FILLED SERVICE TRANSFORMER - Mandatory Spares Details as per Annexure-I	SET	1	
6.0	302-11045-A	EXTRA OIL (10%) IN SEALED NON RETURNABLE STANDARD DRUMS (Type & no. of Transformers, as per annexure-II)	LOT	1	
7.0	302-11051-A	TYPE/ SPECIAL TEST (Details as per Annexure-III)	LOT	1	
Total (1 to 8)					

NOTES

1 BIDDER TO NOTE THAT THE COST OF TRANSFORMER SHALL INCLUDE THE COST OF ROUTINE TESTS AND SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.

2 BIDDER SHALL SUPPLY 10% EXTRA OIL AS PER THE QUOTED PRICE. QUANTITY OF EXTRA OIL SHALL BE SUBJECT TO APPROVAL DURING DETAIL ENGINEERING.

3 **CHARGES FOR CARRYING OUT SHORT CIRCUIT TEST SHALL BE PAYABLE BASED ON ACTUAL INVOICE FROM DESIGNATED LABORATORIES (CPRI, BHOPAL/ CPRI, BANGLORE / ERDA, VADODARA) WITH AN ADDITIONAL LUMP SUM AMOUNT OF 5% OF EX-WORKS PRICE OF TRANSFORMER BEING TESTED TO COVER HANDLING COSTS (TRANSPORTATION, INSURANCE ETC.).

4 IN CASE TYPE/ SPECIAL TESTS ARE WAIVED, THE TYPE/ SPECIAL TEST CHARGES SHALL NOT BE PAYABLE TO THE BIDDER.

5 CHARGES FOR ALL TYPE/ SPECIAL TESTS EXCEPT SHORT CIRCUIT TEST SHALL BE CONSIDERED FOR PRICE COMPARISONS PURPOSE.

6 IN CASE ANY OF THE TYPE/ SPECIAL TESTS ARE REQUIRED TO BE REPEATED THE SAME SHALL BE CARRIED OUT BY THE VENDOR WITHOUT ANY COMMERCIAL / DELIVERY IMPLICATION TO BHEL.

7 PRICE VARIAION FORMULAE MENTIONED IN NIT SHALL REMAIN THE FIX FOR THIS CONTRACT EVEN IF IEEMA CHANGES THE FORMULA.

ANNEXURE-I

3X800 MW PATRATU STPS EXPANSION PHASE-I
OIL FILLED AUXILIARY SERVICE TRANSFORMERS
PRICE SCHEDULE (MANDATORY SPARE)

Sr. No.	Item code	Item Description	Unit	Quantity	Unit Ex-Works Price (INR)
1		HV bushing with metal parts & gaskets	NO EACH RATING		
1 a		11.0/0.433kV, 1000KVA	NO.	3	
1 b		11.0/0.433kV, 1600KVA	NO.	3	
1 c		11.0/0.433kV, 2500KVA	NO.	3	
1 d		11.0/3.45kV, 5000KVA	NO.	3	
2		LV bushing with metal parts & gaskets (see Note 1)	NO EACH RATING		
2 a		11.0/0.433kV, 1000KVA	NO.	3	
2 b		11.0/0.433kV, 1600KVA	NO.	3	
2 c		11.0/0.433kV, 2500KVA	NO.	3	
2 d		11.0/3.45kV, 5000KVA	NO.	3	
3		LV Neutral bushing with metal parts & gaskets	NO EACH RATING		
3 a		11.0/0.433kV, 1000KVA	NO.	1	
3 b		11.0/0.433kV, 1600KVA	NO.	1	
3 c		11.0/0.433kV, 2500KVA	NO.	1	
3 d		11.0/3.45kV, 5000KVA	NO.	1	
4		WTI with contacts	NO EACH RATING		
4 a		11.0/0.433kV, 1000KVA	NO.	1	
4 b		11.0/0.433kV, 1600KVA	NO.	1	
4 c		11.0/0.433kV, 2500KVA	NO.	1	
4 d		11.0/3.45kV, 5000KVA	NO.	1	
5		OTI with contacts	NO EACH RATING		
5 a		11.0/0.433kV, 1000KVA	NO.	1	
5 b		11.0/0.433kV, 1600KVA	NO.	1	
5 c		11.0/0.433kV, 2500KVA	NO.	1	
5 d		11.0/3.45kV, 5000KVA	NO.	1	
6		Pressure relief Device	NO EACH RATING		
6 a		11.0/0.433kV, 1000KVA	NO.	1	
6 b		11.0/0.433kV, 1600KVA	NO.	1	
6 c		11.0/0.433kV, 2500KVA	NO.	1	
6 d		11.0/3.45kV, 5000KVA	NO.	1	

ANNEXURE-I

3X800 MW PATRATU STPS EXPANSION PHASE-I
OIL FILLED AUXILIARY SERVICE TRANSFORMERS
PRICE SCHEDULE (MANDATORY SPARE)

