

**RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.
2 x 660 MW SURATGARH SUPER CRITICAL TPS
UNIT # 7 & 8**

**TECHNICAL SPECIFICATION
FOR
OIL FILLED SERVICE TRANSFORMERS**

SPECIFICATION NO.: PE-TS-392-302-E001, (REV. 00)



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



**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMER**

**2 X 660MW SURATGARH STPS, UNIT#
7 & 8**

SPECIFICATION NO. PE-TS-392-302-E001

VOLUME II B

SECTION

REVISION 0 DATE 06.01.2015

SHEET 1 OF 1

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TOTAL NO. OF SHEETS = 88 (INCLUDING COVER/ SEPARATOR SHEETS)

**IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION IN TOTO, & THAT
THERE ARE NO TECHNICAL DEVIATIONS.**

BIDDER'S STAMP & SIGNATURE
(REFER INSTRUCTION NO. 1 OF INSTRUCTION TO BIDDERS)



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INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer:
 - a. Unpriced Price Schedule (BOQ & price schedule, as enclosed with the specification) with "Quoted" word against each item, bidder's signature and company stamp.
 - b. Datasheet-B duly filled, with bidder's signature and company stamp
 - c. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
 - d. A copy of previous sheet ("List Of Contents"), with bidder's signature and company stamp.
 - e. ("Deviation Schedule"), with "NO DEVIATION" and bidder's signature and company stamp.
2. No technical submittal such as copies of type test certificates, data Sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.
3. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.
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.
4. Any change made by the bidder in the price schedule with respect to the description / quantities, notes etc. from those given in Price schedule of specification (Schedule of prices) shall not be considered (i.e., technical description, quantities, notes etc. as per price schedule furnished by BHEL as part of specification shall prevail)

BIDDER'S STAMP & SIGNATURE



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PREAMBLE

1.0 The Tender documents contains three (3) volumes. The bidder shall meet the requirements of all three volumes.

1.1 **VOLUME - I** **CONDITIONS OF CONTRACT**

This consists of four parts as below:-

Volume – IA This part contains Instructions to bidders for making bids to BHEL.

Volume – IB This part contains General Commercial Conditions of the Tender & includes provision that vender shall be responsible for the quality of item supplied by their sub-vendors.

Volume – IC This part contains Special Conditions of Contract.

Volume – ID This part contains Commercial conditions for Erection & Commissioning site work, as applicable.

1.2 **VOLUME – II** **TECHNICAL SPECIFICATION**

Technical requirements are stipulated in Volume – II, which comprises of:-

Volume – IIA General Technical Conditions.

Volume – IIB Technical Specification including Drawings, if any.

1.3 **VOLUME – IIB**

This volume is sub-divided in to following sections:-

Section – A This section outlines the Intent of Specification

Section – B This section provides “Project Information”.

Section – C This section indicates Technical Requirements specific to Contract.

Section – D This section indicates General Technical Requirements.

Data sheet - A :- Specific data and other requirements pertaining to the equipments.

Data sheet – C :- Indicates data / documents to be furnished after the award of Contract as per agreed schedule by the vendor (as applicable)

2.0 This requirements mentioned in Section – C / Data Sheet – A shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section – D(General Technical Requirements).



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SECTION-A

SCOPE OF ENQUIRY

- 1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of OIL FILLED SERVICE TRANSFORMER as mentioned in different sections of this specification for 2 X 660 MW SURATGARH STPS, UNIT# 7 & 8
- 2.0 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.
- 3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the Technical Specification.
- 4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.
- 5.0 Deviations, if any should be brought at very clearly on deviation sheet enclosed with specification only, Otherwise it will be presumed that the bidder's offer is in line with what has been stated/ asked for in this specification.
- 6.0 The offer should be complete with technical data, catalogue, brochures and drawings as applicable.
- 7.0 The documents shall be in English language and MKS system of units.



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SECTION-B
PROJECT INFORMATION

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME II SECTION – B
	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL PROJECT INFORMATION		SHEET 1 OF 3

1.0	Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur
2.0	Consulting Engineer	TATA Consulting Engineers Ltd. 73/1, St. Marks Road, Bangalore – 560 001 Tel : 080 – 6622 6000 Fax : 080 – 22274874
3.0	Location of the plant	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan.
4.0	Latitude and longitude	Latitude : 29 deg. 10 min. N Longitude : 74 deg.01 min. E
5.0	Elevation above mean sea level	186 m (approximate)
6.0	Climatic conditions	
6.1	Temperatures : Monthly basis	
	Mean of daily max.	32.8 deg.C (in the month of May)
	Mean of daily min.	17.6 deg.C (in the month of Jan)
6.2	Temperatures : Annual basis	
	Mean of daily max.	32.3 deg.C
	Mean of daily min.	19.6 deg.C
	Highest temperature recorded	50 deg.C
	Lowest temperature recorded	(-) 2.8 deg.C
	Design Ambient Temperature for Electrical Equipment design	50 deg C
6.3	Relative humidity	Varies between 21% and 81%
6.4	Annual average rain fall	312 mm
6.5	Annual mean wind speed :	4 km / hr.
7.0	Wind load	

ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED		VOLUME II SECTION – B
	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan GENERAL PROJECT INFORMATION		SHEET 2 OF 3

	Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following:	
	a) Basic wind speed = 47 m/sec	
	b) Factor K1 = 1.07	
	c) Category of terrain = Category 2	
	d) K3 – as per IS 875	
8.0	Seismic data (As per IS: 1893 latest issue)	
	a) Zone	Zone II
	Designs & design coefficients shall be based on IS 1893:2002	
	Design condenser cooling water inlet temperature	33 Deg C
9.0	Auxiliary power supply:	
	Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following system:	
	a) For motors rated 160 kW and below.	415V AC, 3-phase, 3-wire effectively earthed.
	b) For motors rated above 160 kW and up to 1500 kW	6600V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	c) For motors rated above 1500kW	11000V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	d) For motor control centres	415V AC, 3-phase, 3/4-wire effectively earthed.
	e) DC motor starters, DC solenoids, DC alarm control and protection	220 V DC, 2-wire unearthed
	f) AC control & protective devices	110 V 1 phase, 50Hz, 2 wire AC supply. The single phase 110V AC supply shall be derived by VENDOR by providing 415V / 110 V Control transformers of adequate rating with MCCB / MCB on both the primary and secondary sides.
	g) Uninterrupted power supply	230 V, 1-phase, 50 Hz, 2-wire, AC

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SECTION - C



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-392-302-E001
SECTION C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8

1. Scope of Supply & Services:

The scope includes the design, manufacture, inspection and testing , proper packing and delivery to site of following Transformers along with fitting & accessories and 10% extra oil.

MAIN ITEMS:

S. No.	DESCRIPTION	TOTAL (Nos)
1	2000kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02
2	3500kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02
3	10 % extra transformer oil in sealed non-returnable standard drums for 2000 KVA transformers (2 nos.)	
4	10 % extra transformer oil in sealed non-returnable standard drums for 3500 KVA transformers (2 nos.)	

2. ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN RATING AND QUANTITY MAY BE TO THE EXTENT OF $\pm 30\%$ OF THE TOTAL ORDER VALUE.
3. BIDDER TO NOTE THAT IN ADDITION TO THOSE SPECIFIED IN IS:2026, ALL SPECIAL TESTS AS ROUTINE TESTS AS UNDER AS ALREADY INDICATED IN CLAUSE NO. 10.05 OF TECHNICAL SPECIFICATION NO. PE-RC-999-302-E001 DATED 28.05.2010 SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.
 - a) OIL LEAKAKE TEST FOR 24 HRS
 - b) JACKING TEST ON TRANSFORMERS LOAD BEARING MEMBER
 - c) REPEAT NO LOAD TEST AFTER ELECTRICAL TESTS
 - d) MEASUREMENT OF CAPACITANCE & TAN DELTA TO DETERMINE CAPACITANCE BETWEEN WINDING AND EARTH
4. NOS. OF DRAWINGS/ DOCUMENTS REQUIRED FROM VENDOR SHALL BE AS PER ANNEXURE-I
5. STANDARD QUALITY PLAN SHALL BE AS PER ANNEXURE-II.
6. SCHEDULE OF PRICES IS ENCLOSED (ANNEXURE-A, B, C,D,E,F).
7. SCHEDULE OF PRICES – TRANSFORMERS (ANNEXURE-A) , EXTRA OIL (ANNEXURE-B), MANDATORY SPARES (ANNEXUR-D) AND O & M SPARES (ANNEXURE-E) ALONG WITH LIST OF SPARES SHALL BE CONSIDERED FOR PRICE EVALUATION PURPOSE. TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS AS LISTED IN ANNEXURE-C SHALL BE DEEMED TO BE INCLUDED IN TRANSFORMER PRICES.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

8. TECHNICAL SPECIFICATION NO.: PE-RC-999-302-E001 DATED 28.05.2010 AND SUBSEQUENT AMENDMENTS (TECHNICAL SPECIFICATION FOR AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)) IS TO BE FOLLOWED.

