

SINGARENI COLLIERIES COMPANY LTD.

2 X 600 MW SINGARENI, ADILABAD TPP

CONSULTANT – NTPC LTD.

**TECHNICAL SPECIFICATION FOR
OIL FILLED TRANSFORMERS**

DOC. NO. PE-TS-381-302-E001

REV. -0



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA - 201301**



TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMER

2 X 600 MW SINGARENI, ADILABAD TPP

SPECIFICATION NO. PE-TS-381-302-E001

VOLUME II B

SECTION

REVISION 0 DATE 18.11.2013

SHEET 1 OF 1

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TOTAL NO. OF SHEETS = 67 (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)



TITLE :

TECHNICAL SPECIFICATION FOR OIL FILLED TRANSFORMERS
SPECIFICATION NO PE-TS-381-302-E001

INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFER

- 1 Two signed and stamped copies of the following shall be furnished by the bidder as technical offer:
 - a. Unpriced Price Schedule (As enclosed with the specification) with bidder's signature and company stamp.
 - b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer") and previous sheet ("Contents"), with bidder's signature and company stamp.
- 2 No technical deviations with respect to technical specification is acceptable. In case of any technical deviation taken by the bidder, their offer will not be further technically evaluated.
- 3 Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere /covering letter 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.
- 5 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
(REFER INSTRUCTION NO. 1 ABOVE)



TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMER

2 X 600 MW SINGARENI, ADILABAD TPP

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VOLUME II B

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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).

	TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMER	SPECIFICATION NO. PE-TS-381-302-E001	
		VOLUME II B	
		SECTION	
	2 X 600 MW SINGARENI, ADILABAD TPP	REVISION 0	DATE 18.11.2013
		SHEET 1 OF 1	

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 600 MW SINGARENI, ADILABAD TPP.
- 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 No technical deviations with respect to technical specification is acceptable. In case of any technical deviation taken by the bidder, their offer will not be further technically evaluated.
- 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.



