

NTPC
3 x 660 MW NORTH KARANPURA STPP

VOLUME – II

TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS

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



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



**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

**3 X 660 MW NORTH KARANPURA
STPP**

SPECIFICATION NO. PE-TS-405-302-E001

VOLUME II

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REVISION 0 | DATE: 12.12.2016

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**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMER**

SPECIFICATION NO. PE-TS-405-302-E001

VOLUME-II

COMPLIANCE CERTIFICATE

REVISION 00

DATE: 12.12.2016

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

6.00.00

INSULATION LEVEL

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

Highest System Voltage	WINDING		BUSHING	
	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	10	40
7.2 kV	20	60	20	60
12 kV	28	75	28	75
17.5 kV	38	95	38	95
24kV	50	125	50	125
36kV	70	170	70	170
72.5 kV	140	325	140	325
145kV	275/38*	650	275	650
245 kV	395/38*	950/1050**	460	1050/1050**
420 kV	630/38*	1425/1570**	750	1550/1570***

* In case of non-uniformly insulated.

** Chopped wave BIL.

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

SECTION 'I'

SPECIFIC TECHNICAL REQUIREMENTS

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-TS-405-302-E001
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1.0 SCOPE OF ENQUIRY

- 1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **BIS certified OIL FILLED SERVICE TRANSFORMERS (BIS Certification for rating upto 2.5 MVA, 33kV Class as per IS-1180 part-1, however the impedance value, list of tests, fittings shall be as per those mentioned in the specification)** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.
- 1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.
- 1.3 Standard technical requirements of the oil filled service transformers are indicated in Section-II. Project specific requirements/changes are listed in Section-I.
- 1.4 **The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.**

2.0 BILL OF QUANTITIES:

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

3.0 SPECIFIC TECHNICAL REQUIREMENTS

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

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2.	3.03.00	The Clause shall be read as Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core isolation shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.																								
3.	3.08.00	The Clause shall be read as Main tank shall be provided with conservator tanks of adequate capacity for expansion of oil from minimum ambient to 100 deg.C. The equipment rated 7.5MVA and above shall be provided with air bag breathing through indicating type cobalt free silica gel breather with transparent enclosure. However conventional type conservator with indicating type cobalt free breather (transparent enclosure) may be offered for transformer below 7.5 MVA.																								
4.	3.10.00	The Clause shall be read as As per IS: 335. No external inhibitors are permitted. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters. <table border="1"> <thead> <tr> <th>S.No</th><th>Property</th><th>Permissible values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Kinematic Viscosity, mm²/s</td><td> ≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C </td></tr> <tr> <td>2.</td><td>Flash Point, ° C</td><td>$\geq 140^{\circ}$ C</td></tr> <tr> <td>3.</td><td>Pour point, ° C</td><td>$\leq (-)40^{\circ}$ C</td></tr> <tr> <td>4.</td><td>Appearance</td><td>Clear , free from sediment and suspended matter</td></tr> <tr> <td>5.</td><td>Density kg/dm³ at 20 ° C</td><td>≤ 0.895</td></tr> <tr> <td>6.</td><td>Interfacial Tension N/m at 25° C</td><td>≥ 0.04</td></tr> <tr> <td>7.</td><td>Neutralisation value, mgKOH/g</td><td>≤ 0.01</td></tr> </tbody> </table>	S.No	Property	Permissible values	1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C	2.	Flash Point, ° C	$\geq 140^{\circ}$ C	3.	Pour point, ° C	$\leq (-)40^{\circ}$ C	4.	Appearance	Clear , free from sediment and suspended matter	5.	Density kg/dm ³ at 20 ° C	≤ 0.895	6.	Interfacial Tension N/m at 25° C	≥ 0.04	7.	Neutralisation value, mgKOH/g	≤ 0.01
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		8.	Corrosive sulphur	Non Corrosive
		9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
		10.	Anti oxidants additives	Not detectable
		11.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	≤ 1.2 ≤ 0.8
		12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70
		13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005
		14.	PCA content	≤1%
		15.	Impulse withstand Level, kVp	≥ 145
		16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5
		Subsequently oil samples shall be drawn at:		
		Sr. No.	Parameters	Before filling in main tank at site & tested for
				Prior to energization at site for following properties & acceptance norms:
		1.	BDV	60 kV (min)
		2.	Moisture content	10 ppm (max.)
5.	3.12.01	The Clause shall be read as		
		a) Bushing shall be solid porcelain/condenser/oil communicating type. b) No arcing horns to be provided on the bushings. c) LV bushing palms shall be silver/tin plated. The bushings shall conform to the requirements of IS: 2099 and IS: 3347.		
6.	3.16.00	The Clause shall be read as		
		Bidder to provide neutral bushing CT as per details given in data sheet – A of section-I, volume-II for		

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		restricted earth fault protection or standby earth fault protection. CT Shall be of adequate rating for protection as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted. All CT terminals shall be provided as fixed type terminals on the M. Box/CCC/CMB to avoid any hazard due to loose connection leading to CT opening or any other loose connection in power circuit. In no circumstances Plug in type connectors shall be used for CT & Power connection.
7.	3.18.03	The Clause shall be read as The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.
8.	3.22.00	The Clause shall be read as For 33kV, 11kV & 3.3kV winding, type of winding shall be continuous disc & for 433V/ 420V winding, type of winding shall be spiral type. The conductors shall be of Electrolytic grade copper. Windings are made in dust proof & conditioned atmosphere.
9.	4.01.00- 4.02.00	The Clause shall be read as Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

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		a) Conservator for main tank with MOG (with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above rail level) etc. Aircell (for 7.5 MVA & above). b) Buchholz relay, double float type with alarm and trip contacts, along with suitable gas collecting device. c) For 2 MVA & above rating transformer/reactor, minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided. For transformers below 2 MVA, diaphragm type explosion vent shall be provided. d) OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device. (maximum height 1500 mm above rail level) e) Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank. f) Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable) & surge arrestor (as applicable). g) Prismatic/toughened glass oil gauge for transformers. h) Bi-directional wheel & skids, M. Box, OCTC, Bushing CTs, Insulating Oil, Cooling equipment, Valve Schedule Plate. i) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc. j) Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS. k) Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed. The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the Transformers are deemed to be included.
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10.	5.00.00	The Clause shall be read as Paint shade shall be finalised to successful bidder during detail engineering as applicable. Adequate quantity of touch up paint shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure. <table><tr><th>PARTS NAME</th><th>TYPE OF PAINT</th><th>NO.OF COATS</th><th>TOTAL DFT</th></tr><tr><td>Inside of tank and accessories (except CCC, CMB & M Box)</td><td>Oil & heat resistant fully glossy white</td><td>One coat</td><td>Atleast 30 micron</td></tr><tr><td>External surface of Transformer and accessories including CCC, CMB, M Box (except coolers & radiators)</td><td>Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)</td><td>One coat each</td><td>Atleast 100 micron</td></tr><tr><td>External Cooler,Radiator surface</td><td>Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)</td><td>Two coats each</td><td>Atleast 100 micron</td></tr><tr><td>Internal Radiator surface</td><td>Hot oil proof, low viscosity varnish and</td><td>-</td><td>-</td></tr></table>	PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT	Inside of tank and accessories (except CCC, CMB & M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron	External surface of Transformer and accessories including CCC, CMB, M Box (except coolers & radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	Atleast 100 micron	External Cooler,Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)	Two coats each	Atleast 100 micron	Internal Radiator surface	Hot oil proof, low viscosity varnish and	-	-
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				subsequent flushing with transformer oil		
			Internal surface of CCC,CMB & M Box	Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint	Two coats each	Not less than 100 micron
11.	6.03.00	Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out				
12.	New Clause	6.07.00. In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening (i.e. 28.11.2013), he may submit during detailed engineering the type test reports to the owner for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor. 6.08.00 Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by purchaser.				

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		6.09.00 ROUTINE / TYPE TESTS ON TRANSFORMERS:																																						
		<table><tr><th>S.N.</th><th>Routine Tests</th></tr><tr><td>1.</td><td>All routine test in accordance with IEC 60076 shall be carried out in all the transformers.</td></tr><tr><td>2.</td><td>Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)</td></tr><tr><td>3.</td><td>Measurement of winding resistance on all the taps (as per IEC 60076-1)</td></tr><tr><td>4.</td><td>Vector group and Polarity Check (as per IEC 60076-1)</td></tr><tr><td>5.</td><td>Magnetic Balance and Magnetising Current Test</td></tr><tr><td>6.</td><td>Measurement of no load current with 415 V, 50 hz AC supply</td></tr><tr><td>7.</td><td>Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)</td></tr><tr><td>8.</td><td>Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps</td></tr><tr><td>9.</td><td>IR measurement (As per IEC 60076-1)</td></tr><tr><td>10.</td><td>Measurement of capacitance & tan delta to determine capacitance between winding & earth.</td></tr><tr><td>11.</td><td>Dielectric tests shall be carried out as per IEC 60076-3.</td></tr><tr><td>12.</td><td>Separate Source Voltage Withstand Test (as per IEC 60076-3)</td></tr><tr><td>13.</td><td>Induced overvoltage test (ACSD Test)</td></tr><tr><td>14.</td><td>Repeat no load current/loss measurement & IR after completion of all electrical test</td></tr><tr><td>15.</td><td>Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)</td></tr><tr><td>16.</td><td>Jacking test followed by D.P. test</td></tr><tr><td>17.</td><td>Marshalling Box/Cable box:It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.</td></tr><tr><td>18.</td><td>IR measurement on wiring of Marshalling Box.</td></tr></table>	S.N.	Routine Tests	1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)	3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	4.	Vector group and Polarity Check (as per IEC 60076-1)	5.	Magnetic Balance and Magnetising Current Test	6.	Measurement of no load current with 415 V, 50 hz AC supply	7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	9.	IR measurement (As per IEC 60076-1)	10.	Measurement of capacitance & tan delta to determine capacitance between winding & earth.	11.	Dielectric tests shall be carried out as per IEC 60076-3.	12.	Separate Source Voltage Withstand Test (as per IEC 60076-3)	13.	Induced overvoltage test (ACSD Test)	14.	Repeat no load current/loss measurement & IR after completion of all electrical test	15.	Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)	16.	Jacking test followed by D.P. test	17.	Marshalling Box/Cable box:It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	18.	IR measurement on wiring of Marshalling Box.
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		4.	Temperature Rise test at a tap corresponding to maximum losses. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference.
		5.	Measurement of acoustic noise level as per NEMA TR-1 (special test)
		6.	Tank Pressure test (As per CBIP norm)
		7.	Tank vacuum test (As per CBIP norm)
		NOTE:- i) All the type / special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test. ii) The power factors should not exceed 0.5% (at 20 oC). However in case of deviation from limiting values the same shall be resolved in line with IEEE Std-62. iii) (*) this test is applicable on Transformer neutral earthed thru NGR. 6.10.00 All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer. 6.11.00 Oil leakage test on assembled transformer (Routine Test): All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m ² 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.	
13.	7.00.00	The Clause shall be read as Bidder <i>not</i> to consider any COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES in their techno-commercial offer.	

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4.0 STANDARD QUALITY PLAN

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

5.0 DOCUMENTATION

- 5.1 Documents required along with technical offer shall be as per annexure-II.
- 5.2 Documents required after award of LOI shall be as per annexure -III.