PROJECT SPECIFIC AMENDMENTS WITH RESPECT TO SPECIFICATION NO. : PE-RC-999-302-E001 DATED 28.05.2010 ARE AS MENTIONED BELOW AT S. NO. 9.

9. AMMENDMENT TO SPECIFICATION NO. PE-RC-999-302-E001 DATED 28.05.2010

- I) CLAUSE NO. 10.06 A) TYPE TEST CERTIFICATES ON TRANSFORMERS OF SIMILAR TYPE AND DESIGN IN RESPECT OF THE FOLLOWING TESTS SHALL BE FURNISHED BY THE SUCCESSFUL BIDDER.
(i) ALL THE TYPE TESTS SPECIFIED IN ANNEXURE-C & ANNEXURE F OF TECHNICAL SPECIFICATION NO.: PE-TS-392-302-E001. ALL TYPE TEST SHALL BE AS PER IS-2026.

THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER WHICH SHOULD HAVE BEEN CONDUCTED ON SIMILAR TRANSFORMERS WITHIN LAST TEN YEARS. 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.

IRRESPECTIVE OF BIDDER FURNISHING VALID TYPE TEST REPORT, BIDDER TO CONDUCT ALL THE TYPE TEST/SPECIAL TEST INDICATED AT ANNEXURE-C. THESE TESTS SHALL BE CONDUCTED AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND VENDOR TO SUBMIT THE REPORTS FOR APPROVAL.

HOWEVER IF THE CONTRACTOR IS NOT ABLE TO SUBMIT REPORT OF THE TYPE TEST(S) LISTED IN ANNEXURE-F OR IN THE CASE OF TYPE TEST REPORT(S) ARE NOT FOUND TO BE MEETING THE SPECIFICATION REQUIREMENTS, THE CONTRACTOR SHALL CONDUCT ALL SUCH TESTS (EXCEPT SHORT CIRCUIT TEST) UNDER THIS CONTRACT AT NO ADDITIONAL COST TO THE EMPLOYER

- B) TYPE TESTS/ SPECIAL TESTS AS INDICATED IN SCHEDULE OF PRICES ANNEXURE-C SHALL BE CONDUCTED / CARRIED OUT ON ONE TRANSFORMER OF EACH RATING & TYPE.
C) TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS AS LISTED IN ANNEXURE-C SHALL BE DEEMED TO BE INCLUDED IN TRANSFORMER PRICES.

- 2) CLAUSE NO. 6.08.09 f) CREEPAGE DISTANCE SHALL BE MINIMUM 31mm/kV PER UNIT OF SYSTEM PHASE TO PHASE VOLTAGE.

- 3) CLAUSE NO. 6.08.09 g) CURRENT RATINGS OF THE BUSHINGS SHALL BE AS PER THE FAULT CURRENT MENTIONED IN CBIP MANUAL / IS2099.

- 4) CLAUSE NO. 6.12: FLUX DENSITY IN ANY PART OF CORE & YOKE SHALL NOT EXCEEDS 1.65 Wb/m².



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SECTION C

5) CLAUSE NO. 7.01: TRANSFORMER SHALL ALSO BE PROVIDED WITH GASKETS PROTECTION COVERING FOR CABLE BOX & MARSHALLING BOX AS FITTINGS & ACCESSORIES IN ADDITION TO THOSE WHICH ARE ALREADY MENTIONED IN CALUSE NO. 7.01.

6) Clause no. 10.01 - "BHEL'S STANDARD QP (QP NO.- PED-302-00-Q-001/01) IS ENCLOSED AS PER ANNEXURE-V" SHALL BE READ AS "BHEL'S STANDARD QP (PE-QP-999-302-E001 REV-00) IS ATTACHED AS PART OF SPEC. NO.- PE-TS-392-302-E002, REV.-00".

7) Clause no. 10.08: ALL THE TYPE TESTS LISTED IN ANNEXURE-C SHALL BE DEEMED TO BE INCLUDED IN TRANSFORMER PRICES.

8) Clause no. 10.09: CHARGES FOR CARRYING OUT SHORT CIRCUIT TEST SHALL BE PAYABLE BASED ON ACTUAL INVOICE FROM DESIGNATED LABORATORIES (CPRI, BHOPAL/ CPRI, BANGLORE / ERDA, VADODARA) WITH AN ADDITIONAL LUMP SUM AMOUNT OF 5% OF EX-WORKS PRICE OF TRANSFORMER BEING TESTED TO COVER HANDLING COSTS (TRANSPORTATION, INSURANCE ETC.). IF SC TEST IS CONDUCTED & TRANSFORMER FAILS TO PASS THE TEST, VENDOR TO REPEAT THE TEST WITHOUT ANY COMMERCIAL IMPLICATION.

9) Clause no. 10.10: THE CRITERIA FOR ESTABLISHING SIMILARITY OF TRANSFORMER FOR ACCEPTANCE OF SC TEST REPORT SHALL BE AS PER IS 60076-5 ANNEX-B. ADDITIONALLY FOLLOWING SHOULD BE SUBMITTED WITH THE SIMILARITY REPORT IF ASKED BY CUSTOMER.

- a) CALCULATION OF RADIAL BURSTING FORCE ON HV WINDING.
- b) NO. OF RADIAL SUPPORTS FOR LV WINDING.
- c) RESISTANCE TO COLLAPSE
- d) RADIATOR SIZING CALCULATION.

LIST OF ENCLOSURES

- 1. ANNEXURE-I: DOCUMENT DISTRIBUTION SCHEDULE
- 2. ANNEXURE-II: QUALITY PLAN
- 3. DATASHEET-A
- 4. CUSTOMER SPEC FOR OIL TYPE SERVICE TRANSFORMERS.
- 5. SCHEDULE OF PRICES – MAIN ITEMS (ANNEXURE-A, B, C, D, E, F).

Annex B (informative)

Definition of similar transformer

A transformer is considered similar to another transformer taken as a reference if it has the following characteristics in common with the latter:

- same type of operation, for example generator step-up unit, distribution, interconnection transformer;
 - same conceptual design, for example dry type, oil-immersed type, core type with concentric windings, sandwich type, shell type, circular coils, non-circular coils;
 - same arrangement and geometrical sequence of the main windings;
 - same type of winding conductors, for example aluminium, aluminium alloy, annealed or work-hardened copper, metal foil, wire, flat conductor, continuously transposed conductors and epoxy bonding, if used;
 - same type of main windings, for example helical-, disc-, layer-type, pancake coils;
 - absorbed power at short circuit (rated power/per unit short-circuit impedance) between 30 % and 130 % of that relating to the reference transformer;
 - axial forces and winding stresses occurring at short circuit not exceeding 120 % of those relating to the reference transformer;
 - same manufacturing processes;
 - same clamping and winding support arrangement.
-



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**ANNEXURE-I
DOCUMENTS/DRAWINGS SUBMISSION SCHEDULE**

No. of prints to be submitted by vendor after award of contract shall be as under:

S. NO.	DESCRIPTION	No. hard /soft copies	No. of CD-ROMs	REMARKS
1	Master lists of drawings/documents	PDF File + 2 Hard copies	NIL	
2	Docs. /drgs. for approval (First submission)	PDF File + 2 Hard copies	NIL	
3	Drgs. / docs. for approval (Second & subsequent submission till approval)	PDF File + 2 Hard copies	NIL	
4	Final approval drgs. / docs. for Distribution after CAT-1.	PDF File + 5 Hard Copies	NIL	
5	As Built drgs./doc.	6 Hard Copies	4 CD-ROMS	
6	Operation, Erection & Maintenance manual for approval	PDF File + 2 Hard Copies	NIL	
7	Approved Operation & Maintenance Manual for distribution	PDF File + 6 Hard Copies	4 CD-ROMS	
8	Type Test Certificates/ Reports for approval	PDF+ 2 hard Copies	NIL	
9	Type Test Certificates/ Reports for distribution	6 hard Copies	6 CD-ROMS	



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ANN-II

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

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :				
				BIDDER/ : VENDOR		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:				
		SHEET 2 OF 10		SYSTEM		ITEM :OIL FILLED TRANSFORMER		DOC. NO. :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			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 - - - - - - - - -	
1.8	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												

		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 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 Lavel 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	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		CUSTOMER :		PROJECT TITLE :		SPECIFICATION NO. :				
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0		SPECIFICATION TITLE:				
				SHEET 6 OF 10		SYSTEM		ITEM :OIL FILLED TRANSFORMER		DOC. NO. :		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			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	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														



बी एच ई एल BHEL		QUALITY PLAN	CUSTOMER :			PROJECT TITLE :			SPECIFICATION NO. :				
			BIDDER/ : VENDOR			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:				
			SHEET 8 OF 10			SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			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 assy 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													