**PROJECT :2X600 MW SINGARENI COLLIERIES
COMPANY LTD., ADILABAD TPP**

SPECIFICATION NO. PE-TS-381-302-E001

VOLUME II B

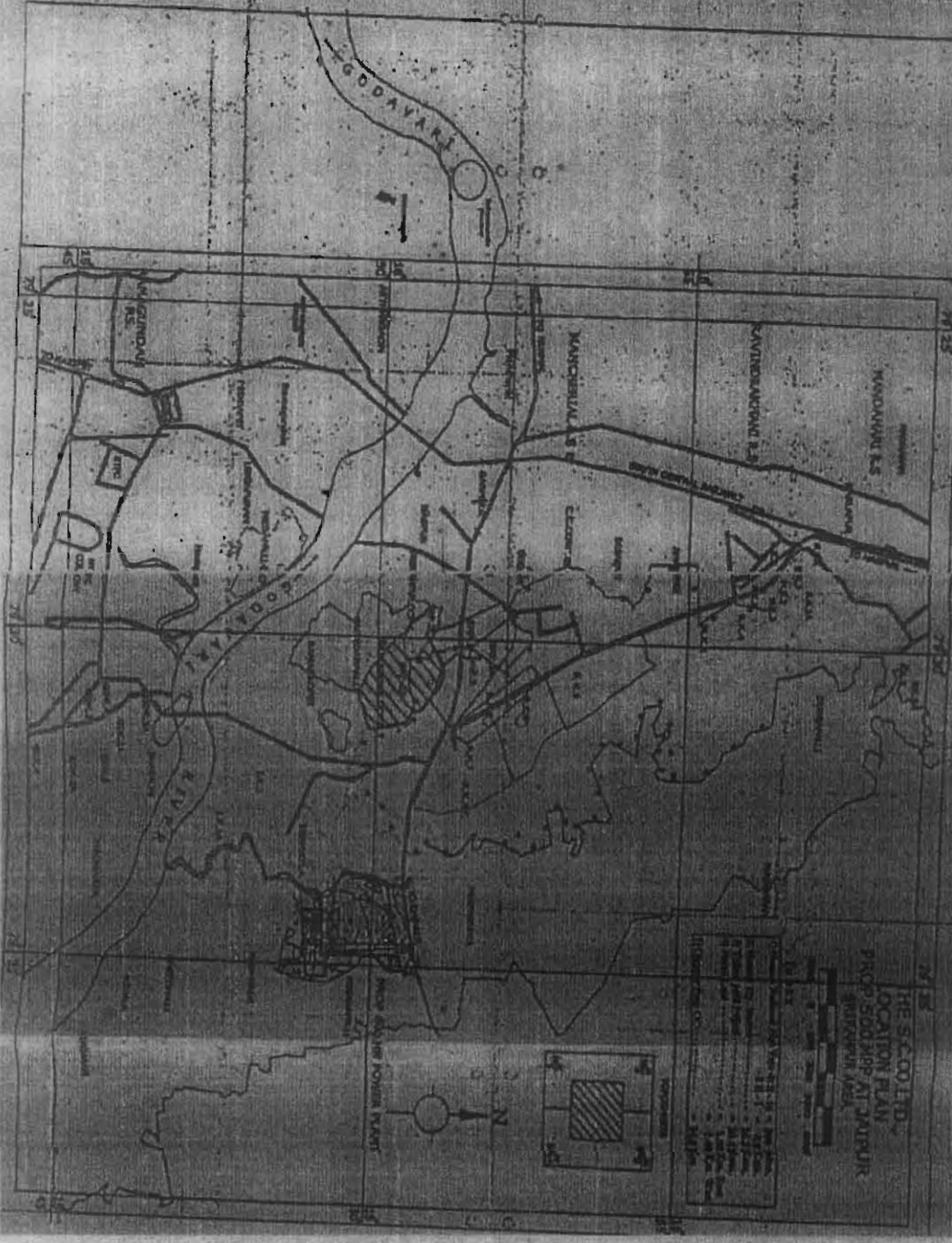
SECTION B

REV.NO. 1 DATE 17-02-2012

Page 2 of 2

PROJECT INFORMATION

1.	Owner	SINGARENI COLLIERIES COMPANY LTD.(A GOVT. OF INDIA UNDERTAKING), HYDERABAD.
2.	Project	2X600 MW SINGARENI COLLIERIES COMPANY LTD., ADILABAD THERMAL POWER PLANT
3.	No of Units	2
4.	Consultant	NATIONAL THERMAL POWER CORPORATION LTD.
5.	Location	The site is located near Pegadapalli Village, Jaipur Mandal, District- Adilabad of Andhra Pradesh The latitude & longitude of site are 18° 48' 30" to 18° 50' 35" and 79° 34' 00" to 79° 35' 30" respectively. The site is 14 km from nearest town Mancherial and 4.6 km from State Highway. Distance from NH-16 is 500 M.
6.	District	Adilabad (Andhra Pradesh)
7.	Nearest Major Town	Mancherial
8.	Nearest Railway station	The nearest railway station is Mancherial railway station on Nagpur-Kazipet main rail line of South central Railway, located at a distance of about 14.6 kms.
9.	Nearest Airport	The nearest airport is Shamshabad Airport, Hyderabad located at a distance of 250 km.
10.	Vicinity Plan of the project	Refer Annexure-I (section-B)
11.	Meterological Data	Refer Annexure-II (section-B)

CLAUSE NO.	PROJECT INFORMATION		
	<p style="text-align: center;">VICINITY PLAN</p> <p style="text-align: right;">ANNEXURE-I</p> 		
<p>SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION - VI PART-A</p>	<p>SUB-SECTION-I PROJECT INFORMATION</p>	<p>PAGE 7 OF 12</p>

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TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

SPECIFICATION NO. PE-TS-381-302-E001

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001**AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)**
2 X 600 MW SINGARENI, ADILABAD TPP**1. SCOPE OF SUPPLY & SERVICES :**

SCOPE INCLUDES DESIGN, MANUFACTURE, INSPECTION AND TESTING , PROPER PACKING AND DELIVERY TO SITE OF FOLLOWING TRANSFORMERS ALONG WITH FITTINGS & ACCESSORIES AND 10% EXTRA OIL.