ANNEXURE – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

- The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.
- Schedule of deviations.
- Schedule of BOQ cum price schedule. (Unpriced)
- 10% Extra oil price schedule (Unpriced)
- Schedule of Mandatory spares. (Unpriced)
- Schedule of Type test. (Unpriced)

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DATA SHEET –A

11/0.433 kV, 3.3/0.433kV
SERVICE TRANSFORMER

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

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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,3.6kV
	b) LV Winding	V	415V + 10%,
15.0	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
16.0	Insulation Levels		
16.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV) 10 (3.3kV)
	b) LV Winding	kV	3
16.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV) 40 (3.3kV)
	b) LV Winding	kVp	-
17.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		
	i) 11KV/0.433KV		Flange throat for TPN non-segregated Al Busduct
	ii) 3.3KV/0.433KV		Cable box (XLPE cables)
	d) LV Neutral		
	i) 11KV/0.433KV		One neutral as part of LV busduct throat and second neutral with copper earthing bar for system

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earthing brought near the base of the transformer.

ii) 3.3KV/0.433KV

One neutral as part of LV cable box and second neutral with copper earthing bar for system earthing brought near the base of the transformer.

18.0 System Fault Level

a) HV Winding

kA

40 kA RMS

b) LV Winding

kA

50 kA RMS

19.0 Method of System Earthing

a) HV System

Low resistance earthed to limit earth fault current to 600A.

(Solidly grounded for 2 no. of 2000KVA Transformers)

b)

LV System

Solidly grounded

c) Through fault withstand time

2 Sec.

20.0 Details of Cooling Equipment

Detachable tank mounted radiators

21.0 Provision/ accommodation of CTs
LV Neutral

2 Core PS CLASS or 5P20.

CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.

22.0 Colour Shade :

a) Interior (For M. Box)

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

b) Exterior

Particulars shall be given to successful bidder during detail engineering. There shall be no

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commercial implication to BHEL
on this account.

23.0 Space/ Layout Limitation if Any

24.1 Cable details (11KV/0.433KV)

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

24.1 Cable details (3.3KV/0.433KV)

- | | | |
|--------------------------------|--|--|
| a) HV side | | |
| i) Type | | XLPE |
| ii) Voltage Grade | | 3.6kV Unearthed |
| iii) Conductor material & size | | Stranded Aluminium,
after award of contract |
| iv) No. of cores & runs | | Three core, one run |
| b) LV side | | |
| i) Type | | XLPE |
| ii) Voltage Grade | | 1.1kV Unearthed |
| iii) Conductor material & size | | Stranded Aluminium,
after award of contract |
| iv) No. of cores & runs | | Three core, one run |

25.0 Penalty for Losses

- | | |
|------------------------------------|---------------------------|
| a) Rates for bid evaluation | N.A. |
| b) 'A' (Losses at 50% Load & 75°C) | Losses not to exceed max. |

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		losses as per annexure-B to section-II, vol-II of the specification
	ii) 'B' (Losses at 100% Load & 75°C)	- Do-
	c) Rates for penalty	
	i) 'A' (Losses at 50% Load & 75°C)	US \$ 3275 per kW
	ii) 'B' (Losses at 100% Load & 75°C)	US \$ 3275 per kW
26.0	Creepage distance	25mm/kV

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DATA SHEET –A

11/3.45kV
SERVICE TRANSFORMER

<u>S. No.</u>	<u>Description</u>	<u>Unit</u>	<u>Particulars</u>
1.0	Quantity	No. & kVA	2 & 5.0MVA 2 & 10.0 MVA
2.0	Installation		Out Door
3.0	Type of insulating oil		Mineral
4.0	No. of phase	No(s)	03
5.0	Frequency	Hz	50
6.0	Type of cooling		ONAN
7.0	Rated Voltage		
	a) HV Winding	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	%	5.0 MVA : 7% 10.0 MVA : 9%
11.0	Total range of tapings 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	V	3.6 kV

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

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commercial implication to BHEL on this account.

22.0 Colour Shade :
a) Interior (For M. Box)

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

b) Exterior

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

23.0 Space/ Layout Limitation if Any

24.0 Cable details

a) HV side

i) Type

XLPE

ii) Voltage Grade

12kV Unearthed

iii) Conductor material & size

Stranded Aluminium,
after award of contract
Three core, one run

iv) No. of cores & runs

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
One core, two run

iv) No. of cores & runs

25.0 Penalty for Losses

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a) Rates for bid evaluation

b) i) 'A' (for no load loss)

ii) 'B' (for load losses)

b) Rates for penalty

i) 'A' (for no load loss)

ii) 'B' (for load loss)

N.A.

losses not to exceed max losses as per annexure-B to section-II, vol-II of the specification

- Do-

US \$ 3275 per kW

US \$ 3275 per kW

26.0 Creepage distance

25mm/kV

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DATA SHEET -A

33/11.5 kV, 33/3.45kV
SERVICE TRANSFORMER

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

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

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	i) 11KV ii) 3.3KV c) Through fault withstand time	Solidly grounded Low resistance earthed to limit earth fault current to 600A 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) b) Exterior	Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account. Particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.
23.0	Space/ Layout Limitation if Any	
24.0	Cable details a) HV side i) Type ii) Voltage Grade iii) Conductor material & size iv) No. of cores & runs b) LV side i) Type ii) Voltage Grade	XLPE 36kV Earthed Stranded Aluminium, after award of contract Single core/phase, one run N.A 12kV Earthed 3.6kV Unearthed

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iii) Conductor material & size

Stranded Aluminium,
after award of contract
After award of contract

iv) No. of cores & runs

25.0 Penalty for Losses

c) Rates for bid evaluation

d) 'A' (for no load loss)

N.A.

Losses not to exceed max.
losses as per annex-B to
sec-II, vol-II of the
specification
- Do-

ii) 'B' (for load losses)

e) Rates for penalty

i) 'A' (for no load loss)

ii) 'B' (for load loss)

US \$ 3275 per kW

US \$ 3275 per kW

26.0 Creepage distance

25mm/kV

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DATA SHEET –B

TECHNICAL PARTICULARS

[TO BE SUBMITTED ALOGWITH TECHNICAL OFFER]

FOR 11kV/0.433V

S. No	Description	2.0MVA	1.6MVA	1.0MVA
1.	Rating			
2.	No Load transformation ratio			
3.	Losses at 50% Load & 75°C (Watts)			
4.	Losses at 100% Load & 75°C (Watts)			
5.	Overall Dimensions			
6.	Total weight			
7.	Total oil Quantity			

FOR 3.3kV/0.433V

S. No	Description	1.0MVA
1.	Rating	
2.	No Load transformation ratio	
3.	Losses at 50% Load & 75°C (Watts)	
4.	Losses at 50% Load & 75°C (Watts)	
5.	Overall Dimensions	
6.	Total weight	
7.	Total oil Quantity	

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FOR 11kV/3.45kV

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

FOR 33kV/3.45kV

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

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-TS-405-302-E001
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FOR 33kV/11.5kV

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

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DATA SHEET –C

TECHNICAL PARTICULARS

[TO BE SUBMITTED AFTER AWARD OF CONTRACT]

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

	(a)Number of coolers and rating as % of transformer cooling equipment	
	(b)Mounting	
	(c)Fan Motor Data	
	(i)Number per cooler/radiator Cooling requirement (indicate n o. of sp are fans also)	
	(ii) Type & make	
	(iii) Rating	
	(iv) Speed	
	(v) Locked rotor current	
	(e) Cooler/radiator details	
	(i)Overall dimensions l x b x h (mm)	
	(ii)Type of mounting	
	(iii)Weight with oil (kg)	
	(iv)Weight without oil (kg)	
1.14.00	Thermal Data	
	(a) Temperature rise in top oil over an ambient of 50 deg.C	
	(b) Temp erature rise in winding by resistance measurement method over a n ambient of 50deg. C.	
	(c) Thermal time constant (Hours)	
	(d) Oil temperature at cooler inlet at rated load at max temperature	

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

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

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

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

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

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

	iii) LV (A/mm ²)	
	iv) Tap	
	c) Conductor area (mm ²)	
	i) HV	
	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	
1.34.00	Tank	
	a) Tank cover-Conventional/Bell Type	
	b) Approximate thickness of	
	i) Side (mm)	
	ii) Bottom (mm)	
	iii) Cover	
1.35.00	Vacuum withstand capability of	
	a) Main tank	
	b) Coolers and accessories	
1.36.00	Minimum draw bar pull required to move the transformer on level track(kg)	
1.37.00	Size of filter hose	
1.38.00	Fault level	

QUALITY ASSURANCE

OUT DOOR TRANSFORMER

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

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

ANNEXURE-II
STANDARD QUALITY PLAN

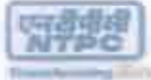
REVIEWED BY	APPROVED BY
Ranish K. Jhu H Shekhar W H Prasad	<i>[Signature]</i> Chairman

Sl No	COMPONENT & DIMENSIONS	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	10	11	12	13	
L00 L01	RAW MATERIAL Steel Plate & Pipe	a) Thickness b) Surface defects c) Chemical Composition d) Mechanical Properties e) Hydraulic Test of Pipes	Major -do- -do- -do- -do-	Measure Visual Test -do- -do-	As per IS/ Plant Std -do- -do- -do- -	As per IS/ Plant Std -do- -do- -do- -	Mfr Plant Std./ IS:2062 / IS:1239 -do- -do- -do- -do-	Mfr Plant Std./ IS:2062 / IS:1239 -do- -do- -do- -do-	QC Record -do- -do- -do- -do-	P P V V V	V - - - V	V - - - V	A) Supplier's TC for all BOIs shall be submitted by Mfr for NTPC verification. B) Make of all BOIs & Raw Material shall be subject to NTPC acceptance and Vendor to submit the same shall be submitted as annexure to project/package specific endorsement sheet.
L02	CARGO Steel	a) Make, Thickness, Finish & Cr b) Cutting & edge burr c) Waviness & edge camber d) Specific corr loss e) Surface resistivity/Insulation resistance of surface coating f) Stacking factor g) Permeability at 800A/m h) Bend Test / Ductility	Major -do- -do- -do- -do- -do- -do- -do-	Measure Test -do- -do- -do- -do- -do- -do-	As per IS/ Plant Std -do- -do- -do- -	As per IS/ Plant Std -do- -do- As per IS/ Plant Std -do- -	Mfr Plant Std./ IS:3024/IS:649 -do- -do- -do- -do- -do- -do- -do-	Mfr Plant Std./ IS:3024/IS:649 -do- -do- -do- -do- -do- -do- -do-	QC Record Supplier's TC -do- -do- -do- -do- -do- -do- -do-	P P V V V V V V	V - - V - - - - -	V - - V - - - - -	
L03	Paper Insulated Copper Conductor	a) Dimensions & tolerances (Bare & Insulated) b) Resistivity/Conductivity c) Paper Covering d) Voltage Test betn Strands for bundled conductor e) Cu Purity f) Elongation g) Tensile Strength	Major -do- -do- -do- -do- -do- -do- -do-	Measure Test Measure Test -do- -do- -do-	As per IS/ Plant Std -do- -do- -do- -	As per IS/ Plant Std -do- -do- -do- -	Mfr Plant Std./ IS:13730/IEC 60554 -do- -do- -do- -do- -do- -do-	Mfr Plant Std./ IS:13730/IEC 60554 -do- -do- -do- -do- -do- -do-	QC Record Supplier's TC -do- -do- -do- -do- -do- -do-	P V P V V V V	V V - - - - -	V V - - - - -	For CTC only
L04	Insulating Paper	a) Make, Dimensions & Type b) Density & substance c) Tensile Strength d) Elongation e) Water Absorption f) Moisture Content g) pH Value & conductivity aqueous extract h) Ash Content i) Electrical Strength in Air j) Air Permeability k) Tear Index l) Heat Stability	Major -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- -do-	Measure -do- Test -do- -do- -do- -do- Test -do- -do- -do- -do-	As per IS/ Plant Std -do- -do- -do- -do- -do- -	As per IS/ Plant Std -do- -do- -do- -do- -do- As per IS/Plant Std -do- -	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554 -do- -do- -do- -do- -do- -do- -do- -do- -do- -do-	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554 -do- -do- -do- -do- -do- -do- -do- -do- -do- -do-	QC Record Supplier's TC -do- -do- -do- -do- -do- -do- -do- -do- -do- -do-	P V V V V V V V V V V V	V - - - - - - - - V V V V	V - - - - - - - - V V V V	

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION

¹⁰⁰ M: MDS; SUB-SUPPLIER. C: MAIN SUPPLIER. N: NTPC. P: PERFORM. W: WITNESS AND V: VERIFICATION, AS APPROPRIATE.