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
4	Type & Special Test on Transformer	a)Review of type test & special test report b) Review of all previous stage of insp. As per QR prior to final testing	Major	Verify	100%	Reports			2	1	-	Type test as per enclosed annexure-1 to be conducted.
5	ROUTINE TEST Each Transformer Shall be completely assembled with all fittings and accessoriesmeant for particular transformerbefore offering for inspection & Test	a) Verification of completeness / Dimensional check b) Measurement of Voltage Ratio at all taps,polarity & vector group verification c) Measurement of winding resistance on HV & LV on all the Taps. d) Vector group and polarity check e) Magnetic balance Test f) Induced overvoltage g) Sepatate Source Voltage Withstand test h)Measurementof capacitance & Tan delta to determine capacitance between winding & earth, i) Measurement of No-load losses & current at 90)%, 100% & 110% rated voltage. j) .2 kV core Isolation (If Applicable), k) Measurement of no load current with 415 V, 50 hZ AC supply. l) IR & measurement of Insulation power factor & capacitance between winding and earth m) Load loss & short circuit Impedence measurement on principal & extreme taps. n) Repeat no load currents/loss measurement after completion of all dielectric test. o) Test on OLTC/OCTC.	Major	Measure	100%				2	1		
			PARTICULARS			BIDDER/VENDOR						
BHEL			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			
LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION												

		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												

ANNEXURE-1 TO QP

TYPE TEST	APPLICABLE (Y/N)	REMARKS
a) Measurement of winding resistance	N	
b) Measurement of voltage ratio and check of voltage vector relationship	N	
c) Measurement of impedance voltage/short-circuit impedance (principal tapping) and load loss	N	
d) Measurement of no-load loss and current	N	
e) Measurement of insulation resistance	N	
f) DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES	Y	
g) Temperature-rise	Y	
h) DGA TEST ON OIL BEFORE AND AFTER TEMPERATURE TEST	N	
i) Tests on on-load tap-changers, where appropriate	N	
SPECIAL TEST		
a) DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES	Y	
b) Measurement of zero-sequence impedance of three-phase transformers	N	
c) Short-circuit test	**	**CHARGES FOR CARRYING OUT SHORT CIRCUIT TEST SHALL BE PAYABLE BASED ON ACTUAL INVOICE FROM DESIGNATED LABORATORIES (CPRI, BHOPAL/ CPRI, BANGLORE / ERDA, VADODARA) WITH AN ADDITIONAL LUMP SUM AMOUNT OF 5% OF EX-WORKS PRICE OF TRANSFORMER BEING TESTED TO COVER HANDLING COSTS (TRANSPORTATION, INSURANCE ETC.).
d) Measurement of acoustic noise level	Y	
e) Measurement of the harmonics of the no-load current	N	
f) Measurement of the power taken by the fans and oil pumps	N	
g) Degree of Protection on Cable Box	N	
h) Degree of Protection on Marshalling Box	N	
i) PRD operation test (if PRD is applicable]	N	

ANNEXURE – 1

INSTRUCTIONS FOR QUALITY PLAN

The Quality Plan shall include all the Quality Control Measures and Checks adopted by the Vendor to ensure that the material/component/assembly/services supplied by him meet/will meet the requirements as per specifications and good practices. They shall include all stages of operation such as materials, processes, manufacture, assembly, packing and despatch. The following guide lines may be noted:

Column 1-	Serial Number
Column 2-	Component/Operation- The component and/or operation being checked shall be given here.
Column 3-	Characteristics check- The characteristics being checked shall be given here, e.g., chemical composition, mechanical properties, leak tightness, surface defects etc..
Column 4-	Category -'CR' stands for critical characteristic - affecting safety of equipment and personnel 'MA' stands for major Characteristic - affecting safety of equipment and personnel 'MI' stands for minor characteristic - affecting appearance etc.
Column 5-	Type/Method of check e.g. chemical analysis tensile testing, hydraulic test, visual examination radiography etc.
Column 6-	Extent of check, such as, 100, 10, 1 percent etc.
Column 7-	Reference Documents - Documents, such as technical specification, drawings, standard specifications (IS, BS ETC.) procedure, etc. according to which check is done.
Column 8-	Acceptance Norms - Standards etc. according to which acceptability or otherwise of the characteristics being checked is decided.
Column 9-	Format of Record - Formats, log sheets, reports, etc. in which the observations are recorded. Standard log sheets, reports, formats etc. of the Vendors shall be numbered and such reference numbers shall be included here.
Column 10-	Agency - The agency which performs the test/instruction shall be written in sub-column 'W' The agency which verifies test certificates/inspection records and carries out audit check of the components/operation shall be written in sub-column 'V'
The agencies are codified as 1,2 & 3	
'1'	stands for (BHEL)
'1' *	means the operation shall be cleared by BHEL before the start of the next operation.
'2'	Stands for Vendor
'3'	stands for sub-Vendor of the Vendor and so on.
Example :	
Entry	'3' in column 'P' means test./inspection to be performed by sub-Vendor's QC
Entry	'2' in column 'W' means test./inspection to be witnessed by Vendor's QC
Entry	'1' in column 'V' means verification shall be done by BHEL and next stage to be started only after the hold point is cleared by BHEL
Column11-	Remarks - Any special remarks shall be given here.

NOTES :

1. In absence of correlation with the test certificate(s) (e.g. material identification) samples shall be drawn bgy BHEL and all tests as per relevent specifications shall be carried out in their presence or in recognized Government Laboratory.
2. When materials and components are initially identified and stamped by BHEL QS engineer, the identification marks shall be presserved till despatch. Wherever this is not possible, the identification mark shall be transferred to the components in the presence of BHEL QS Engineer unless other wise agreed.
3. For castings and forgings integral test specimens shall be provided, When this is not possible for casting, they shall be poured in the presence of BHEL QS Engineer unless otherwise, if witnessing of test by BHEL is called for.
4. When welders qualified by reputed inspection agencies or statutory bodies are not available, qualification tests shall be conducted in the presence of BHEL QS Engineer.
5. This Quality Plan is liable to be modified as per the requirements of approved drawings and changes in technical specifications/drawings. If there are contradictions in respect of column 7 & 8 between this Quality Plan and the approved drawings specifications, the latter shall prevail.
6. Wherever inspection by BHELs Purchaser/Third Party/Statutory authorities are mandatory, this shall be compiled with.
7. Inspection reports, log sheets, test reports/certificate. etc. shall be furnished to BHEL at the appropoate stages or at the time of final inspection, as required.
8. This Quality Plan is also applicable to spares, if any, under scope of supply of Vendor.
9. **The quality plan shall be submitted in minimum 4 copies with a soft copy of the same or in line with contract requirements.**



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-392-302-E001**

**SPECIFIC TECHNICAL REQUIREMENTS
(DATA SHEET-A)**



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-392-302-E001**

11/6.9 kV

<u>S. No.</u>	<u>Description</u>	<u>Unit</u>	<u>Particulars</u>
1.0	Quantity	As per Requirement	3500 kVA 2000 kVA
2.0	Service (Unit/Station)		Unit/Station
3.0	Installation		Out Door
4.0	Type of insulating oil		Mineral
5.0	No. of phase	No(s)	03
6.0	Frequency	Hz	50
7.0	Type of cooling		ONAN
8.0	Rated output under site conditions	kVA	As indicated
9.0	Rated Voltage		
	a) HV Winding	kV	11
	b) LV Winding	kV	6.9
10.0	No Load transformation ratio		11/6.9
11.0	Vector group		
	a) 11/6.9 KV		Dyn11
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	2000 kVA : 6% 3500 kVA : 6%
13.0	Total range of tapings and tapping steps		± 5% in steps of 2.5%
14.0	Type of tap changing equipment		Off-Circuit
15.0	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
16.0	System Highest Voltage		
	a) HV Winding	kV	12
	b) LV Winding	V	7.2



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-392-302-E001**

17.0	Phase Connection	
	a) HV Winding	Delta
	b) LV Winding	Star
18.0	Insulation Levels	
18.1	One minute power frequency withstand voltage	
	a) 11 KV Winding	kV (rms) 28
	b) 6.6 KV Winding	kV (rms) 20
18.2	Impulse withstand voltage	
	a) 11 KV Winding	kVp 75
	b) 6.6 kV Winding	kVp NA
19.0	Terminal details	
	a) HV Line	Cable box
	b) LV Line	Flange Throat for TPN segregated Al Busduct (as applicable).
	c) LV Neutral on Star	One neutral as part of cable box and second neutral with copper earthing bar for system earthing brought near the base of the transformer.
20.0	System Fault Level	
	a) 11 KV Winding	44 kA RMS
	b) 6.9 KV Winding	40 kA RMS
21.0	Method of System Earthing	
	a) 11 KV System	Non effectively earthed
	b) 6.9kV System	low resistance earthed to limit earth fault current to 400A
	c) Through fault withstand time	30 Sec.
22.0	Details of Cooling Equipment	Detachable tank mounted radiators
23.0	CTs Details (Tentative) : (Final details after award of contract)	
23.1	Provision/ accommodation of CTs in Neutral on Star side	Single core 2 CT ,one for PS CLASS & other for 5P20 CT particulars shall be given to successful bidder during detail