MAIN ITEM:

SL. No.	DESCRIPTION	TOTAL (Nos)
1	1600kVA, 11kV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 8.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	16
2	1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	2
3	1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination) [Max. losses at 50% loading – 3.0 KW, Max. losses at 100% loading – 9.8 KW For Green Building as per ECBC table 8.2]	2
4	10 % extra transformer oil in sealed non-returnable standard drums for 1600 KVA transformers (16 nos.)	
5	10 % extra transformer oil in sealed non-returnable standard drums for 1000 KVA transformers (4 nos.)	

2. ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN QUANTITY MAY BE TO THE EXTENT OF +30% OF THE TOTAL ORDER VALUE.
3. NOS. OF DRAWINGS/ DOCUMENTS REQUIRED FROM VENDOR SHALL BE AS PER ANNEXURE-I
4. STANDARD QUALITY PLAN SHALL BE AS PER ANNEXURE-II.
5. SCHEDULE OF PRICES IS ENCLOSED (ANNEXURE-A, B,C,D).
6. SCHEDULE OF PRICES – TRANSFORMERS (ANNEXURE-A) , EXTRA OIL (ANNEXURE-B), TYPE TESTS (ANNEXURE-C) & MANDATORY SPARES (ANNEXURE-D) SHALL BE CONSIDERED FOR PRICE EVALUATION PURPOSE.
7. TECHNICAL SPECIFICATION NO.: PE-RC-999-302-E001 DATED 28.05.2010 IS TO BE FOLLOWED. PROJECT SPECIFIC REQUIREMENTS WITH RESPECT TO SPECIFICATION NO. PE-RC-999-302-E001 DATED 28.05.2010 ARE AS MENTIONED BELOW :
 - l) Clause no. 6.04 - CORE SHALL BE HIGH GRADE NON-AEGING COLD ROLLED SUPER GRAIN ORIENTED SILICON STEEL LAMINATIONS OF M4 GRADE OR BETTER QUALITY. THE INSULATION OF CORE TO TANK & CORE TO CORE CLAMP SHALL BE ABLE TO WITHSTAND A VOLTAGE OF 2KV(RMS.) FOR 1 MINUTE IN AIR.



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001

II) Clause no. 10.06 - REPLACE CLAUSE NO. 10.06 OF TECHNICAL SPECIFICATION PE-RC-999-302-E001 WITH THE FOLLOWING :

A) TYPE TEST CERTIFICATES ON TRANSFORMERS OF SIMILAR TYPE AND DESIGN FOR ALL THE TYPE TESTS SPECIFIED IN ANNEXURE-C & ANNEXURE-F OF SECTION-C OF TECHNICAL SPECIFICATION NO.: PE-TS-381-302-E001 SHALL BE FURNISHED BY THE SUCCESSFUL BIDDER FOR THE APPROVAL OF CUSTOMER. ALL TYPE TESTS SHALL BE AS PER IEC 60076.

THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER 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) LISTED IN ANNEXURE-F, 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 (EXCEPT SHORT CIRCUIT TEST) UNDER THIS CONTRACT AT NO ADDITIONAL COST TO THE EMPLOYER EITHER AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND SUBMIT THE REPORTS FOR APPROVAL.

IRRESPECTIVE OF BIDDER FURNISHING VALID TYPE TEST REPORTS, BIDDER TO CONDUCT ALL THE TYPE TEST/SPECIAL TEST ON ONE TRANSFORMER OF EACH RATING & TYPE, INDICATED AT ANNEXURE-C OF SECTION-C OF TECHNICAL SPECIFICATION PE-TS-381-302-E001. THESE TESTS SHALL BE CONDUCTED AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND BIDDER TO SUBMIT THE REPORTS FOR APPROVAL.

B) IN CASE SHORT CIRCUIT TEST IS CONDUCTED, ALL THE TYPE TESTS SHALL BE CONDUCTED AFTER SHORT CIRCUIT TEST.

III) Clause no. 10.05 – IN ADDITION TO THE TESTS MENTIONED AT 10.05 OF SPECIFICATION NO. PE-RC-999-302-E001 DATED 28.05.2010, PLEASE NOTE THAT FOLLOWING ADDITIONAL TESTS SHALL ALSO BE CARRIED OUT AS ROUTINE TESTS ON ALL TRANSFORMERS :
5) DIELECTRIC TESTS

IV) 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 (PED-302-00-Q-001 REV-03) IS ATTACHED IN ANNEXURE-II OF SECTION-C OF SPEC. NO.- PE-TS-381-302-E002, REV.-00".