Sr. No.	Item code	Item Description	Unit	Quantity	Unit Ex-Works Price (INR)
7		MOG	NO EACH RATING		
7 a		11.0/0.433kV, 1000KVA	NO.	1	
7 b		11.0/0.433kV, 1600KVA	NO.	1	
7 c		11.0/0.433kV, 2500KVA	NO.	1	
7 d		11.0/3.45kV, 5000KVA	NO.	1	
8		Buchholz relay complete	NO EACH RATING		
8 a		11.0/0.433kV, 1000KVA	NO.	1	
8 b		11.0/0.433kV, 1600KVA	NO.	1	
8 c		11.0/0.433kV, 2500KVA	NO.	1	
8 d		11.0/3.45kV, 5000KVA	NO.	1	
9		Set of gaskets (see Note 1)	SET EACH RATING		
9 a		11.0/0.433kV, 1000KVA	SET	1	
9 b		11.0/0.433kV, 1600KVA	SET	1	
9 c		11.0/0.433kV, 2500KVA	SET	1	
9 d		11.0/3.45kV, 5000KVA	SET	1	
10		Set of valves	NO OF EACH TYPE/SIZE		
10 a		11.0/0.433kV, 1000KVA	NO.	2	
10 b		11.0/0.433kV, 1600KVA	NO.	2	
10 c		11.0/0.433kV, 2500KVA	NO.	2	
10 d		11.0/3.45kV, 5000KVA	NO.	2	
Total					

NOTES

1 set consists of gaskets required for 1 No. transformer for the following
(a) protection and monitoring devices
1 (b) cooler circuit, if applicable
(c) largest inspection cover, if applicable
(d) HV/LV turret, if applicable
(e) OCTC inspection cover, if applicable

ANNEXURE-II

3X800 MW PATRATU STPS EXPANSION PHASE-I
OIL FILLED AUXILIARY SERVICE TRANSFORMERS
PRICE SCHEDULE (EXTRA OIL)

Sr. No.	Item Description	Unit	Quantity	Unit Ex-Works Price (INR)
	EXTRA OIL (10%) IN SEALED NON RETURNABLE STANDARD DRUMS (Type & no. of Transformers, as below)			
1.0	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=5.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	4	
2.0	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	4	
3.0	2500kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.	32	
4.0	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	NO.	4	
	Total			

NOTES

1	BIDDER SHALL SUPPLY 10% EXTRA OIL AS PER THE QUOTED PRICE. QUANTITY OF EXTRA OIL SHALL BE SUBJECT TO APPROVAL DURING DETAIL ENGINEERING.

ANNEXURE-III

3X800 MW PATRATU STPS EXPANSION PHASE-I
OIL FILLED AUXILIARY SERVICE TRANSFORMERS
PRICE SCHEDULE (TYPE/ SPECIAL TEST)

Sr. No.	Description of Type/ Special Test	Unit	Quantity	Unit Prices (INR)
1.0	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=5.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.		
1.a	TANK PRESSURE TEST	NO.	1	
1.b	TANK VACUUM TEST	NO.	1	
1.c	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	NO.	1	
1.d	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).	NO.	1	
1.e	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	NO.	1	
1.f	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	NO.	1	AS PER NOTE 1
2.0	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.		
2.a	TANK PRESSURE TEST	NO.	1	
2 b	TANK VACUUM TEST	NO.	1	
2 c	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	NO.	1	
2 d	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).	NO.	1	
2 e	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	NO.	1	
2 f	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	NO.	1	AS PER NOTE 1
3.0	2500kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	NO.		
3.a	TANK PRESSURE TEST	NO.	1	
3 b	TANK VACUUM TEST	NO.	1	
3 c	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	NO.	1	

Sr. No.	Description of Type/ Special Test	Unit	Quantity	Unit Prices (INR)
3 d	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).	NO.	1	
3 e	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	NO.	1	
3 f	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	NO.	1	AS PER NOTE 1
4.0	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	NO.		
4.a	TANK PRESSURE TEST	NO.	1	
4 b	TANK VACUUM TEST	NO.	1	
4 c	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	NO.	1	
4 d	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).	NO.	1	
4 e	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	NO.	1	
4 f	LIGHTNING IMPULSE ON NEUTRAL	NO.	1	
4 g	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	NO.	1	AS PER NOTE 1
Total				

NOTES

1 **CHARGES FOR CARRYING OUT SHORT CIRCUIT TEST SHALL BE PAYABLE BASED ON ACTUAL INVOICE FROM DESIGNATED LABORATORIES (CPRI, BHOPAL/ CPRI, BANGLORE / ERDA, VADODARA) WITH AN ADDITIONAL LUMP SUM AMOUNT OF 5% OF EX-WORKS PRICE OF TRANSFORMER BEING TESTED TO COVER HANDLING COSTS (TRANSPORTATION, INSURANCE ETC.).

2 IN CASE TYPE/ SPECIAL TESTS ARE WAIVED, THE TYPE/ SPECIAL TEST CHARGES SHALL NOT BE PAYABLE TO THE BIDDER

3 CHARGES FOR ALL TYPE/ SPECIAL TESTS EXCEPT SHORT CIRCUIT TEST SHALL BE CONSIDERED FOR PRICE COMPARISONS PURPOSE.

4 IN CASE ANY OF THE TYPE/ SPECIAL TESTS ARE REQUIRED TO BE REPEATED THE SAME SHALL BE CARRIED OUT BY THE VENDOR WITHOUT ANY COMMERCIAL / DELIVERY IMPLICATION TO BHEL.