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-392-302-E001**

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

- | | | |
|------|---------------------------------|---|
| 24.0 | Colour Shade : | |
| | a) Interior (For M. Box) | RAL 7032 |
| | b) Exterior | shade 631 of IS-5 |
| 25.0 | Space/ Layout Limitation if Any | |
| 26.0 | Cable details (Tentative) | Final details after award of contract. |
| | a) HV side | |
| | i) Type | XLPE |
| | ii) Voltage Grade | 12.0 kV Unearthed |
| | iii) Conductor material & size | Stranded Aluminum,
after the award of
contract |
| | iv) No. of cores & runs | Three core, one run |
| | b) LV side | Segregated Bus-Duct (SPB) for 6.6kV |
| 27.0 | Penalty for Losses | |
| | a) Rates for bid evaluation | N.A. |
| | b) 'A' (for no load loss) | Losses not to be exceed
maximum losses as per
cl. no.37.0 of this data sheet. |
| | ii) B' (for load losses) | Losses not to be exceed
maximum losses as per
cl. no.37.0 of this data sheet. |
| | c) Rates for penalty | Refer 6.1 (a) of customer spec |
| 28.0 | Type of winding | |
| 28. | 2000 KVA,11/6.9 KV | |
| | a) 11/6.9 kV Winding | Cont. disc |
| 29. | 3500 KVA,11/6.9 KV | |
| | a) 11/6.9 kV Winding | Cont. disc |



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-392-302-E001**

30.0 Voltage & Frequency variations (11KV/6.9V)

- a) Voltage (V+/- 10%)
- b) Frequency (f+/-5%)
- c) V & f (10% sum of absolute value)

31.0 2 independent sets of 4-20mA signals to be made available at marshalling box for display of winding temperature & oil temperature for remote display on DDCMIS.

32.0	TYPE OF VOLTAGE VARIATION	CFVV
33.0	OVERFLUXING CAPABILITY	110% CONTINUOUS
34.0	WINDING INSULATION TYPE	
	a) HV WINDING	UNIFORM
	b) LV WINDING	UNIFORM
35.0	CLEARANCE IN AIR BETWEEN PHASES	AS PER IS
36.0	CREEPAGE DISTANCE	31mm/kV

37.0 TRANSFORMER LOSSES

- a) The No-Load and Load losses for transformers are given below:

11KV/6.9V TRANSFORMERS

	<u>3.5MVA</u>	<u>2.0MVA</u>
Maximum No-Load losses at rated frequency and 100%voltage	4.5kW	2.4kW
Maximum Load losses at normal ratio, rated current and 75 deg. C	30 kW	22.0kW

- b) 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.
- c) Above indicated lossess are applicable if the losses are not indicated in CBIP.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

PRICE SCHEDULES



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

ANNEXURE-A**AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)****2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8****SCHEDULE OF PRICES – TRANSFORMERS**

S. No	DESCRIPTION	TOTAL (Nos)	UNIT PRICE Rs.	TOTAL PRICE Rs.
1	2000kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02		
2	3500kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02		

NOTES

1. ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN RATING AND QUANTITY MAY BE TO THE EXTENT OF $\pm 30\%$ OF THE TOTAL ORDER VALUE.
2. BIDDER TO NOTE THAT THE COST OF TRANSFORMER SHALL INCLUDE THE COST OF FOLLOWING SPECIAL TESTS AS ROUTINE TESTS:
 - a) OIL LEAKAGE TEST FOR 24 HRS
 - b) JACKING TEST ON TRANSFORMERS LOAD BEARING MEMBER
 - c) REPEAT NO LOAD TEST AFTER ELECTRICAL TESTS
 - d) MEASUREMENT OF CAPACITANCE & TAN DELTA TO DETERMINE CAPACITANCE BETWEEN WINDING AND EARTHTHE ABOVE MENTIONED TEST SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.
3. THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER WHICH SHOULD HAVE BEEN CONDUCTED ON SIMILAR TRANSFORMERS WITHIN LAST TEN YEARS. 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.

IRRESPECTIVE OF BIDDER FURNISHING VALID TYPE TEST REPORT, BIDDER TO CONDUCT ALL THE TYPE TEST/SPECIAL TEST INDICATED AT ANNEXURE-C. THESE TESTS SHALL BE CONDUCTED AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND VENDOR TO SUBMIT THE REPORTS FOR APPROVAL
4. TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS AS LISTED ANNEXURE-C SHALL BE DEEMED TO BE INCLUDED IN TRANSFORMER PRICES. THESE TESTS ARE:
 - a) TANK PRESSURE TEST
 - b) TANK VACUUM TEST



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

- c) MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1
- d) TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES.
- e) DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

ANNEXURE-B

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)

2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8

SCHEDULE OF PRICE - EXTRA OIL

S. NO.	DESCRIPTION	QTY. OF TRANSFORMERS	COST OF 10% EXTRA OIL PER TRANSFORMER	TOTAL COST OF 10% EXTRA OIL
	10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR			
1	2000kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02		
2	3500kVA, 11kV/6.9kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.0%, Dyn11, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	02		

Note:

Bidder shall supply 10% extra oil as per the quoted price. Quantity of extra oil shall be subject to approval during detail engineering.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-392-302-E001
SECTION C

ANNEXURE-C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8

LIST OF
TYPE TESTS/ SPECIAL TESTS ON TRANSFORMERS

S.NO	DESCRIPTION	11.0/6.9kV	11.0/6.9kV
		3500kVA	2000kVA
1	TANK PRESSURE TEST	APPLICABLE	APPLICABLE
2	TANK VACUUM TEST	APPLICABLE	APPLICABLE
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	APPLICABLE	APPLICABLE
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES.	APPLICABLE	APPLICABLE
5	DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES	APPLICABLE	APPLICABLE

NOTE:-

a) THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER WHICH SHOULD HAVE BEEN CONDUCTED ON SIMILAR TRANSFORMERS WITHIN LAST TEN YEARS. 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.

IRRESPECTIVE OF BIDDER FURNISHING VALID TYPE TEST REPORT, BIDDER TO CONDUCT ALL THE TYPE TEST/SPECIAL TEST INDICATED AT ANNEXURE-C .THESE TESTS SHALL BE CONDUCTED AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND VENDOR TO SUBMIT THE REPORTS FOR APPROVAL

b) TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS AS LISTED IN ANNEXURE-C SHALL BE DEEMED TO BE INCLUDED IN TRANSFORMER PRICES.

c) BIDDER TO NOTE THAT NO SEPARATE TYPE TEST CHARGES SHALL BE PAYABLE .



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

ANNEXURE-D**AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)****2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8****SCHEDULE OF PRICES – MANDATORY SPARES**

S. NO.	DESCRIPTION	QTY.	UNIT PRICE (Rs)	TOTAL PRICE (Rs)	REMARKS
1	HV bushing with metal parts & gaskets	1 no each type			
	a) 11.0/6.9kV, 3500KVA	1 no.			
	b) 11.0/6.9kV, 2000KVA	1 no.			
2	LV bushing with metal parts & gaskets	1 no each type			
	a) 11.0/6.9kV, 3500KVA	1 no.			
	b) 11.0/6.9kV, 2000KVA	1 no.			
3	Neutral bushing with metal parts & gaskets	1 no each type			
	a) 11.0/6.9kV, 3500KVA	1 no.			
	b) 11.0/6.9kV, 2000KVA	1 no.			
4	WTI	1 set			
	a) 11.0/6.9kV, 3500KVA	1			
	b) 11.0/6.9kV, 2000KVA	1			
5	OTI	1 set			
	a) 11.0/6.9kV, 3500KVA	1			
	b) 11.0/6.9kV, 2000KVA	1			



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

6	EXPLOSION VENT DIAPHRAGM/ PRV	1 no. of each type			
7	Magnetic oil gauge	1 no. of each type			
8	Buchholz relay	1 no. for each			
9	Set of gaskets	1 set			
10	Set of valves	1 set			
11	SILICA GEL BREATHER	1 no.			