CHP: 81PC SMALL IDENTITY IN COLUMN "N" AS "W".

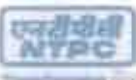
		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): Oil Filled Transformers (Up to 5 MVA, 33 kV Class)		STANDARD QUALITY PLAN					QP No: 0000-999-QOE-S-036, Rev No: 0 Date: 20.02.2013 Page: 2 of 8 VALID UPTO: 19.02.2016		REVIEWED BY B.D. Prasad APPROVED BY B.D. Prasad Dt. 20.02.2013 P.C.	
Sl. No.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		
					M	C/N				M	C	N
1.05	Press-Board	a) Make, Type, Dimensions b) Compressibility c) Density d) Tensile strength e) pH Value/Conductivity of Water extract f) Electrical Strength in air and oil g) Shrinkage in air & oil h) Flexibility/ Elongation i) Ash content j) Moisture content k) Oil absorption l) Cohesion between plies	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS-1576	Plant Std./ IS-1576	QC Record Supplier's TC	P	V	V
		-do-	-do-	Test	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	As per IS/ Plant Std	-do-	-do-	-do-	P	V	V
		-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	V	V	V
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
1.06	Densified Wood	a) Dimensions & Type b) Surface finish c) Electrical Strength in air and oil d) Oil absorption e) Shrinkage in air & oil f) Moisture content g) Compression strength h) Crossbreaking strength i) Tensile strength j) Density k) Specific gravity	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 Supplier's TC	P	-	-
		-do-	-do-	Visual	-do-	-do-	-do-	-do-	-do-	P	-	-
		-do-	-do-	Test	-do-	-do-	-do-	-do-	-do-	V	V	V
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	Test	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
1.07	Gasket Synthetic Rubber or Acrylo Nitrile Butadiene Rubber for Gasket	a) Dimensions, Grade & Type b) Hardness c) Tensile strength d) Compressibility e) Recovery f) Compression set g) Flexibility h) Ageing in air & oil i) Accelerated ageing j) Chloride/Sulphate content of water extract k) Density	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 Supplier's TC	P	-	-
		-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	V	V	V
		-do-	-do-	Test	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	V	V	V
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-
		-do-	-do-	-do-	-do-	-	-do-	-do-	-do-	V	-	-

LEGEND: * RECORDS IDENTIFIED WITH "TICK" (/) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

M: Mfr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE, C/N: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".

		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE, HTC) : Oil Filled Transformers (Up to 5 MVA, 33 kV Class)		STANDARD QUALITY PLAN					QIP No: 0000-999-QOE-S-036, Rev No: 0		REVIEWED BY		APPROVED BY	
				CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076					Date: 20.02.2013 Page: 3 of 8 VALID UPTO: 19.02.2016		Ranish K. Jha S. D. Prasad		REMARKS	
Sl. No.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				
					M	C/N				M	C	N		
1	2	3	4	5	6	7	8	9	10*	11	12	13	14	
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 Sulfur Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	V	V	V	
		h) Water content	-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, Neutralisation 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° C for 96 hours	-do-	-do-	-do-	-do-	IS-335-1993	IS-335-1993	-do-	✓	V	V	V	
		r) S.K. Value	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	V	V	V	
2.00	FITTING AND ACCESSORIES													
2.01	Porcelain Bushings	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	Buchholz 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 Volume 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	-	

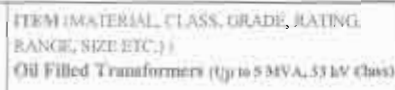
LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: Mfr; SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE.
 CRP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".

		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): Oil Filled Transformers (Up to 5 MVA, 33 kV Class)		STANDARD QUALITY PLAN				QIP No: 0000-999-QOE-S-036, Rev No: 0		REVIEWED BY		APPROVED BY	
				CONFORMING TO CODE: NTPC TECHNICAL SPECIFICATION / IEC:60076				Date: 20.02.2013 Page: 4 of 8 VALID UPTO: 19.02.2016		Banshi K. Jha H. Shrivastava B.D. Prasad		  	
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	10	11	12	13	14
2.04	Magnetic Oil Level Gauge	a) Type, Size & Make b) Dial Marking c) Switch Continuity d) Leak Test e) HV Test f) Operational test	Major	Visual	10%	-	NTPC Spec/ Plant Std/Mfr Drg	NTPC Spec/ Plant Std/Mfr Drg	QC Record Supplier's TC	P V V V V	- - - - -	- - - - -	
2.05	Off-Circuit Tap Changer (if applicable)	a) Dimensions, Alignment of padlocking arrangement b) Physical condition c) Operation of Switch d) Insulation Resistance Test e) Leak Test of Handle Stuffing Box	Major	Measure Visual Test -do- -do-	10% 100% -do- -do- -do-	As per IS / Plant Std -do- -do- -do- 100%	Mfr Drg. /Mfr Plant Std -do- -do- -do- -do-	Mfr Drg. /Mfr Plant Std -do- -do- -do- -do-	QC Record -do- -do- Supplier's TC -do-	P P P V V	V - - - V V	- - - - V	
2.06	On Load Tap (if applicable)	a) Visual Check, make, type b) Dimensional check c) Mechanical operation on Diverter & selector switch d) HV test on auxiliary circuit	Major	Visual Measure verify Test	100% -do- -do- -do-	- -do- 100% -do-	IS: 2026/IS:8468 -do- -do- -do-	IS: 2026/IS:8468 -do- -do- -do-	QC Record -do- Supplier's TC -do-	P P P V	V - V V	- - - V	
2.07	Valves (Gate/Globe/Butterfly)	a) Dimensional check b) Type, Size & Make c) Hydraulic/Leakage Test (for Body & Seat) d) Operational Test (Smooth Close & Open)	Major	Measure Visual Test -do- -do-	10% -do- As per IS/ Plant Std -do-	- -do- As per IS/ Plant Std -	Mfr Drg./Plant Std/ IS:778-P-1 -do- IS:778-P-1 -do-	Mfr Drg./Plant Std/ IS:778-P-1 -do- IS:778-P-1 -do-	QC Record -do- Supplier's TC -do- -do-	P P V V V	- V V - -	- - V -	Drain and Sample Valve should have zero leakage rate.
2.08	Marshalling Kiosk & Remote Tap Control (RTCC)	a) Dimensional/Visual checks, makes of MB & mountings b) 2 kV insulation test on auxiliary wiring c) IP-55 Degree of protection by thin paper insertion d) Check for paint, shade & thickness	Major	Visual Test Test Measure/ Test	100% -do- -do- On random basis	100% -do- -do- On random basis	NTPC Appd Drgs -do- IS:13947-1993 NTPC Specn./ IS:101-P-IV-Sec-2	NTPC Appd Drgs Should withstand for one minute IS:13947-1993 NTPC Specn./ IS:101-P-IV-Sec-2	QC Record Test Report -do- -do-	W W P W	W W W W	V V V V	At Marshalling Kiosk's manufacturer's works.
2.09	OTI & WTI	a) Type, Size & Make b) HV Test c) Temperature Calibration d) Switch setting & switch differential e) Calibration & operation of Switch	Major	Visual Test -do- -do- -do- -do-	As per IS/ Plant Std -do- -do- -do- -do-	As per IS/ Plant Std -do- -do- -do- -do-	NTPC Specs/ Apvd drgs/ Mfr Std/ IS:11222/IS:2848 -do- Mfr Std / IS 2848 -do-	NTPC Specs/ Apvd drgs/ Mfr Std/ IS:11222/IS:2848 -do- Mfr Std / IS 2848 -do-	QC Record Supplier's TC -do- -do- -do-	P V V V V	V V V V V	- V V V V	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: Mfr/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE.

CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".



QP No: 0000-999-QOE-5-036, Rev No: 0

REFERENCES

APPROVED BY _____

Date: 20.02.2013

Page: 5 of 8

VALID UPTO: 19.07.2016

Hansky K. J.

H. Sheldon C.

IS IT PAINFUL?

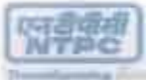
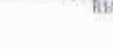
REMARKS

Sl No	COMPONENT & DIMENSIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY 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	10	11	12	13	
2.10	Bushing CT	a) Make & rating b) Dimensions/Visual check c) Routine Test	Major Major -do-	Visual Measure Test	100% As per IS 100%	10% - 100%	Mfr Drg/IS:2705 -do- -do-	Mfr Drg/IS:2705 -do- -do-	QC Record Supplier's TC -do-	P V V	V - V	V - V	
2.11	Radiator	a) Type, Model, Rating, make b) Dimensions & No. of elements c) Paint, Shade, Finish & thickness d) Pressure test e) Adhesion Test on paint	Major -do- -do- -do- -do-	Visual Measure Visual / Measure Test -do-	100% -do- -do- -do- -do-	100% -do- -do- 1 amp/ des./lot As per IS	NTPC Specs/ Apvd drgs/ Mfr Std -do- -do- -do- -do- IS:101	NTPC Specs/ Apvd drgs/ Mfr Std -do- -do- -do- -do- IS:101	QC Record -do- -do- Supplier's TC -do-	P W W W W	V V V V V	V - V V V	
2.12	Terminal Connector	a) Dimensional check b) Surface Finish c) Acceptance Test	Major -do- -do-	Measure Visual Test	10% As per IS -	- - -	Mfrs Drg/IS:5561 -do- -do-	Mfrs Drg/IS:5561 -do- -do-	QC Record -do- Supplier's TC	P V V	- - -	- - -	
2.13	Silicagel Breather	a) Type, Size, Model b) Pressure/Breathing Leakage Test c) Colour of Silica gel	Major -do- -do-	Visual Test Visual	10% -do- -do-	- - -	Mfr Plant Std. -do- -do-	Mfr Plant Std. -do- -do-	QC Record Supplier's TC -do-	P V V	- - -	- - -	
3.00	IN-PROCESS												
3.01	Fabrication of Tank, Cover, Conservator and welding requirement	a) Welding Procedure Specification b) Process Qualification Records c) Welders Qualification d) Welding Electrodes e) Fitup for Butt weld joints of tank and cover f) Visual check on weldment g) Dimensional check after welding h) DP Test on welded joints of load bearing member i) Check for flatness of gasket surface j) Rim flatness k) Surface cleaning by sand/shot blasting l) Primer coating, Paint shade, thickness inside and outside m) Paint adhesion test	Major -do- -do- -do- -do- -do- -do- -do- -do- -do- -do- Major -do-	Verify Test -do- -do- Visual Visual Measure Test Visual Measure Visual Measure Test	100% -do- -do- As per IS -do- 100% -do- -do- 100% -do- 10% 100% 100% -do- 5%	100% -do- -do- - - - - 100% - - - - 30%	ASME-Sec-IX -do- -do- As per WPS/IS:814 Mfr Drg/Plant Std -do- -do- Mfr Drg/Plant Std/IS:3658 Mfr Drg/Plant Std -do- -do- IS:101/ NTPC Specification IS:101	Approved WPS/ ASME-Sec-IX -do- -do- As per WPS/IS:814 Mfr Drg/Plant Std -do- -do- Mfr Drg/Plant Std/IS:3658 Mfr Drg/Plant Std -do- -do- IS:101/ NTPC Specification IS:101	QW-482 QW-483 QW-484 Supplier's TC QC Record -do- -do- -do- -do- -do- -do- -do-	V W W V V V V W W W W W W W	V V/W V/W - - - - - - - - - - V V V	V V/W V/W - - - - - - - - - - V V V	1-WPS approval, Welders & PQR qualification shall be done as per following - A) Upto 2 MVA - by Transformer Mfr B) 2-5 MVA - by Main Contractor
3.02	Core Stamping	a) Burr & Bow b) Dimensional check	Major -do-	Visual Measure	Plant Std -	- -	Mfr Drg/Plant Std -do-	Mfr Drg/Plant Std -do-	QC Record -do-	P P	- -	- -	
3.03	Core Building	a) Dimensional check b) Assembly of limb insulation and limb plates c) Rectangularity of core assembly	Major -do- -do-	Measure Visual -do-	100% -do- -do-	- - -	Mfr Drg/Plant Std -do- -do-	Mfr Drg/Plant Std -do- -do-	QC Record -do- -do-	P P P	- - -	- - -	

LEGEND: * REVISIONS IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: MFR / SUB-SUPPLIER. C: MAIN SUPPLIER. N: NTPC. P: PERFORM. W: WITNESS AND V: VERIFICATION, AS APPROPRIATE.