V) Clause no. 10.04 - "relevant standards" shall be replaced with 'IEC – 60076'.

VI) Clause no. 10.08 is deleted.

VII) Clause no. 11.01 is deleted as no details are required for submitting the offer.



TITLE :

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SPECIFICATION NO. PE-TS-381-302-E001

8. Insulating Oil – The oil supplied with transformers shall be new and previously unused and must confirm to following while tested at supplier's premises and shall have following parameters.

S.No.	Property	Permissible values
1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C
2.	Flash Point, ° C	≥ 140° C
3.	Pour point, ° C	≤ (-)40 ° C
4.	Appearance	Clear , free from sediment and suspended matter
5.	Density kg/dm ³ at 20 ° C	≤ 0.895
6.	Interfacial Tension N/m at 25° C	≥ 0.04
7.	Neutralisation value, mgKOH/g	≤ 0.01
8.	Corrosive sulphur	Non Corrosive
9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
10.	Anti oxidants additives	Not detectable
11.	Oxidation Stability Neutralisation value, mgKOH/g Sludge, % by mass	≤ 1.2
		≤ 0.1
12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70
13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005
14.	PCA content	≤ 1%
15.	Impulse withstand Level, kVp	≥ 145
16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5

Subsequently Oil samples shall be drawn at :

Sr. No.	Parameters	Before filling in main tank at site & tested for	Prior to energization at site for following properties & acceptance norms:
i)	BDV	60 kV (min)	60 kV (min)
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)



TITLE :

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LIST OF ENCLOSURES

1. ANNEXURE-I: DOCUMENT DISTRIBUTION SCHEDULE
2. ANNEXURE-II: QUALITY PLAN
3. DATA SHEET-A
4. SCHEDULE OF PRICES – MAIN ITEMS (ANNEXURE-A, B, C, D).



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001**ANNEXURE-I****DOCUMENTS/ DRAWINGS DISTRIBUTION SCHEDULE**

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		




TITLE :