NOTES

WHEREVER 'SET' IS INDICATED ABOVE, IT MEANS THE TOTAL PARTS / ACCESSORIES REQUIRED TO REPLACE THE PARTICULAR ITEM FOR A GIVEN EQUIPMENT.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-392-302-E001

SECTION C

ANNEXURE-E

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)

2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8

O & M SPARES

NOTES:

LIST OF O & M SPARES FOR 3 YEARS OPERATION SHALL BE SUBMITTED BY BIDDERS.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-392-302-E001
SECTION C

ANNEXURE - F

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 660 MW SURATGARH STPS, STAGE V, UNIT 7 & 8
LIST OF
TYPE TESTS/SPECIAL TESTS ON TRANSFORMERS

SL. NO.	DESCRIPTION	11.0/6.9kV	11.0/6.9kV
		2000 KVA	3500 KVA
1	PRD OPERATION TEST(APPLICABLE FOR 2000kVA & 2500kVA TRANSFORMER)	APPLICABLE	APPLICABLE
2	DEGREE OF PROTECTION (IP 55) TESTS ON MARSHALLING BOX	APPLICABLE	APPLICABLE
3	DEGREE OF PROTECTION (IP 55) TESTS ON CABLE BOX.	APPLICABLE	APPLICABLE
4	DGA TEST ON OIL BEFORE AND AFTER TEMPERATURE RISE TEST	APPLICABLE	APPLICABLE
5	CAPACITANCE AND TAN DELTA OF WINDINGS	APPLICABLE	APPLICABLE
6	MEASUREMENT OF HARMONICS CURRENT IN NO LOAD CURRENT	APPLICABLE	APPLICABLE
7	ZERO SEQUENCE IMPEDANCE	APPLICABLE	APPLICABLE
8	SHORT CIRCUIT TEST**	APPLICABLE	APPLICABLE

NOTE:

- 1 THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER WHICH SHOULD HAVE BEEN CONDUCTED ON SIMILAR TRANSFORMERS WITHIN LAST TEN YEARS. 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.

HOWEVER IF THE CONTRACTOR IS NOT ABLE TO SUBMIT REPORT OF THE TYPE TEST(S) CONDUCTED WITHIN LAST TEN YEARS FROM DATE OF BID OPENING, OR IN THE CASE OF TYPE TEST REPORT(S) ARE NOT FOUND TO BE MEETING THE SPECIFICATION REQUIREMENTS, THE CONTRACTOR SHALL CONDUCT ALL SUCH TESTS (LISTED UNDER S.NO 1 TO 7, EXCEPT SHORT CIRCUIT TEST) UNDER THIS CONTRACT AT NO ADDITIONAL COST TO THE EMPLOYER

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

SECTION D8-1

OIL TYPE SERVICE TRANSFORMERS

SPEC. NO. TCE.5750A-H-500-001	TATA CONSULTING ENGINEERS LIMITED	VOLUME IV SECTION: D8-1
PART B	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan OIL TYPE SERVICE TRANSFORMERS	SHEET 1 OF 5

1.0 GENERAL

1.1 Service Transformers required for Construction supply shall be oil filled and outdoor type. The final quantities and rating of these Transformers shall be decided based on the requirement of the construction works. Please refer to Construction Power SLD (TCE.5750A-EL-SK-2004) for further details. The transformers shall generally comply with specific requirements as follows:

1.2 The service transformers shall be three-phase, two winding, 33000/11500V, 11000/433V; ONAN cooled with off-circuit taps of +/- 5% in steps of 2.5% on HV side. The transformers shall be suitable for outdoor applications having Dyn11 Vector group. The star point shall be solidly earthed.

1.3 The impedance of the transformers shall be chosen such that the fault level does not exceed 50 kA on 415V switchgear including the motor contributions and also voltage dip at the Motor terminals, while starting any auxiliary does not exceed the limit acceptable for the equipment concerned but not exceeding 15%. *Refer Datasheet-A of SECTION C*

1.4 In case of single core cable termination, gland plate shall be of aluminium.

1.5 Transformer shall operate without injurious heating, at rated MVA at any voltage within 110% of rated voltage of that particular tap.

1.6 Transformers shall be capable of delivering the rated current, at a voltage equals to 115% of rated voltage without exceeding rated temperature rise.

1.7 Transformer shall operate below the knee of the saturation curve at 110% voltage to preclude ferro resonance and non-linear oscillations.

Refer Datasheet-A of section C
1.8 Transformers and accessories shall be designed for fault levels indicated in 11kV and 415V switchgear specifications. Dynamic ability and thermal ability to withstand the short circuit force shall be demonstrated by tests / calculations.

1.9 Noise level shall not be more than the values specified as per NEMA TR-1.

1.10 The transformers shall be designed with particular attention to suppress harmonic voltage, especially third and fifth, so as to eliminate wave form distortion

2.0 MVA RATING

2.1. The three-phase 415 V power supply for construction power supply shall be derived from 33kV/11.5kV & 11kV / 433V oil type auxiliary service transformers.

2.2. The Quantity and rating of the 33000/11500V & 11000/ 433 V service Transformers shall be based on the actual load figures. The maximum rating of the 11000/ 433 V transformers shall be limited to 2.5 MVA. In case the 11000/ 433 V transformer rating cannot be limited to 2.5 MVA then 3 X 50 % rated Transformers or 4 X 50 % rated Transformers shall be provided. Each

**ISSUE
R1**

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transformer shall be rated to take care of the entire load on the respective switchgear considering the outage of the other transformer. An appropriate load factor with a minimum of 0.9 for continuously running loads and 0.2 for intermittent loads like valve actuators, dampers, cranes, plug points, elevator etc., shall be considered. The rating established shall be taken into account, load variations during the course of engineering.

3.0 SPECIFIC REQUIREMENTS

The transformer shall generally comply with all following specific requirements

- (a) The tank cover shall be conventional one with bolted joint at the top
- (b) The transformers shall be provided with detachable built on radiators of adequate number.
- (c) Off-circuit tap changers with lockable operating handle and mechanical tap position indicator shall be provided.
- (d) Pressure relief device shall be provided.
- (e) Conservator need not be sealed expansion type.
- (f) The wheels shall be flat roller type
- (g) The transformer shall be suitable for cable/bus duct connection for HV and LV side.
- (h) If bus ducts are used a flanged bushing connection shall be provided to suit the bus-duct. The winding terminations shall be brought out on outdoor type of bushings. If cables are used the neutral of the LV side of the transformer shall be brought out in a separate cable box or if the same cable box is used for neutral also, then metallic partition between phases and neutral shall be provided.
- (i) OTI/WTI/PRD/MOG etc... Transformer mounted protective devices shall be provided and wiring from all devices mounted on transformer such as PRD, OTI, WTI etc. shall be brought to one terminal box with cables for connection to plant protection and controls. The cables should not touch transformer body to avoid heating.
- (j) The HV and LV winding of all transformers shall be brought out through suitably rated bushing mounted on non magnetic material in separate air insulated cable box with disconnecting chambers. The cable box shall also be provided with facility for supporting from ground.
- (k) Necessary lifting lugs, jacking pads, and pulling eyes shall be provided capable of lifting and skidding of transformers.
- (l) Each radiator bank shall be provided independently mounted with inlet and out let valves to enable replacement of radiator with transformer in service.

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(m) The rating and nameplate shall contain all details as per IS 2026. In addition, following details shall also be included. i) Connection diagram showing internal connections. ii) Temperature rise iii) Insulation level of windings iv) Transportation weight. v) Untanking weight. vi) Core and winding weight. vii) Table showing tapping voltage, tapping current, Taping power for each winding. viii) Values of short circuit impedance on extreme tapping and on principle tapping and an indication of the winding to which impedance is related. 4.0 <u>MATERIALS OF CONSTRUCTION AND DESIGN :-</u> 4.1. <u>CORE:-</u> Core shall be constructed with high-grade cold rolled non-ageing grain oriented silicon steel. The flux density shall not exceed 1.65 Wb/m^2 at rated voltage. Each lamination shall have insulated coating. The insulated structure for core to bolts and core to clamp plates shall withstand 2.0 KV for 01 minute. The core clamping structure shall be designed to minimise eddy current losses. The core shall be provided with lugs for lifting of core with coils. The core and coil assembly shall be rigidly fixed to avoid their shifting during transport or short circuit. 4.2. <u>WINDING:-</u> Winding shall be of copper unless and otherwise specified. Permanent current carrying connection in the winding shall be brazed or welded. The coils shall be properly supported and shall be subjected to seasoning process so that further shrinkage should not occur during service. 4.3. <u>TANK:-</u> The tank shall be made from good commercial grade low carbon steel and shall be of welded constructions with suitable lugs and bosses for lifting and shifting. Tank together with accessories shall be designed to withstand full vacuum of 760mm of HG and Internal gas pressure of 0.35 KG/CM²l. Top cover shall be bolted type to remove the core and winding at site. Manholes with bolted covers shall be provided in the top / side of transformer for access to lower end of bushings, tap changers and to permit replacement of auxiliaries without removal of top covers.		
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Adequate space shall be provided at bottom for collection of sediments. At the bottom, wheels shall be provided for skidding with pulling eyes. All the gasket shall be of cork neoprene or better type and all gasketed joints shall be so arranged that gaskets shall not be exposed to weather. Valves of forged carbon steel up to 50mm and of gunmetal or of cast iron bodies with gun metal fittings above 50mm shall be provided. 4.4. <u>BUSHINGS :-</u> All the bushing shall be of porcelain type. Bushing rated for 400A and above shall have non-ferrous flange and hardware. 5.0 <u>LOSSES</u> 5.1. The Maximum Guaranteed values of No load, Load losses and Cooler losses indicated in the bid shall be at rated name plate rating of the Transformer and inclusive of positive tolerance as per IS-2026. 5.2. Transformer losses shall be limited to the values specified in CBIP manual No. 295 for Transformers (March 2006) with tolerance limit specified therein. 6.0 <u>PENALTY & REJECTION CRITERIA</u> 6.1. The criteria for imposing penalty and for rejection of any transformer is as follows: if during tests or service any of the following conditions arise: (a) At the time of testing of transformers (shop test), if total (No Load losses+ Load Losses + Cooler Losses) exceeds the maximum guaranteed value (including tolerance, if any) prescribed in CBIP manual, by a value up to and including 10% penalty shall be imposed @ Rs. 4.50 Lacs per KW, for the losses exceeding the maximum guaranteed values indicated in the bid. However, if Total Transformer losses measured during testing of transformers (shop test) exceeds the maximum guaranteed value (Indicated in the technical bid) by more than 10%, the transformer shall be rejected. 6.2. The PURCHASER may reject any transformer if during tests or service any of the following conditions arise: (a) Impedance value exceeds the guaranteed value of $\pm 10\%$ or more. (b) The difference in impedance values of any two phases during single-phase short circuit impedance test exceeds 2 percent of the average value guaranteed by the VENDOR. (c) Oil or winding temperature rise exceeds the specified value by 50C. (d) Transformer fails on impulse test (e) Transformer fails on power frequency voltage withstand test. ISSUE R1		