[IMP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"]

		ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): Oil Filled Transformers (Up to 5 MVA, 33 kV Class)		STANDARD QUALITY PLAN					QF No: 0000-999-QOE-S-036, Rev No: 0		REVIEWED BY		APPROVED BY	
				CONFORMING TO CODE: NTPC TECHNICAL SPECIFICATION / IEC:60076					Date: 20.02.2013 Page: 6 of 8 VALID UPTO: 19.02.2016		Bunesh K. Jha H Shekhar B D Prasad		  	
Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
					M	CN				M	C	N		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
		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 thickness	-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	-	-		
		k) Lead & Coil identification and marking	-do-	-do-	-do-	-	-do-	-do-	-do-	P	-	-		
		l) Free from damages	-do-	-do-	-do-	-	-do-	-do-	-do-	P	-	-		
		m) Continuity test for leads	-do-	Test	-do-	100%	-do-	-do-	-do-	P	V	V		
		n) 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) Isolation 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	-	-		

LEGEND: * RECORDS, UNIDENTIFIED WITH "TRICK" (V) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** N: MFR / SUB-SUPPLIER C: MAIN SUPPLIER, S: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE.
 CNP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".



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: 9000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 7 of 8
VALID UPTO: 19.02.2016

REVIEWED BY
Ranjit K. Jha
H. Shrivastava
B.D. Prasad

APPROVED BY
[Signature]
[Signature]
[Signature]

REMARKS

S.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	10	11	12	13	14	
3.08	Overvoting and	a) Cleanliness of tank b) Drying c) Check tightness of clamped blocks and measurements of winding height d) Electrical Clearances e) Tightening of Coil & Spacers; Locking of tie rods & fasteners g) Check Paint shade, thickness & Adhesion h) Oil filling and air release	Major -do- -do- -do- -do- -do- -do-	Visual Physical Measure -do- -do- Visual/ Phys. Physical	100% -do- -do- -do- -do- -do- -do-	- - - 100% - - -	Mfr Drg/ Plant Std -do- -do- -do- -do- -do- -do-	Mfr Drg/ Plant Std -do- -do- -do- -do- -do- -do-	QC Record -do- -do- -do- -do- -do- -do-	P P P P P P P	- - - V - - -	- - - V - - -	- - - V - - -	
4.00	Type & Special Test	a) Review of Type test & Special test report b) Review of all previous stage of inspection as per QIP	- Major	- Verify	- 100%	- 100%	- NTPC Specs/ Apvd Drg/ DS	- CHP Reports/ Protocols	- TC / TR	- V	- V	- V	- V	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. Each transformer shall be assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by NTPC.
5.00	Routine Test	a) Dimensional check b) Measurement of winding resistance of HV at normal, extreme taps & LV winding c) Measurement of voltage ratio at all taps, polarity & vector group d) Magnetic balance test e) Measurement of No-Load Losses & magnetising current at 90%, 100% & 110% voltage at 50 Hz. f) Measurement of No Load Current with 415 Volt/50 Hz AC Supply g) Measurement of impedance & short circuit impedance at normal & extreme taps h) Measurement of load loss i) Measurement of insulation resistance of winding	Critical -do- -do- -do- -do- -do- -do- -do- -do-	Measure -do- -do- -do- -do- -do- -do- -do- -do-	100% -do- -do- -do- -do- -do- -do- -do- -do-	15 sample /Lot/Rating 100% -do- -do- -do- -do- -do- -do- -do-	NTPC Spec/ Apvd Drgs/ DS/IS:2026 / IEC-60076 -do- -do- -do- -do- -do- -do- -do- -do-	NTPC Spec/ Apvd Drgs/ DS/IS:2026 / IEC-60076 -do- -do- -do- -do- -do- -do- -do- -do-	QC Record -do- -do- -do- -do- -do- -do- -do- -do-	V P P P P P P P P	W W W W W W W W W	W W W W W W W W W		

LEGEND: * RECORDS, IDENTIFIED WITH "TICKS" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: MFR/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".

NTPC		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					QIP 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 Shukla B D Prasad		APPROVED BY [Signature] [Signature] [Signature]		REMARKS
Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY					
					M	C/N				M	C	N			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		j) Dielectric Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		1) Separate source AC withstand voltage test of HV & LV	-do-	-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-	-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-	-do-	✓	P	W	W	
		l) Measurement of Capacitance & tan delta for winding to earth	-do-	-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-	-do-	✓	P	W	W	
		n) Jacking test on oil filled transformer followed by DP Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		o) Oil Leakage test	-do-	-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-	-do-	✓	P	W	W	
		q) Functional/Continuity checking of wiring, IR, & HV on MB	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		r) Functional / Continuity checking of WTI, OTL, PRV, Buchholz Relay	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		s) Paint, Shade, Thickness, Adhesion	Critical	-do-	Random basis	Random basis	-do-	-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-	-do-	✓	P	-	-		

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: Mfr/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE,
 CHF: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W".

		ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) LT AUXILIARY TRANSFORMER UPTO 10 MVA, 11/6.6/0.433 kV		STANDARD QUALITY PLAN				TO BE FILLED BY NTPC								
				CONFORMING TO: IS:2026-1977 (R1, A3) CONTROLLED COPY				QP No. 0000-999-QOE-S-010-R0		DATE: 07-06-99 PAGE: 1 OF 13 VALID UP TO 06-06-2002 REVIEW BY APPROVED BY 						
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	**	M	C	N	REMARKS		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1.00	RAW MATERIAL	RAW MATERIAL														
1.01	STEEL PLATE	a) Surface Finish b) Thickness c) Chemical composition d) Mechanical properties	Major	Visual Testing	100%	IS:1730-1989 (R1) IS:2062-1992(R4A2) IS:1608-1995(R2)	IS:1730-1989 (R1) IS:2062-1992(R4A2) IS:1608-1995(R2)	Supplr TC	✓	P	V	V		Review of T.C.		
1.02	CRGO STEEL	a) Thickness & Finish b) Specific loss c) Bend Test/Ductility d) Ageing Test e) Surface resistivity f) Stacking factor g) Permeability at 800 A/m h) Chemical composition	"	Measure Testing	100%	IS:3024-1997(R1) IS:649-1996	IS:3024-1997(R1) IS:649-1996	"	✓	P	V	V		"		
1.03	Paper Insulated copper conductor (PICC)	a) Conductor finish b) Dimnsions c) Resistivity / conductivity d) Tensile strength e) Electric Proof Strength f) Elongation at break point g) 0.1 % Proof Stress h) Ash content of paper i) Chemical composition	"	Visual Measure Testing	One sample supplier's different sizes of conductor	IEC:317-27-1990 IS:482-1981(R3) IS:4800(P-III)-1968 IS:2069-1991(R2) IS:7404(P-I)-1991 IS:1608-1995(R2)	IEC:317-27-1990 IS:482-1981 IS:4800(P-III)-1968 IS:2069-1991 IS:7404(P-I)-1991 IS:1608-1995(R2)	"	✓	P	V	V		"		
			"	"	"	As per NTPC Specification and IS:191-1980(R3)	As per NTPC Specification and IS:191-1980(R3)	"	✓	P	V	V		"		
LEGEND: * RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. **M:MANUFACTURER/SUB-CONTRACTOR, C:CONTRACTOR NOMINATED INSPECTION AGENCY, N:NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS PER APPROPRIATE "CHP" NTPC SHALL BE IDENTIFIED IN COLUMN "N"			TO BE FILLED IN BY NTPC WHILE EXTENDING APPLICABILITY TO SPECIFIC PACKAGE TO PACKAGE OF PROJECT										DOC.NO			
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		ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) LT AUXILIARY TRANSFORMER UPTO 10 MVA, 11/6.6/0.433 kV		STANDARD QUALITY PLAN				TO BE FILLED BY NTPC					
				CONFORMING TO: IS:2026-1977 (R1, A3) CONTROLLED COPY				QP No. 0000-999-QOE-S-010-R0		DATE: 07-06-99 REVIEW BY: <i>[Signature]</i>		APPROVED BY: <i>[Signature]</i> Di: <i>[Signature]</i>	
								PAGE : 2 OF 13		VALID UP TO 06-06-2002			
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
1.04	Insulating Paper	a) Dimensions	Major	Measmnt	One Sample	IS:1060(P-I)1966	IS:1060(P-I)1966	Supplr	✓	P	V	V	Review of T.C.
		b) Density	"	Testing	per lot	IS:9335(P-I)-1979	IS:9335(P-I)-1979	TC	✓	P	V	V	
		c) Tensile Strength	"	"	"	IS:9335(P-II)-1981	IS:9335(P-II)-1981	"	✓	P	V	V	
		d) Oil absorption	"	"	"	IS:9335(P-III)/Sec-I	IS:9335(P-III)/Sec-I	"	✓	P	V	V	
		e) Water absorption	"	"	"	-1984(A1)	-1984(A1)	"	✓	P	V	V	
		f) Moisture content	"	"	"	"	"	"	✓	P	V	V	
		g) Shrinkage in air & oil	"	"	"	"	"	"	✓	P	V	V	
		h) pH Value	"	"	"	"	"	"	✓	P	V	V	
		i) Ash content	"	"	"	"	"	"	✓	P	V	V	
		j) One minute withstand voltage at 90+2 Deg. C	"	"	"	"	"	"	✓	P	V	V	
		k) Air permeability	"	"	"	"	"	"	✓	P	V	V	
		l) Tear index	"	"	"	"	"	"	✓	P	V	V	
		m) Conductivity	"	"	"	"	"	"	✓	P	V	V	
1.05	Press-Board (Pre-Compressed & Self calendered)	a) Dimensions	Major	Measmnt	One Sample	IS:1576-1992(R1)	IS:1576-1992(R1)	"	✓	P	V	V	
		b) Compressibility	"	Testing	per lot	"	"	"	✓	P	V	V	
		c) Density	"	"	"	"	"	"	✓	P	V	V	
		d) Tensile Strength	"	"	"	DIN-7735	DIN-7735	"	✓	P	V	V	
		e) Elongation	"	"	"	"	"	"	✓	P	V	V	
		f) pH Value/Conductivity of Water extract	"	"	"	"	"	"	✓	P	V	V	
		g) Electraical strength in air and oil	"	"	"	IEC:641-3-1-1992	IEC:641-3-1-1992	"	✓	P	V	V	
		h) Ash content	"	"	"	DIN-7735	DIN-7735	"	✓	P	V	V	
		i) Moisture content	"	"	"	"	"	"	✓	P	V	V	
		j) Water absorption	"	"	"	"	"	"	✓	P	V	V	
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ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.)
LT AUXILIARY TRANSFORMER
UPTO 10 MVA, 11/6.6/0.433 kV