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(f) Transformer is proved to have been manufactured not in accordance with the agreed specification.

(g) The PURCHASER reserves the right to retain the rejected transformer and take it into service until the VENDOR replaces, at no extra cost to the PURCHASER, the defective transformer by a new transformer.

(h) Alternatively, the CONTRACTOR shall repair or replace the transformer within a reasonable period to the OWNER's satisfaction at no extra cost to the OWNER.

7.0 CRITERIA FOR TRANSFORMER LOSSES EVALUATION

7.1. The lowest value of the total loss (No load + load + cooler) inclusive of the positive IS tolerance indicated by the bidders shall be considered as the base value for evaluation. A figure of Rs.3.0 Lacs per kW shall be applied for cost loading/evaluation purpose. The difference between the Maximum Guaranteed loss indicated by the bidder in kW and the base value shall be multiplied by 3.0 Lacs to arrive at the cost loading for evaluation purpose

8.0 TESTS

8.1. For type tests valid type test certificate shall be submitted. If valid test certificate is not available then type test shall be carried out on each type of transformer.

8.2. Routine test as per relevant standards shall be conducted on all transformers including transformer for used for construction supply.

9.0 CODES & STANDARDS

Refer Section-D28 for the requirements.

10.0 For technical particulars refer datasheet-A.

Refer Clause No. 09 of Section C. for type tests.

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SECTION D28

CODES AND STANDARDS

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	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
In the event of conflict between the codes and standards referred below and the specification included in tender documents, the stringent requirement shall be considered.					
A.	TRANSFORMERS				
1.	Power Transformer	2026	171	176	
2.	Fittings and accessories for Power Transformer	3639			
3.	Distribution transformer	1180			
4.	Loading of oil immersed transformer	6600	CP:1010	354	
5.	Oil	335	148	296	
6.	Bushing for > 1000V, AC	2099	223	137	
7.	Bushing for ≤ 1000V, AC	7421			
8.	Dry type transformers	11170			C-75.12.01
9.	Buchholz relay	3637			
10.	Pulse transformer	6297	2214		
11.	Reactor	5553	60289	60289	
12.	Code of practice for Selection, Installation and Maintenance	10028-1			
13.	Neutral earthing transformer	3151	171 / BSEN 60076	60076	
B.	SWITCHGEARS				
1.	LV Switchgear and control panel	13947	7354		
2.	Degree of protection for LV Switchgear	2147		144 / 947	
3.	Factory built assemblies of low voltage switchgear and control gear	13947		439	

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TECHNICAL SPECIFICATION
FOR
OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO.: PE - RC - 999 - 302 - E001

REV. NO. 00



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

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		VOLUME NO. : II-B
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SECTION ‘A’

SCOPE OF ENQUIRY



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SCOPE OF ENQUIRY

- 1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS**.
- 2.0 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.
- 3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the tender specification.
- 4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.
- 5.0 Bidders shall confirm total compliance to the specification without any deviation from the technical/ quality assurance requirements stipulated



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SECTION 'D' GENERAL TECHNICAL REQUIREMENTS



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1.00 INTENT OF SPECIFICATION

- 1.01 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 The intent of specification is not to specify all details of design & construction of equipment. The equipment shall, however, conform in all aspects to high standard of design, engineering and workmanship and be capable of performing in continuous operation upto & after bidder's guarantee period in manner acceptable to purchaser who will interpret the drawings & specification and shall have power to reject any work or material which in his judgement is not in full accordance with this specification.

2.00 CODES AND STANDARDS

- 2.01 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.
- 2.02 The design, material, construction, manufacture, inspection, testing and performance of LT Service Transformers shall conform to the currently applicable standards and codes of practices as per Annexure-VIII. General design, electrical & constructional features and various fittings & accessories shall be as per CBIP manual on Transformers Publication No. 275 (latest edition).
- 2.03 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.00 SCOPE OF ENQUIRY

- 3.01 Bidder shall quote for mineral oil filled LT Service Transformers including 10% spare oil in accordance with various sections of this specification. The transformer shall be provided with all fittings & accessories (including foundation hardware) & shall be complete in all aspects, for satisfactory operation, in accordance with this specification & technical particulars. Design ambient temperature shall be 50 deg. C. Project information shall be given separately for the specific project.
- 3.02. Bidder shall quote for following equipment & services:
1. Transformers (Rating & quantity of transformers shall be as per specific project requirement).

- 6.02 Equipment shall give continuous service under specified site conditions.
- 6.03 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.



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

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

6.06 Underbase of tank shall be fixed type.

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

6.08 Specific technical requirements are as follows:

6.08.01 Tank Fabricated from tested quality steel and designed to withstand continuous internal pressure of 35 kN per sq. m. over normal pressure as well as short circuit forces. The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish. Tank shields, if provided, shall not resonate at natural frequency of equipment.

6.08.02 Tank mounting Transformer tank shall be mounted on bi-directional rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. 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.

6.08.03 Tank openings At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections.

6.08.04 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.



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- 6.08.05 **Radiators** Tank mounted with shut off valves.
- 6.08.06 **Insulating Oil** As per IS: 335. No external inhibitors are permitted.
- 6.08.07 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A.
- 6.08.09 **Bushings/ Insulators**
- 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 can be acceptable .
 - For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.
 - The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.
 - Clamps and fittings of steel or malleable cast iron shall be galvanised.
 - Where bushing current transformer is provided, the bushing shall be mounted so that it can be removed and replaced without disturbing the current transformers. CTs shall be cast resin type & suitable for operation at ambient temperature existing at its location on the transformer.
 - Creepage distance shall be minimum 25mm/ kV per unit of system phase to phase voltage.
 - Minimum rated current for bushings shall be as under:
 - H V Bushing for 11kV & 6.6kV
 - 10.0MVA= 1000A
 - 8.0MVA = 1000A
 - 6.3MVA = 800A
 - 5.0MVA = 630A
 - 3.5MVA = 250A
 - 2.5 MVA = 250A
 - 2.0 MVA = 250A
 - 1.6 MVA = 250A
 - 1.0 MVA = 100A
 - 630 kVA = 100A
 - H V Bushing for 3.3kV
 - 2.5 MVA = 630A

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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
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

6.08.10 Cable Box

a) 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. Suitable cable glands (double compression type) and lugs shall be provided for cable termination.

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

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

d) Creepage distance and clearances in air shall be as per CBIP manual.

e) 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.

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

g) 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.

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6.08.11 Busduct Termination

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

6.08.12 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.

6.09 Neutral CT

Bidder to provide neutral bushing CT as per details given in data sheet - A 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. CTs shall be cast resin type. CT mounted inside the tank shall not be acceptable.

6.10 Voltage control (off circuit type)

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

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	6.11 Marshalling box a) Tank mounted vermin and dust proof marshalling box shall be provided. b) The marshalling box shall be fabricated using sheet steel of at least 2.5mm thickness. The marshalling box shall have domed or sloping roof. c) 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. d) The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm² stranded copper wire. At least 20% spare terminals shall be provided. e) The marshalling box shall be provided with thermostatically controlled space heaters and shall have IP:55 degree of protection. f) CT terminals shall be with shorting and disconnecting facility. 6.12 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/m². 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 6.13 Winding For 11KV & 3.5KV winding, type of winding shall be continuous disc & for 433 winding, type of winding shall be spiral type. 6.14 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. 6.14 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds.	