STANDARD QUALITY PLAN

CONFORMING TO: IS:2026-1977 (R1, A3)

CONTROLLED COPY

TO BE FILLED BY NTPC

QP No. 0000-999-QOE-S-010-R0

DATE: 07-06-99

PAGE: 3 OF 13

VALID UP TO

06-06-2002

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
1.05	Press-Board (Pre-Compr-essed & Self calendered)	k) Shrinkage in air & oil	Major	Testing	Sample	DIN:7735	DIN:7735	Supplr	✓	P	V	V	Review of T.C.
		l) Cohesion between plies	"	"	per lot	IS:1576-1992(R1)	IS:1576-1992(R1)	TC	✓	P	V	V	"
		m Oil absorption	"	"	"	"	"	"	✓	P	V	V	"
1.06	Insulators for bushings	a) Dimension	"	Measmnt	Sample	IS:3347-(P-I/Sec-I)	IS:3347-(P-I/Sec-I)	"	✓	P	V	V	"
		b) Visual	"	Visual	per lot	-1979(A1)	-1979(A1)	"	✓	P	V	V	"
		c) Temperature cycle test	"	Testing	100%	IS:5621-1980(R1A2)	IS:5621-1980(R1A2)	"	✓	P	V	V	"
		d) Electraicl test	"	"	"	"	"	"	✓	P	V	V	"
		e) Porosity test	"	"	"	"	"	"	✓	P	V	V	"
		f) Dry power frequency test	"	"	"	"	"	"	✓	P	V	V	"
		g) Measurement of partial discharge level.	"	"	"	"	"	"	✓	P	V	V	"
1.07	Condenser Bushing	a) Dimensions	"	Measmnt	Sample	IS:2099-1986(R2A2)	IS:2099-1986(R2A2)	"	✓	P	V	V	"
		b) Visual	"	Visual	per lot	IEC-137	IEC-137	"	✓	P	V	V	"
		c) Measurement of capac- itance & tan delta											
		a) Before voltage test	"	Testing	100%	"	"	"	✓	P	V	V	"
		b) After voltage test	"	"	"	"	"	"	✓	P	V	V	"
		d) Dry power frequency withstand voltage test.	"	"	"	"	"	"	✓	P	V	V	"
		e) Measurement of partial discharge level.	"	"	"	"	"	"	✓	P	V	V	"
		f) Power frequency test on test tap insulation.	"	"	"	"	"	"	✓	P	V	V	"
		g) Test for leakage of inter- nal filling	"	"	"	"	"	"	✓	P	V	V	"

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TO BE FILLED IN BY NTPC WHILE EXTENDING APPLICABILITY TO SPECIFIC PACKAGE TO PACKAGE OF PROJECT

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				DATE: 07-06-99 PAGE : 5 OF 13 VALID UP TO 06-06-2002		REVIEW BY: APPROVED BY: 07 JUNE 1999							
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
1.10	Marshalling Kiosk	a) Dimensional/Visual check for wiring b) Check for make of instrument c) 2 kV insulation test on auxiliary wiring e) Check for paint and thickness f) IP-55 Degree of protection g) Functional/Continuity checking of wiring	Major	Visual	100%	NTPC Approved Drawing	NTPC Approved Drawing	Supplr TC		P	V	V	Review of T.C.
		b) Check for make of instrument	"	Visual	Sample	As per Drawing	As per Drawing	"		P	V	V	"
		c) 2 kV insulation test on auxiliary wiring	"	Testing	"	Should withstand for one minute	Should withstand for one minute	"	✓	P	V	V	"
		e) Check for paint and thickness	"	"	"	IS:101(P-IV/Sec 2) -1988(R3)	IS:101(P-IV/Sec 2) -1988(R3)	"	✓	P	V	V	"
		f) IP-55 Degree of protection	"	"	"	IS:2147-1962	IS:2147-1962	"		P	V	V	Review of Engg. clearance
		g) Functional/Continuity checking of wiring	"	"	100%	Functional Checks of Component	Functional Checks of Component	"	✓	P	V	V	Review of T.C.
1.11	RADIATORS	a) Weldign Procedure & Welders qualification	"	Review	100%	Approved WPS & Welders Qualificati-	Approved WPS & Welders Qualificati-	"	✓	P	V	V	"
		b) Welding electrode-mechanical & chemical properties	"	"	"	on as per ASME SEC-IX	on as per ASME SEC-IX	"	✓	P	V	V	"
		c) Surface cleaning/preparation	"	Visual	"	As per manufacturer's standard	As per manufacturer's standard	"	✓	P	V	V	"
		d) Air pressure test on element	"	Testing	"	"	"	"	✓	P	V	V	"
		e) Air pressure test on radiator assemblies	"	"	"	"	"	"	✓	P	V	V	"
		f) Paint film thickness	"	"	"	IS:101(P-IV/Sec 2) -1988(R3)	IS:101(P-IV/Sec 2) -1988(R3)	"	✓	P	V	V	"
		g) Paint film adhesion test	"	"	"	"	"	"	✓	P	V	V	"
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				CONTROLLED COPY		DATE: 07-07-99 PAGE: 6 OF 13 VALID UP TO 06-06-2002		REVIEW BY 		APPROVED BY 			
						07 JUN 1999		REMARKS					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	**	10	N	REMARKS
1	2	3	4	5	6	7	8	9					11
1.12	Bucholz Relay	a) Dimension/Visual check b) 2 kV insulation test for one minute c) Insulation resistance test d) Porosity and element test at 3 Kg/cm.sq. for 30 minutes e) Static response characteristics for gas and volume surge test	Major	Visual Testing	100%	IS:3637-1966(A1) Should withstand	IS:3637-1966(A1) Should withstand	Supplr TC		P	V	V	Review of T.C.
			"	"	"	IS:3637-1966(A1)	IS:3637-1966(A1)	"		P	V	V	"
			"	"	"	"	"	"		P	V	V	"
			"	"	"	"	"	"		P	V	V	"
1.13	OTI & WTI	a) Insulation test at 2 kV for one minute for all electrical terminal b) Accuracy c) Switch setting d) Switch differential e) Calibration and operation of contacts	"	"	"	Should withstand	Should withstand	"	✓	P	V	V	"
			"	"	"	IS:2848-1986(R1)	IS:2848-1986(R1)	"	✓	P	V	V	"
			"	"	"	BS:5235-1992	BS:5235-1992	"	✓	P	V	V	"
			"	"	"	IS:11222-1985	IS:11222-1985	"	✓	P	V	V	"
			"	"	"	"	"	"	✓	P	V	V	"
1.14	Pressure Relief Valve	a) Functional test with compressed air. b) Switch operation c) Switch contact position d) 2 kV test for one minute	"	"	"	As per Approved Drawing /Manufacturer's Plant	As per Approved Drawing /Manufacturer's Plant	"	✓	P	V	V	"
			"	"	"	Stanard	Stanard	"	✓	P	V	V	"
			"	"	"	Should withstand	Should withstand	"	✓	P	V	V	"
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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
1.15	Magnetic Oil Level Gauge	a) Dimension/Visual check b) 2 kV insulation test for one minute c) Operation of contacts d) Calibration of switch contacts	Major	Visual Testing	100%	As per Drawing Should withstand	As per Drawing Should withstand	Suppl TC		P	V	V	Review of T.C.
			"	"	"	Continuity checking	Continuity checking	"		P	V	V	"
			"	"	"	Functional check	Functional check	"		P	V	V	"
1.16	Off-Load Tap Changer	a) Dimension/Visual check b) Torque test c) Operation Test	"	Visual Testing	"	As per Drawing IS:8468-1977/	As per Drawing IS:8468-1977/	"		P	V	V	"
			"	"	"	Manufacturer's Plant Standard	Manufacturer's Plant Standard	"		P	V	V	"
1.17	Gate Valves, Cast Iron/ Gun Metal Valves/ Butterfly Valves	a) Dimension/Visual b) Leak/Pressure Test for body & seat at 1.5 times of Design Pressure c) Seepage test at one time of Design pressure for for 12 hrs with Oil.	"	"	"	As per Approved Drawing IS:778-1984	As per Approved Drawing IS:778-1984	"	✓	P	V	V	"
			"	"	"	IS:778-1984 No Seepage	IS:778-1984 No Seepage	"	✓	P	V	V	"
1.18	Bushing CT	a) Dimension/Visual check b) Class of accuracy c) Ratio & Phase angle error test. d) High Voltage power frequency dry withstand test e) Over voltage power inter turn test	Major	Measurement Testing	Sample 100%	IS:2705-1992	IS:2705-1992	"	✓	P	V	V	"
			"	"	"	"	"	"	✓	P	V	V	"
			"	"	"	"	"	"	✓	P	V	V	"
			"	"	"	"	"	"	✓	P	V	V	"
			"	"	"	"	"	"	✓	P	V	V	"

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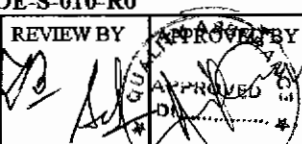
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PROJECT :	REVIEWED BY	CONTRACT NO.:	CONTRACTOR:	
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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS			
									M	C	N				
1	2	3	4	5	6	7	8	9	D*	**	10	11			
1.18	Bushing CT	f) Verification of terminal marking & polarity test	Major	Testing	100%	IS:2705-1992	IS:2705-1992	Supplr TC	✓	P	V	V	Review of T.C.		
		g) Composite error test marking & polarity test	"	"	"	"	"	"	✓	P	V	V	"		
		d) Calibration of switch contacts	"	"	"	"	"	"	✓	P	V	V	"		
1.19	Tank & Cover Assembly	a) Welders & Weld Procedure qualification	"	Review Testing	"	ASME Sec-IX Approved WPS	ASME Sec-IX Approved WPS	"	✓	P	V	V	"		
		b) Dimension/Visual	"	Measure	"	Welders will be qualified bt NTPC	Welders will be qualified bt NTPC	"	✓	P	V	V	"		
		c) Jacking test on tank followed by DP test on welding	"	Testing	"	Manufacturer's Plant Standard	Manufacturer's Plant Standard	"	✓	P	W	W	"		
		d) Pressure Test/deflection on tank.	"	"	Sample	CBIP Sect-A	CBIP Sect-A	"	✓	P	W	W	"		
		e) Vacuum test/deflection measurement on tank.	"	"	Sample	"	"	"	✓	P	W	W	"		
		f) Shot blasting of surface prior to painting	"	"	100%	Manufacturer's Plant Standard	Manufacturer's Plant Standard	"	✓	P	W	W	"		
		g) Primer application on surface excet for load bearing member where taping is done	"	Physical	"	"	"	"	✓	P	W	W	"		
2.00	Terminal connector	a) Dimension/Visual	"	Visual	100%	Approved Drawing	Approved Drawing	"	✓	P	W	V	"		
		b) Tensile Test	"	Testing	Sample	IS:5561-1970	IS:5561-1970	"	✓	P	W	V	"		
		c) Resistance Test	"	"	"	"	"	"	✓	P	W	V	"		
		d) Galvanising test (Where applicable)	"	"	"	"	"	"	✓	P	W	V	"		
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1	2	3	4	5	6	7	8	9	D*	**	M	C	N	10	11
2.00	CORE														
2.01	Core stamping	a) Check on Burr & Bow b) Check dimensions	Major	Measmnt	100%	Check List of Manufacturer	Check List of Manufacturer	Record			P	V	V		Reviw of Records
			"	"	"			"			P	V	V		"
2.02	Core building	a) Dimensions b) Leaning of core (i.e. core verticality) c) Dia over resiglass tape	"	Visual Checking	"	"	"	"			P	V	V		"
			"	"	"	"	"	"			P	V	V		"
			"	Measmnt	"	"	"	"	✓		P	V	V		"
2.03	Test on Core	a) Insulation test at 2 kV for one minute between core & end frame to yoke bolts, core clamp to yoke bolt. b) Magnetising characteristics of core material. c) Pre Core Loss measurement of built core d) Dimension/Visual check	"	Testing	"	"	"	"	✓		P	V	V		"
			"	"	"	"	"	"	✓		P	V	V		"
			"	"	Sample	"	"	"	✓		P	V	V		"
			"	Visual	100%	"	"	"			P	V	V		"
3.00	WINDING														
3.01	Winding of coils	a) Dimension/Visual b) No. turns c) Oil ducts d) Insualtion e) Pressed length after drying in chamber	"	"	100%	Winding Schedule of Manufacturer	Winding Schedule of Manufacturer	"			P	V	V		"
			"	"	"	"	"	"			P	V	V		"
			"	"	"	"	"	"			P	V	V		"
			"	"	"	"	"	"			P	V	V		"
			"	"	"	"	"	"			P	V	V		"

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 **M:MANUFACTURER/SUB-CONTRACTOR, C:CONTRACTOR NOMINATED INSPECTION AGENCY, N:NTPC . INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS PER APPROPRIATE "CHP" NTPC SHALL BE IDENTIFIED IN COLUMN "N"

TO BE FILLED IN BY NTPC WHILE EXTENDING APPLICABILITY TO SPECIFIC PACKAGE TO PACKAGE OF PROJECT		DOC.NO	
PROJECT :	REVIEWED BY		MFRER AGREED BY
PACKAGE :			
CONTRACT NO.:			
CONTRACTOR:		NAME & SIGN. OF APPROVING AUTHORITY & SEAL	

		ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) LT AUXILIARY TRANSFORMER UPTO 10 MVA, 11/6.6/0.433 kV		STANDARD QUALITY PLAN CONFORMING TO: IS:2026-1977 (R1, A3) CONTROLLED COPY				TO BE FILLED BY NTPC QP No. 0000-999-QOE-S-010-R0 DATE: 07-06-99 REVIEW BY: PAGE : 10 OF 13 VALID UP TO 06-06-2002 APPROVED BY: QUALITY CONTROL 07 JUN 1999					
				CONFOMING TO: IS:2026-1977 (R1, A3)									
SL. NO.	COMPONENT & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
3.02	Core coil assembly	a) Dimension/Visual	Major	Visual	100%	Manufacturer's Check List for the Activity	Manufacturer's Check List for the Activity	Record		P	V	V	Review of Records
		b) Assembly of winding arrangement on core	"	"	"	"	"	"		P	V	V	"
		c) Assembly of insulation items	"	"	"	"	"	"		P	V	V	"
		d) Top yoke assembly	"	Visual	"	"	"	"		P	V	V	"
		e) 2 kV Insualtion test on core bolt	"	Testing	"	Should withsatand	Should withsatand	"		P	V	V	"
		f) Internal clearance meas-urement	"	Measmnt	"	Manufacturer's Check List for the Activity	Manufacturer's Check List for the Activity	"		P	V	V	"
		g) Other checks as per Drawings	"	Visual	"	"	"	"		P	V	V	"
		h) Cleanliness	"	"	"	"	"	"		P	V	V	"
3.03	Connection	a) Dimension/Visual	"	Measmnt	"	"	"	"		P	V	V	"
		b) Assembly of bushing on the lid	"	Visual	"	"	"	"		P	V	V	"
		c) Connection to the bush-ing terminals	"	"	"	"	"	"		P	V	V	"
		d) Insulation of brazed joints	"	Testing	"	"	"	"		P	V	V	"
		e) Clearances	"	Visual	"	"	"	"		P	V	V	"
		f) Preliminary ratio test	"	Testing	"	"	"	"		P	V	V	"
		g) Vecotor group after connections	"	"	"	"	"	"		P	V	V	"
		h) Other checks as per drawings	"	Visual	"	"	"	"		P	V	V	"
LEGEND: * RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. **M:MANUFACTURER/SUB-CONTRACTOR, C:CONTRACTOR NOMINATED INSPECTION AGENCY, N:NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS PER APPROPRIATE "CHP" NTPC SHALL BE IDENTIFIED IN COLUMN "N"			TO BE FILLED IN BY NTPC WHILE EXTENDING APPLICABILITY TO SPECIFIC PACKAGE TO PACKAGE OF PROJECT							DOC.NO			
			PROJECT : PACKAGE : CONTRACT NO.: CONTRACTOR:			REVIEWED BY		NAME & SIGN. OF APPROVING AUTHORITY & SEAL				MFRER AGREED BY	

		ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) LT AUXILIARY TRANSFORMER UPTO 10 MVA, 11/6.6/0.433 KV		STANDARD QUALITY PLAN				TO BE FILLED BY NTPC							
				CONFORMING TO: IS:2026-1977 (R1, A3)				QP No. 0000-999-QOE-S-010-R0		DATE: 07-06-99		REVIEW BY		APPROVED BY	
				CONTROLLED COPY				PAGE : 11 OF 13		VALID UP TO					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	M	C	N	REMARKS		
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
3.03	Connection	h) Brazing a) Contact resistance b) Solderability c) Strength of the Brazed joint	Major	Measmnt Testing	100% "	Manufacturer's Check List for the Activity	Manufacturer's Check List for the Activity	Record "		P P P	V V V	V V V	Reviw of Records " "		
3.04	Active Part Completion	a) Dimension/Visual check b) Drying of Active part in vacuum c) Clamping of windings, core, connection etc. d) Clearance before assembly in tank e) Assembly in tank f) Assembly of accessories g) Oil filling h) MBT, Ratio test, 2 kV core bolt test	"	Visual Monito- ring Visual Testing	" " " " " " "	" " " " " " "	" " " " " " "	" " " " " " "		P P P P P P P	V V V V V V V	V V V V V V V	" " " " " " "		
4.00	FINAL INSPECTION														
4.01	Routine Test	a) Oil sample b) Voltage Ratio Test c) Vector Group & Polarity	Critical	Testing	100% " "	IS:1866-1983(R2A2) IS:2026-1977 "	IS:1866-1983(R2A2) IS:2026-1977 "	" " "	✓ ✓ ✓	P P P	W W W	W W W	CHP at manufacturer's Works "		
LEGEND:			TO BE FILLED IN BY NTPC WHILE EXTENDING APPLICABILITY TO SPECIFIC PACKAGE TO PACKAGE OF PROJECT							DOC.NO					
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		ITEM: (MATERIAL, CLASS, GRADE, RATING, SIZE ETC.) LT AUXILIARY TRANSFORMER UPTO 10 MVA, 11/6.6/0.433 kV		STANDARD QUALITY PLAN CONFORMING TO: IS:2026-1977 (R1, A3)				TO BE FILLED BY NTPC QP No. 0000-999-QOE-S-010-R0					
				DATE: 07-06-99 PAGE : 12 OF 13 VALID UP TO 06-06-2002		REVIEW BY 		APPROVED BY 					
CONTROLLED COPY													
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
									M	C	N		
1	2	3	4	5	6	7	8	9	D*	**	10	11	
4.01	Routine Test	d) Measurement of Impedance Voltage and Short Circuit Impedance at principal Tap & two extreme taps & load losses e) Measurement of winding resistance f) Measurement of No-Load losses & magnetising current at rated frequency & 90%, 100% and 110% rated voltage g) Dielectric test Power frequency/ separate source AC withstand Voltage test. h) Induced over voltage withstand test i) Measurement of iron loss (Repeat after Induced over voltage withstand test) j) Oil sample (Repeat) k) Measurement of insulation resistance l) Magnetic Balance Test	Critical	Testing	100%	IS:2026-1977	IS:2026-1977	Record	✓	P	W	W	CHP at manufacturer's Works
			"	"	"	"	"	"	✓	P	W	W	"
			"	"	"	"	"	"	✓	P	W	W	"
			"	"	"	"	"	"	✓	P	W	W	"
			"	"	"	"	"	"	✓	P	W	W	"
			"	"	"	IS:1866-1983(R2A2)	IS:1866-1983(R2A2)	"	✓	P	W	W	"
			"	"	"	IS:2026-1977	IS:2026-1977	"	✓	P	W	W	"
			"	"	"	"	"	"	✓	P	W	W	"
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SL. NO.		COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1		2	3	4	5	6	7	8	9	D*	**	10	11
4.01	Routine Test	m Oil Leakage test n) Jacking test on assembled transformer followed by D.P.Test o) Oil Sample a) Moisture b) BDV	Critical	Testing	100%	IS:2026-1977	IS:2026-1977	Record	✓	P	W	W	CHP at manufacturer's Works
4.02	Type Test	→		→	→	→	→	→					As per agreement with NTPC Engg. & Technical Specification
5.03	Pre-shipment Checks	Check on completeness of assembled transformer	"	Visual	100%	-	-			P	V	V	

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DOC.NO

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

ANNEXURE-III
DOC REQUIRED AFTER AWARD OF CONTRACT

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

SECTION ‘II’

STANDARD TECHNICAL SPECIFICATION

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1.00.00

SCOPE

1.01.00

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

1.02.00

TERMINAL POINTS

1.02.01

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

1.02.02

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

1.02.03

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

1.02.04

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

1.02.05

Transformer earthing pads.

1.02.06

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

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2.00.00 CODES AND STANDARDS

S.NO.	STANDARD NUMBER	STANDARD TITLE
1 I	S:2026 IEC: 60076	POWER TRANSFORMERS
2	IS:1180	OUTDOOR TYPE OIL IMMERSSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 kVA, 33kV - SPECIFICATION
2 I	S:6600	GUIDE FOR LOADING OF OIL IMMERSSED 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 I	S:1271 IEC: 60216	Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service
10	IS/IEC: 60529	Classification of degrees of protection provided by enclosures of electrical equipment
11 IS:	2071 IEC: 60060	Method of high voltage testing
12	IS: 5	Colours for ready mixed paints & enamels
13 NEMA,	STANDARD-TR1	Noise level
14 CBIP	Publication (latest edition)	Manual on transformers

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

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3.00.00 TECHNICAL REQUIREMENTS

- 3.01.00 Technical particulars of transformers are specified in Data Sheet –A of section-I, volume-II.
- 3.02.00 All windings shall be fully insulated. Material of the windings shall be electrolytic grade copper, free from scales and burrs. Winding shall be uniformly insulated.
- 3.03.00 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.
- 3.04.00 Internal design of transformer shall ensure that air is not trapped in any location.
- 3.05.00 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts
- 3.06.00 **Tank**
- 3.06.01 Under base of tank shall be fixed type.
- 3.06.02 Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. Tank shields, if provided, shall not resonate at natural frequency of equipment.
- 3.06.03 All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish.
- 3.06.04 Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.
- 3.06.05 At least two adequately sized inspection openings, one at the each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.
- 3.06.06 The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum.