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Calculation shall be furnished by the bidder during contract engineering stage to substantiate the adequacy of support system to withstand short circuit forces.			
6.15 Maximum Transformer losses including tolerances shall be as per annexure – III.			
6.16 LOADING CAPABILITY			
Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of ± 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IEC 354/IS: 6600.			
7.0 Fittings & accessories			
7.01 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:			
a) Conventional type conservator with drain plug and oil filling hole.			
b) Magnetic oil level gauge with low-level alarm contact.			
c) Prismatic & toughened glass oil level gauge.			
d) Silica gel breather with oil seal.			
e) Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.			
f) Diaphragm type explosion vent for transformers of rating less than 2MVA			
g) Pocket on tank cover for thermometer.			
h) Protected type mercury in glass thermometer.			
i) Dial type (150 mm) Oil temperature indicator (OTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The OTI shall be provided with anti-vibration mounting. OTI shall have maximum reading pointer along with resetting device. For remote oil temperature metering, an independent 4-20 mA should be made available.			
j) 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.			
k) Drain Valves.			
l) Sampling devices.			
m) Filter valves.			
n) Earthing terminals – 2 Nos.			
o) Rating & Diagram plates.			
p) Valve schedule plate.			
q) Two sets of lifting lugs (one for transformer with oil and other for tank cover).			
r) Jacking pads.			
s) Skids and pulling eyes on both sides.			
t) Air release devices.			

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u) Inspection cover. v) Oil filling hole and cap. w) Tank mounted marshalling box. x) Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism. y) Clamping arrangement for rollers. z) Ground support for cable box. aa) Neutral CT secondary box. bb) Haulage facilities. cc) 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. dd) Gas collection device along with all accessories. 7.02 Breather shall be fitted at a height not exceeding 1.5 M. 7.03 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level. 7.04 The WTI and OTI shall have accuracy class of ± 2 deg. C or better. 7.05 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering. Such plates shall be bi- lingual with Hindi inscription first, followed by English. Alternatively, two separate plates with Hindi & English inscription shall be provided. 8.00 PAINTING Paint shade shall be informed to successful bidder during detail engineering as applicable for specific project. Successful bidder shall furnish painting specification/ procedure to be used for BHEL/ CUSTOMER approval during detailed engineering. 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. 9.00 COMMISSIONING, O & M SPARES AND SPECIAL TOOLS & TACKLES 9.01 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer 9.02 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-I.		

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9.03 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.

10.00 QUALITY ASSURANCE, TESTING & INSPECTION

10.01 BHEL's Standard QP (QP NO. PED-302-00-Q-001/01) is enclosed as per Annexure-V for reference. However, at contract stage, the successful bidder shall submit the QP for BHEL/ ultimate customer's approval. 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 implication to BHEL on account of QP approval.

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

10.03 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.

10.04 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers. Charges for all these routine and acceptance tests for all the equipments & components shall be deemed to be included in the bid price.

10.05 Additionally, the bidder shall include in his equipment price the cost of carrying out the following special tests as routine tests on all the transformers:

- 1) Oil Leakage test for 24 hours
- 2) Jacking test on transformer's load bearing members.
- 3) Repeat no load loss tests after electrical tests.
- 4) Measurement of capacitance & tan delta to determine capacitance between winding & earth.

10.06 Type tests & special tests shall be conducted on one transformer of each rating and type as per Annexure-II. The charges for each of the type test & special test shall be quoted in "Schedule of Prices –Type/special Tests on Transformers". These charges shall also be applicable in case of waiver of any type test/special test by the purchaser at a later date.

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



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10.08 All type tests except Short circuit test shall be considered for price comparisons purpose.

10.09 Charges for carrying out Short circuit test shall be payable based on actual invoice from the designated laboratories (CPRI, Bhopal / CPRI, Bangalore / ERDA, Vadodara) with an additional lump sum amount of 5% of ex-works price of transformer being tested to cover handling costs (transportation, insurance etc.).

10.10 The criteria for establishing similarity of transformer for acceptance of Short circuit test report is as follows :

Bidder to furnish calculations and design considerations to prove ability to withstand the dynamic effects of short circuit.

This shall be supported by 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-A of IEC-60076-5 of clause no.4.2.1.

]

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11.00 DRAWINGS, DATA & DOCUMENTS TO BE SUBMITTED

11.01 Following shall be submitted along with the offer:

- a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.
- b) Clause – wise deviation, if any.
- c) Out line General Arrangement Drawings for each rating & type of transformer.
- d) Foundation plan drawing for each rating & type of transformer.**

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

- a) The enclosed Data Sheet – C duly filled up.
- b) Vendor Drawing submission schedule.
- c) Design calculations for short circuit withstand capability (refer cl.6.14 & cl 10.10)
- d) Overall General Arrangement Drawing clearly showing all fittings, accessories, termination details, foundation details with roller locking arrangement.
- e) General Arrangement of Marshalling Box.
- f) Rating & Diagram Plate Drawing.
- g) Valve Schedule Plate Drawing.
- h) Cable Box Arrangement Drawing.
- i) Bushing/ Insulator Drawings.
- j) Busduct Trunking Drawings.
- k) Quality Plan.
- l) Type test procedure
- m) Wiring Diagrams.
- n) Type/ Special Test certificates for tests already carried out on similar transformers.
- n) Painting procedure of vendor for approval of customer.
- o) Recommended Field Quality Plan
- q) Routine test reports
- r) O & M Manuals

The documents listed at sl. no. a),b) & c) shall be submitted by successful bidder within 2 weeks from L.O.I while documents sl. no. d) through o) shall be submitted by successful bidder within 4 weeks from L.O.I.

No. of documents/ drawings required shall be as per “Documents/ Drawings Distribution Schedule” enclosed as per Annexure-IV.

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12.00 O & M MANUALS

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

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

- a) General description of equipment.
- b) Approved Technical Data Sheet
- c) Salient constructional features.
- d) Technical leaflets of fittings/ important parts.
- e) All drawings.
- f) Type and routine test certificates.
- g) Instructions to be followed on receipt of equipment at site & for storage.
- h) Instructions for foundation arrangement.
- i) Erection procedures and checks.
- j) Pre-commissioning checks.
- k) Commissioning procedures.
- l) Withdrawal arrangement/ material handling instructions.
- m) Operation instructions.
- n) Maintenance instructions.
- o) Trouble-shooting.
- p) Safety instructions.

13.00 All drawings/ documents indicated at clause no. 11 & 12 above shall be computer generated. Drgs. / documents shall be required in soft form (PDF format) also. All drawings shall be prepared in AUTOCAD latest version. Drawings & documents shall be submitted in CD also. The number of copies of various drawings/ documents shall be as per Annexure -IV.



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ANNEXURE I

LIST OF O & M SPARES

Please refer
Annexure-E in
price schedule

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	OII 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.



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~~ANNEXURE-II~~

Please refer Annexure-C
and Annexure-F in
price schedule

TYPE/SPECIAL TESTS FOR OIL FILLED SERVICE TRANSFORMERS

- a) Tank Pressure test
- b) Tank Vacuum test
- c) Capacitance & tan delta of windings
- d) Noise level
- e) Measurement of harmonic current in no load current
- f) PRD operation test (applicable for 2000kVA & 2500kVA transformer)
- g) Short circuit test
- h) Degree of protection (IP55) test on marshalling box.
- i) Degree of protection (IP55) test on cable box.
- j) Zero sequence impedance.
- k) Temp rise test
- l) Dielectric type test (including chopped wave impulse test)
- m) DGA test on oil before and after temperature test.

Please refer Annexure-C & Annexure-F in price schedule



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ANNEXURE III
TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers are given below:

	<u>10.0 MVA</u>	<u>8.0MVA</u>	<u>6.3MVA</u>	<u>5.0MVA</u>	<u>3.5kVA</u>
Maximum No-Load losses at rated frequency and 100%voltage	9.0kW	7.5 kW	6.5kW	5.5kW	4.5kW
Maximum Load losses at normal ratio, rated current and 75 deg. C	72.0kW	57.0kW	45.0kW	36.0kW	32kW
	<u>2.5 MVA</u>	<u>2.0MVA</u>	<u>1.6MVA</u>	<u>1.0MVA</u>	<u>630kVA</u>
Maximum No-Load losses at rated frequency and 100%voltage	2.8kW	2.4 kW	2.1kW	1.5kW	1.0kW
Maximum Load losses at normal ratio, rated current and 75 deg. C	30.0kW	24.0kW	19.0kW	12.0kW	7.5kW

2. 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.
3. In case measured losses of transformers during testing exceeds the above mentioned values, BHEL may accept the transformer with penalty. The rate of penalty shall be Rs. 1.95 lacs per kW. The penalty shall be calculated for each transformer as given below:

$$\text{PENALTY} = \text{Penalty Rate} \times [\text{measured No-Load losses} - \text{maximum No-Load losses}] + (\text{measured Load losses} - \text{maximum Load losses})$$



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ANNEXURE- IV

DOCUMENTS/ DRAWINGS DISTRIBUTION SCHEDULE

Please refer Annexure-I in Section-C

S. NO.	DESCRIPTION	No. hard prints/copies	No. of CD-ROMs	REMARKS
1	Master List of Drgs./ Docs.	10 Copies		
2	Docs. /drgs. submission schedule for approval	10 Copies		
3	Approved Docs. /Drgs. submission schedule for distribution	25 Copies	4 CD-ROMS	
4	Docs. /drgs. for approval (First submission)	10 Copies	4 CD-ROMS	
5	Drgs. / docs. for approval (Second & subsequent submission till approval)	10 copies	4 CD-ROMS	
6	Final approval drgs. / docs. for Distribution	25 Copies	4 CD-ROMS	
7	Operation & Maintenance manual for approval	10 Copies		
8	Approved Operation & Maintenance Manual for distribution	25 Copies	4 CD-ROMS	
9	Type Test Certificates/ Reports	10 Copies		

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Please refer Annexure-II in
section - C



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ANNEXURE - VI

SPECIAL TOOLS AND TACKLES REQUIRED FOR ERECTION, COMMISSIONING AND MAINTENANCE OF EQUIPMENT

S. NO.	DESCRIPTION	QTY.

Note

Bidder shall furnish the list of special tools & tackles and quantity along with the offer. Price shall be included in the total bid price.



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ANNEXURE -VII

COMMISSIONING SPARES FOR EACH TRANSFORMER

S. NO.	DESCRIPTION	QTY.					REMARKS
		10.0MVA	8.0 MVA	6.3 MVA	5.0 MVA	3.5 MVA	

S. NO.	DESCRIPTION	QTY.					REMARKS
		2500kVA	2000 kVA	1600 kVA	1000 kVA	630 kVA	

Note

Bidder shall furnish the list of commissioning spares and quantity for each type of transformer along with the offer. Price shall be included in the transformer price.

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ANNEXURE - VIII

APPLICABLE STANDARDS & CODES FOR TRANSFORMERS

Specification for power transformers	IS: 2026 []	IEC: 76 []	BS: 171 []
	IS: 11171 []	IEC:354 []	
	IS:6600 []		
Fittings & accessories for power transformer	IS: 3639 []	IEC: []	BS: []
Specification for new insulation oil	IS: 335 []	IEC: 296 []	BS: 148 []
Bushing for alternative voltage above 1000 volts	IS: 2099 []	IEC: 137 []	BS: 223 []
Dimension for porcelain transformer bushings	IS: 3347 []		
Current transformers	IS: 2705 []	IEC: 185 []	BS: 3938 []
Gas operated relays	IS: 3637 []		
Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service	IS:1271 []	IEC: 216 []	
Classification of degrees of protection provided by enclosures of electrical equipment	IS: 12063 []	IEC: 529 []	IS: 13947 []
Method of high voltage testing	IS: 2071 []	IEC: 60 []	
Colours for ready mixed paints & enamels	IS: 5 []		
Specifications for power & distribution transformers	CBIP Publication No275(1999 edition []		
Guide for loading of oil immersed transformers	IS: 6600 []	IEC: 354 []	BS: []
Noise level	NEMA, STANDARD-TR1		



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DATA SHEET-B
(TO BE SUBMITTED ALONG WITH
OFFER FOR EACH RATING)



TITLE :
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FOR 11kV/0.433V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	630kVA
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 6.6kV/0.433V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	630kVA
1.	Rating					
2.	No Load transformation ratio					
3.	Maximum No- load losses at rated frequency and 100% rated voltage					
4.	Maximum load losses at normal ratio, rated current and 75 deg. C					
5.	Overall Dimensions					
6.	Total weight					
7.	Total oil Quantity					

FOR 3.3kV/0.433V

S. No	Description	2.5MVA	2.0MVA	1.6MVA	1.0MVA	630kVA
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 :
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FOR 11kV/6.9kV

S. No	Description	10.0MVA	8.0MVA	6.3MVA	2MVA	3.5MVA
1.	Rating					
2.	No Load transformation ratio					
3.	Maximum No- load losses at rated frequency and 100% rated voltage					
4.	Maximum load losses at normal ratio, rated current and 75 deg. C					
5.	Overall Dimensions					
6.	Total weight					
7.	Total oil Quantity					

FOR 11kV/3.5kV

S. No	Description	10.0MVA	8.0MVA	6.3MVA	5.0MVA	3.5MVA
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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**GUARANTEED TECHNICAL PARTICULARS
(DATA SHEET-C)**

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS DATA SHEET-C		SPECIFICATION NO. PE-RC-999-302-E001																																																																																														
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TITLE :
TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS
DATA SHEET-C

SPECIFICATION NO. PE-RC-999-302-E001
VOLUME NO. : III
SECTION : D
REV NO. : 00 DATE : 28/05/10
SHEET : 2 OF 5

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

- | | | |
|------|--|-------------|
| 14.0 | Power frequency withstand voltage for one minute | |
| | a) HV Winding | kV |
| | b) LV Winding | kV |
| 15.0 | Maximum No load losses at rated frequency and | |
| | a) 100% rated voltage | kW |
| | b) 110% rated voltage | kW |
| 16.0 | Maximum Load losses at normal ratio, rated current and 75 deg. C | |
| 17.0 | Tolerance on losses (+/-) | |
| 18.0 | Guaranteed maximum Temperature rise of | |
| | a) Top oil by thermometer | deg. C |
| | above ambient of 50 deg. C | |
| | b) Winding by resistance | deg. C |
| | above ambient of 50 deg. C | |
| 19.0 | Efficiency at 75 deg. C and unity power factor for | |
| | a) 100% full load | % |
| | b) 75% full load | % |
| | c) 50% full load | % |
| 20.0 | Voltage regulation at full load at 75 deg. C | |
| | a) Unity power factor | % |
| | b) 0.8 Power factor (Lagging) | % |
| 21.0 | External short circuit withstand capacity | MVA |
| 22.0 | Max. short time (30 sec.) rating of transformer | KVA |
| 23.0 | Type of magnetic circuit | Core/ Shell |
| 24.0 | Type of core joints | |

Name of Vendor			Project		
Revision number	0	1	2	3	
					VANDOR'S SEAL
Vendor's Signature					
Date					



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VOLUME NO. : **III**

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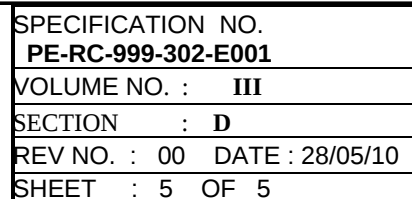
SHEET : 3 OF 5

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

- 25.0 Type of winding
a) HV Winding
b) LV Winding
- 26.0 Type of insulation
a) HV winding
b) LV winding
c) Between core & adjacent winding
d) Between windings
- 27.0 HV terminal arrangement
a) Bushing with or without CTs
b) CT details (Ratio, ACC. Class, VA, Type)
c) Clearance between phases in air mm
d) Clearances to earth in air mm
- 28.0 LV terminal arrangement
a) Bushing with or without CTs
b) CT details (Ratio, ACC. Class, VA, Type)
c) Clearance between phases in air mm
d) Clearances to earth in air mm
- 29.0 Neutral terminal arrangement
a) No. of neutral terminals
b) Neutral CT provided or not
c) NCT details (Ratio, ACC. Class, VA, Type)
- 30.0 HV Bushing
a) Rated voltage class kV
b) Rated current A
- 31.0 LV Bushing
a) Rated voltage class kV
b) Rated current A
- 32.0 LV Neutral Bushing
a) Rated voltage class kV
b) Rated current A

Name of Vendor			Project		
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41.0	Dimensions	
42.1	Tank dimensions	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.2	Shipping dimensions of the largest package	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.3	Overall Dimensions (LxBxH)	(mmXmmXmm)
43.0	Details of tank and other material	
	a) Thickness of tank side plate	mm
	b) Thickness of tank bottom plate	mm
	c) Thickness of tank cover plate	mm
	d) Thickness of radiator sheets	mm
	e) Minimum clearance height for lifting core and winding from tank	mm
44.0	Positive sequence impedance at	
	a) Maximum voltage tap	%
	b) Minimum voltage tap	%
45.0	Zero-sequence impedance at principal tap	%

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SCHEDULE OF DEVIATIONS

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-RC-999-302-E001
		VOLUME NO. : III
		SECTION : D
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		SHEET : 1 OF 1

Sl. No	Specification Clause Ref.	Technical Deviation	Reason for Deviation
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We the undersigned hereby certify that the above mentioned are the only Technical deviations

Particulars of bidder/Authorised representative				COMPANY SEAL
NAME	Designation	Signature	Date	