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- 3.06.07 All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m² measured at the base of the tank.
- 3.07.00 **Tank mounting**
Tank shall also be provided with lifting lugs and minimum four jacking pads. Rollers shall be provided with holding clamp plates (04 nos), required hardware and foundation bolts etc. for each transformer.
- 3.08.00 **Oil preservation**
Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C shall be provided. The transformers rated 6.3MVA and above shall be provided with air bag breathing through silica gel breather. For lower rating transformers with conventional conservator with dry air filling of the space above oil and connected to silica gel breather shall be provided.
- 3.09.00 **Radiators**
The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank.
- 3.10.00 **Insulating Oil**
As per IS: 335. No external inhibitors are permitted.
- 3.11.00 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A of section-I, volume-II.

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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 res in 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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- 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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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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- 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 2.5mm².
- 3.20.04 The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm² 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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3.21.00 **Flux density**

Flux density in any part of the core & yoke on any tap position with $\pm 10\%$ 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 & 3.3kV winding, 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 No **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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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 provide d with anti-vibration mounting. OTI sh all have maximum reading pointer along with resett ing devic e. Fo r remote oil temperature m etering, a n independent 4-20 mA should be made available.

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

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- 4.01.13 Drain Valves.
- 4.01.14 Sampling devices.
- 4.01.15 Filter valves.
- 4.01.16 Earthing terminals – 2 Nos.
- 4.01.17 Rating & Diagram plates.
- 4.01.18 Valve schedule plate.
- 4.01.19 Two sets of lifting lugs (one for transformer with oil and other for tank cover).
- 4.01.20 Jacking pads.
- 4.01.21 Skids and pulling eyes on both sides.
- 4.01.22 Air release devices.
- 4.01.23 Inspection cover.
- 4.01.24 Oil filling hole and cap.
- 4.01.25 Tank mounted marshalling box.
- 4.01.26 Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.
- 4.01.27 Clamping arrangement for rollers.
- 4.01.28 Ground support for cable box.
- 4.01.29 Neutral CT secondary box.
- 4.01.30 Haulage facilities.

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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- 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 ± 2 deg. C or better.
- 4.05.00 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering. Such plates shall be bilingual (requirement will be finalised during detailed engineering) with Hindi inscription first, followed by English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

5.00.00 PAINTING

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

6.00.00 QUALITY ASSURANCE, TESTING & INSPECTION

- 6.01.00 BHEL's Standard QP (PE-QP-999-302-E001 Rev. 0) is enclosed as per Annexure-A of section-II, volume-II for reference. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of QP approval.
- 6.02.00 All materials, components and accessories of the transformers shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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- 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 bidders shall furnish List of sub-vendors/ makes of items for BHEL/ customer approval at contract stage. This shall not have any commercial implication to BHEL.
- 6.06.00 For acceptance of short circuit reports for tests carried out earlier on similar transformers, successful bidders shall furnish the following documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL
- 6.06.01 Calculations and design considerations to prove ability to withstand the dynamic effects of short circuit.
- 6.06.02 Short circuit test report of previously tested similar transformer for validation by comparison. Criteria for similarity of transformer for acceptance of Short circuit test report shall be as given in the Annexure-B of IEC-60076-5.
- 7.00.00 COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES**
- 7.01.00 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer as per annexure-IV of section-I, volume-II.
- 7.02.00 The bidder shall supply with the equipment, one unused complete set of all special tools & tackles required for the erection, assembly, disassembly and proper maintenance of the equipment. A list of such tools & tackles (price deemed to be included in the total bid price) shall be submitted by the bidder along with the offer as per annexure-V of section-I, volume-II.
- 7.03.00 O & M spares are those which are required for satisfactory & trouble free operation of equipment. List of O & M spares is enclosed as per Annexure-D of section-II, volume-II. O & M spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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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 P re-commissioning checks.
- 8.02.11 Co mmissioning procedures.
- 8.02.12 Withdrawal arrangement/ material handling instructions.
- 8.02.13 O peration instructions.
- 8.02.14 Main tenance instructions.
- 8.02.15 Tro uble-shooting.
- 8.02.16 Safety instructions.

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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		REV NO. : 00 DATE : 30/06/2016
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ANNEXURE - A

STANDARD QUALITY PLAN

		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			REMARKS
									P	W	V	
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 b) Surface defects c) Chemical composition d) Mechanical Properties e) Hydraulic test of pipes	Major Major Major Major Major	MEASURE VISUAL TEST TEST TEST	10% 100% - - -	'MANFUF. STD / IS:2062 / IS:1239	'MANFUF. STD / IS:2062 / IS:1239	QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC	3/2 3/2 3/2 3/2 3/2		1 2 - 2 2	
1.2	CRGO Steel	a) Thickness Dimension & Finish b) Grade of CRGO c) Cutting & burr d) Scratches, surface finish e) Waviness & edge camber f) Specific core loss g) Surface resistivity h) Stacking factor i) Permeability j) Bend test/ Ductility	Major Major Major Major Major Major Major Major Major Major	MEASURE MEASURE MEASURE VISUAL MEASURE TEST TEST TEST TEST TEST MEASURE	10% - 10% 10% 10% - - - - - -	DRG/DATA SHEET/ 'MANFUF. STD / IS:3024 / IS:649	DRG/DATA SHEET/ 'MANFUF. STD / IS:3024 / IS:649	QC Record. TC QC Record. QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 2 3/2 2 3/2 3/2 3/2 3/2 3/2 3/2		1 2 - - 1 2 2 2 2 2 2	
1.3	Paper Insulated Copper Conductor	a) Dimensions b) Resistivity/Conductivity c) Elongation d) Tensile Strength e) Proof stress if applicable f) Insulation test between strands for bunched conductors g) Cu purity of CC rod h) Chemical composition i) Surface Finish	Major Major Major Major Major Major Major Major Major	MEASURE TEST TEST TEST TEST TEST TEST TEST TEST VISUAL	100% 10% - - - - - - - 100%	'MANFUF. STD / IS:13730-P-27/IEC 60554	'MANFUF. STD / IS:13730-P-27/IEC 60554	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC QC Record.	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 2		1 1 2 2 2 2 2 2 2 2	
1.4	Insulating Paper	a) Dimensions b) Density & substance c) Tensile Strength d) Elongation e) Water absorption f) Moisture content g) pH value & conductivity aqueous extract h) Ash content i) Electrical strength j) Air permeability k) Tear index l) Heat stability	Major Major Major Major Major Major Major Major Major Major Major Major	MEASURE TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST TEST	10% - - - - - - - - - - - -	'MANFUF. STD / IS:9335-P-2/IS:9335-P-III/IEC 60554	'MANFUF. STD / IS:9335-P-2/IS:9335-P-III/IEC 60554	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2		1 2 2 2 2 2 2 2 2 2 2 2	
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE				BIDDER'S/VENDORS COMPANY SEAL						
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION												

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :				
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:				
		SHEET 2 OF 10		SYSTEM		ITEM :OIL FILLED TRANSFORMER		DOC. NO. :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	Insulation & Press-Board moulding (stock items)	a) Dimension b) Compressibility c) Density d) Tensile strength e) pH value/Conductivity of water extract f) Electrical strength in air & oil g) Shrinkage in air h) Flexibility i) Ash content j) Moisture content k) Cohesion between plies l) Elongation m) Oil absorption	Major Major Major Major Major Major Major Major Major Major Major Major	Measure Test Test Test Test Test Test Test Test Test Test Test	10% - - - - - - - - - - -	'MANUF. STD / IS:1576	'MANUF. STD / IS:1576	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2	1 2 2 2 2 2 2 2 2 2 2		
1.6	Densified wood	a) Dimension b) Surface finish c) Electrical strength in oil d) Oil absorption e) Moisture content f) Compression strength g) Crossbreaking strength h) Tensile strength i) Specific gravity/ Density	Major Major Major Major Major Major Major Major Major	Measure Visual Test Test Test Test Test Test Test	10% 10% - - - - - - -	'MANUF. STD / IS:3513	'MANUF. STD / IS:3513	QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 2 3/2 3/2 3/2 3/2 3/2 3/2 3/2	1 - 1 - - - - - -		
1.7	Gasket(Rubber Bonded Cork sheet (if applicable)	a) Dimension b) Hardness c) Tensile strength d) Compressibility e) Recovery f) Compression set g) Flexibility h) Fluid resistance test i) Chloride/Sulphate content of water extract j) Density	Major Major Major Major Major Major Major Major Major Major	Measure Test Test Test Test Test Test Test Test Test Test	10% - - - - - - - - - -	'MANUF. STD / IS:4253	'MANUF. STD / IS:4253	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2 3/2	- 1 - 1 - - - - - -		
1.8	Nitrile Rubber Cord and "O" Ring (if applicable)	a) Dimension b) Shore Hardness c) Tensile strength d) Elongation at break e) Compression set f) Accelerated Ageing in oil	Major Major Major Major Major Major	MEASURE Test Test Test Test Test	10% - - - - -	'MANUF. STD / IS:4253	'MANUF. STD / IS:4253	Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2	- - - - - -		
			PARTICULARS		BIDDER/VENDOR							
BHEL			NAME									
			SIGNATURE									
			DATE				BIDDER'S/VENDORS COMPANY SEAL					
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION												

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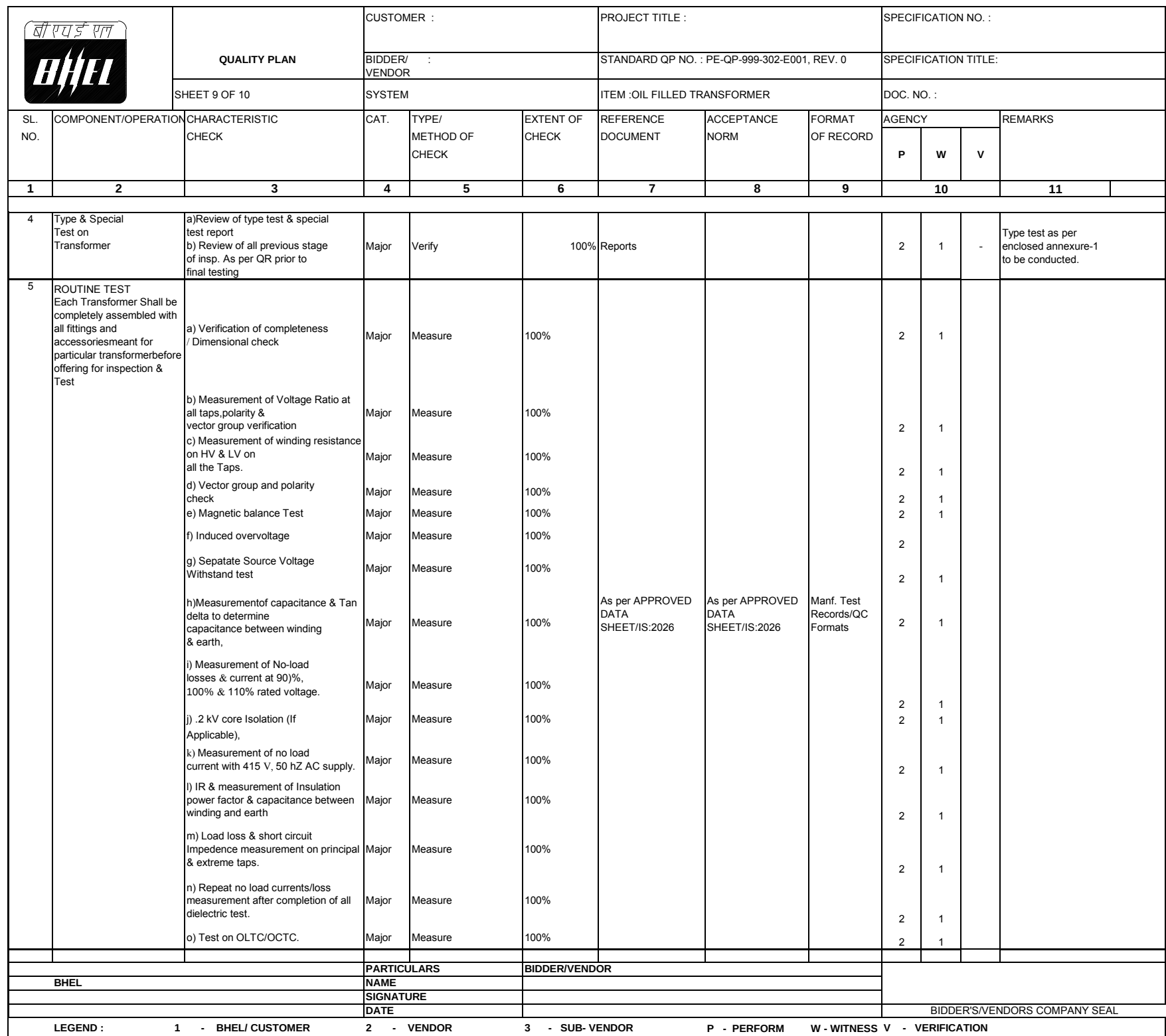
		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :				
				BIDDER/ : VENDOR		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:				
		SHEET 4 OF 10		SYSTEM		ITEM :OIL FILLED TRANSFORMER		DOC. NO. :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK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

		QUALITY PLAN SHEET 5 OF 10		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :					
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:					
				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			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.8	Gun Metal / Cast Iron Valves Gate/globe/ Butterfly)	a) Dimensional check b) Type, size & make c) Leakage test(Hydraulic test for Body & Seat) d) Operational test (close & open)	Major Major Major Major	Measure Visual Test Test Test	100% 100% - - -	Manf. Std./IS:778 Class 1	Manf. Std./IS:778 Class 1	QC Record QC Record Supplier's TC Supplier's TC	2 2 3/2 3/2	- - 2,1 2			
2.9	Bushing CT	a) Visual check/Dimensional check b) Routin test	Major Major	Measure/Visual test Test	100% -	Manf. Std./IS:2705 Manf. Std./IS:2705	Manf. Std./IS:2705 Manf. Std./IS:2705	Supplier's TC Supplier's TC	2 3/2	- 2,1			
2.10	Marshaling box/RTCC	a) Visual check for wiring b) Dimensional check c) Check for make of components d) 2 kV insulation test on auxiliary wiring e) Check for paint, shade & thickness f) Degree of Prot. By paper insertion	Major Major Major Major Major Major	Test Measure/Test Measure/Test Measure/Test Measure/Test Measure/Test	100% 100% 100% 100% 100% 100%	Drg./Manf. Std./IS:5/IS:13947	Drg./Manf. Std./IS:5/IS:13947	Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	3/2 3/2 3/2 3/2 3/2 3/2	2 2 2 2 2 2	- - - - - -		
2.11	OTI&WTI	a)Type size & make b) HV test c) Temperature calibration d) Switch setting & switch deferential e) Calibration & operation of switch	Major Major Major Major Major	Visual Test Test Test Test	100% - - - -	Manf. Std.	Manf. Std.	QC records Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2	1 2,1 2,1 2,1 2,1			
2.12	Radiator	a) Type, Model, Rating b) Dimensions & No. of elements c) Paint shade, Finish & film thickness d) Pressure test e) Adhesion test on paint f) Welding quality	Major Major Major Major Major Major	Visual Measure Measure/test Test Test Visual/ DPTTest	100% 100% 100% 100% 100% 100%	Drg./Manf. Std./IS:101	Drg./Manf. Std./IS:101	QC records QC records QC records Supplier's TC Supplier's TC	3/2 3/2 3/2 3/2 3/2	2 2 2 2 2	1 - - 1 1		
2.13	Hardware	a) Dimensional check b) Tensile strength	Major Major	Measure Test	100% -	Manf. Std.	Manf. Std.	QC records Supplier's TC	2 3/2	- -			
			PARTICULARS		BIDDER/VENDOR								
BHEL			NAME										
			SIGNATURE										
			DATE				BIDDER'S/VENDORS COMPANY SEAL						
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION													

		QUALITY PLAN SHEET 6 OF 10		CUSTOMER :		PROJECT TITLE :			SPECIFICATION NO. :			
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:			
				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			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.14	Oil Pump Motor set (if applicable)	a) Type, Model, Rating b) Dimensional check c) Hv test at 2 kV for one minute d) Input power taken by pump e) Performance test (I/P, O/P, DISCH, NO LOAD, Locked Rotor te)	Major Major Major Major Major	Visual Measure Test Test Test	100% 100% - - -	Manf. Std.	Manf. Std.	QC records QC records Supplier's TC Supplier's TC Supplier's TC	2 2 3/2 3/2 3/2		- - 2,1 2,1 2,1	
2.15	Cooling Fan (if applicable)	a) Type, Model, Rating b) Dimensional check c) HV test at 2 KV for one minute d) IR test e) Power consumption & RPM	Major Major Major Major Major Major	Visual Measure Test Test Test Test	100% - - - - -	Approved drgs/docs/spec./ IS:2312	Approved drgs/docs/spec./ IS:2312	QC records QC records Supplier's TC Supplier's TC Supplier's TC	2 2 3/2 3/2 3/2		- - 2,1 - - 2,1	
2.16	Roller Assembly	a)Dimensions b) Mechanical & Chemical properties of Raw material used for Shaft & Roller	Major Major	Measure Measure	100% -	Manf. Drg./docs	Manf. Drg./docs	QC records Supplier's TC	2 3/2		- 2	
2.17	Terminal Connector (if applicable)	a) Dimensional check b) Surface finish c) Acceptance test	Major Major Major	Measure Visual Test	100% - -	Manf. Drg./docs/IS:5561	Manf. Drg./docs/IS:5561	QC records Supplier's TC Supplier's TC	2 3/2 3/2		- 2 2,1	
2.18	Air Cell for Conservator (if applicable)	a) Dimensional check b) Surface finish c) Acceptance test	Major Major Major	Measure Visual Test	100% 100% 100%	Manf. Drg./docs/PO	Manf. Drg./docs/PO	QC records Supplier's TC Supplier's TC	2 3/2 3/2		- 2 2,1	
2.19	Oil Flow Indicator (if applicable)	a) Type, Model, Rating b) Dimensional check c) Functional test	Major Major Major	Visual Measure Test	100% 100% -	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records QC records Supplier's TC	2 2 3/2		- - 2,1	
2.20	Silicagel Breather	a) Type, Size, Model b) Pressure/ Leakage test c) Colour of silica gel	Major Major Major	Visual Test Visual	100% - -	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records Supplier's TC Supplier's TC	2 3/2 3/2		- 2 2,1	
			PARTICULARS		BIDDER/VENDOR							
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION												

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :						
				BIDDER/ VENDOR		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:						
		SHEET 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			REMARKS		
									P	W	V			
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%	Manf. Drg./stand.	Manf. Drg./stand.	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%			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 SPEC./CBIP	Appd. Doc./BHEL SPEC./CBIP	QC formate	3/2		1	
		o) Pressure test (Tank)	CR	Pressure test	1 unit each type					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%	Manf. Drg./stand.	Manf. Drg./stand.	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%			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			
PARTICULARS			BIDDER/VENDOR											
BHEL			NAME											
			SIGNATURE											
			DATE											
BIDDER'S/VENDORS COMPANY SEAL														
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION														

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :			SPECIFICATION NO. :			
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:			
		SHEET 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			REMARKS
									P	W	V	
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 (OD,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												



		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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		p) Verification of oil leakage test with all fitting & accessories at normal pressure plus 35KPA for 24 hours. q) Jacking Test followed by D.P. Test r) Paint shade & adhesion test s) Protection on M. Box by paper insertion t) 2 KV test on M.Box wiring & functional check for component of MB u) Slope and alignment of Buchholz relay v) DFT of paint	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/MAN F. STD.	As per APPROVED DATA SHEET/IS:2026/MAN F. STD.	Manf. Test Records/QC Formats	2	1		
		Major	Measure	100%	2				1			
		Major	Measure	100%	2				1			
		Major	Measure	100%	2				1			
		Major	Measure	100%	2				1			
		Major	visual	100%	2				1			
		Major	Measure	100%	2				1			
6	Pre Shipment check & Despatch	a) Transformer- verification of final transportation. b) Dew points measurement of N2/Dry gas tightness/ Pr reading (Only applicable for transformers dispatched with Gas Filling) c) Packing of loose items							2			
									2			
									2			
BHEL			PARTICULARS		BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL				
			NAME									
			SIGNATURE									
			DATE									
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION												

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
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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
<u>10.0 MVA</u>	9.0kW 72	.0kW
<u>8.0MVA</u>	7.5 kW	57.0kW
<u>7.5 MVA</u>	7.2 kW	50.0kW
<u>6.3MVA</u>	6.5kW 45	.0kW
<u>5.0MVA</u>	5.5kW	36.0kW
<u>3.5MVA</u>	4.5kW 32	.0kW
<u>2.5 MVA</u>	2.8kW	30.0kW
<u>2.0MVA</u>	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.

	TITLE :	SPECIFICATION NO. PE-SS-999-302-E001
	STANDARD TECHNICAL SPECIFICATION FOR	VOLUME NO. : II
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ANNEXURE – C

Terminal No.	Description	Remarks	Notes:
T-01	230V, Single Phase, 50Hz, AC		1). The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (ONAN cooling).
T-02	Supply		
T-03	MOG (Oil Level) Alarm		
T-04			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.
T-05	Buchholz Relay Alarm		
T-06			
T-07	Buchholz Relay Trip		3). Provide 20% spare TBs.
T-08			
T-09	PRV-1 Alarm		
T-10		If applicable	
T-11	PRV-1 Trip		
T-12			
T-13	PRV-2 Alarm		
T-14			
T-15	PRV-2 Trip		
T-16			
T-17	OTI Alarm		
T-18			
T-19	OTI Trip		
T-20			
T-21	WTI-1 Alarm		
T-22			
T-23	WTI-1 Trip		
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	CT Shorting Terminal		
T-53			
T-54	WTI 2-CT		
T-55	CT Shorting Terminal		
T-56			
T-57	LV Neutral CT (REF Protection)		
T-58	CT Shorting Terminal		
T-59			
T-60	LV Neutral CT (E/F Protection)	If applicable	
T-61			
T-62	CT Shorting Terminal		
T-63			
T-64	HV Neutral CT (REF Protection)		
T-65	CT Shorting Terminal		
T-66			
T-67	HV U-PHASE CT		
T-68	CT Shorting Terminal		
T-69			
T-70	HV V-PHASE CT		
T-71	CT Shorting Terminal		
T-72			
T-73	HV W-PHASE CT		
T-74	CT Shorting Terminal		
T-75 to T-80	SPARE TBs (for CT)		

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
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ANNEXURE – D

LIST OF O & M SPARES

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

Note:

- 1) Wherever set is indicated above, it means the total parts/ accessories required to replace the particular item for a given equipment
- 2) O & M spares shall be supplied along with transformers and packed separately with proper inscription.