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ANNEXURE – II

STANDARD QUALITY PLAN

***IF BIDDER HAS ANY REFERENCE QAP AGREED WITH NTPC SAME
SHALL BE APPLICABLE FOR THIS PROJECT**


<div></div>		CUSTOMER :		PROJECT		SPECIFICATION : PE-TS-381-302-E001				
		QUALITY PLAN		TITLE		NUMBER :				
		BIDDER/ VENDOR		NUMBER PED-302-00-Q-001 Rev. 03		SPECIFICATION AUXILIARY SERVICE TRANSFORMER				
		SYSTEM CAT.		ITEM: OIL FILLED TRANSFORMER		VOLUME III				
SL. NO.	COMPONENT/OPERATING CHARACTERISTICS CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	REMARKS		
							P W V			
1	2	3	4	5	6	7	8	9	10	11
1.0	RAW MATERIALS & BOUGHT OUT ITEMS									
1.1	Mild Steel plate, MS Pipe, Channels, MS Angles	a) Thickness b) Surface defects c) Chemical composition d) Mechanical Properties e) Hydraulic test of pipes	Major Major Major Major Major	MEASURE VISUAL TEST TEST TEST	10% 100% - - -	BHEL SPECIFICATION/ 'MANUF. STD / IS:2082 / IS:1239	BHEL SPECIFICATION/ 'MANUF. STD / IS:2082 / IS:1239	QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC	3/2 3/2 3/2 3/2 3/2	1 2 - 2 2
1.2	CRGO Steel	a) Thickness Dimension & Finish b) Grade of CRGO c) Cutting & burr d) scratches, surface finish e) Waviness & edge camber f) Specific core loss g) Surface resistivity h) Stacking factor i) Permeability j) Bend test/ Ductility	Major Major Major Major Major Major Major Major Major Major	MEASURE MEASURE VISUAL MEASURE TEST TEST TEST TEST TEST TEST	10% - 10% 10% - - - - - -	DRG/DATA SHEET/ 'MANUF. STD / IS:3024 / IS:649	DRG/DATA SHEET/ 'MANUF. STD / IS:3024 / IS:649	QC Record. QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 2 2 3/2 3/2 3/2 3/2 3/2	1 2 - - 1 2 2 2 2 2
1.3	Paper Insulated Copper Conductor	a) Dimensions b) Resistivity/Conductivity c) Elongation d) Tensile Strength e) Proof stress if applicable f) Insulation test between strands g) Cu purity of CC rod h) Chemical composition i) Surface Finish	Major Major Major Major Major Major Major Major Major	MEASURE TEST TEST TEST TEST TEST TEST TEST VISUAL	100% 10% - - - - - - 100%	'MANUF. STD / IS:13730-P-27/IEC 60554	'MANUF. STD / IS:13730-P-27/IEC 60554	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2	1 1 2 2 2 2 2 2
1.4	Insulating Paper	a) Dimensions b) Density & substance c) Tensile Strength d) Elongation e) Water absorption f) Moisture content g) pH value & conductivity aqueous extract h) Ash content i) Electrical strength j) Air permeability k) Tear index l) Heat stability	Major Major Major Major Major Major Major Major Major Major	MEASURE TEST TEST TEST TEST TEST TEST TEST TEST TEST	10% - - - - - - - -	'MANUF. STD / IS:9335-P-2/IS:9335-P-III/IEC 60554	'MANUF. STD / IS:9335-P-2/IS:9335-P-III/IEC 60554	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	2 3/2 3/2 3/2 3/2 3/2 3/2 3/2	1 2 2 2 2 2 2 2
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
										BIDDER/SVENDORS COMPANY SEAL

<div></div>		QUALITY PLAN	CUSTOMER :		PROJECT		SPECIFICATION : PE-TS-381-302-E001						
			BIDDER/ VENDOR	SYSTEM CAT.	EXTENT OF CHECK	TYPE/ METHOD OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	NUMBER :			
										SECTION	VOLUME III		
												TITLE	TRANSFORMER
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	3	4	5	6	7	8	9	10		11	
1	2												
1.5	Insulation & Press- Board moulding (stock items)	a) Dimension	Major	Measure	10%	'MANUF. STD / IS:1576	'MANUF. STD / IS:1576	QC Record.	2	1			
		b) Compressibility	Major	Test	-			Suppliers TC	3/2	2			
		c) Density	Major	Test	-			Suppliers TC	3/2	2			
		d) Tensile strength	Major	Test	-			Suppliers TC	3/2	2			
		e) pH value/Conductivity of water extract	Major	Test	-			Suppliers TC	3/2	2			
		f) Electrical strength in air & oil	Major	Test	-			Suppliers TC	3/2	2			
		g) Shrinkage in air	Major	Test	-			Suppliers TC	3/2	2			
		h) Flexibility	Major	Test	-			Suppliers TC	3/2	2			
		i) Ash content	Major	Test	-			Suppliers TC	3/2	2			
		j) Moisture content	Major	Test	-			Suppliers TC	3/2	2			
		k) Cohesion between piles	Major	Test	-			Suppliers TC	3/2	2			
		l) Elongation	Major	Test	-			Suppliers TC	3/2	2			
		m) Oil absorption	Major	Test	-			Suppliers TC	3/2	2			
1.6	Densified wood	a) Dimension	Major	Measure	10%	'MANUF. STD / IS:3513	'MANUF. STD / IS:3513	QC Record.	2	1			
		b) Surface finish	Major	Visual	10%			QC Record.	2	-			
		c) Electrical strength in oil	Major	Test	-			Suppliers TC	3/2	1			
		d) Oil absorption	Major	Test	-			Suppliers TC	3/2	-			
		e) Moisture content	Major	Test	-			Suppliers TC	3/2	-			
		f) Compression strength	Major	Test	-			Suppliers TC	3/2	-			
		g) Crosstreng strength	Major	Test	-			Suppliers TC	3/2	-			
		h) Tensile strength	Major	Test	-			Suppliers TC	3/2	-			
		i) Specific gravity/ Density	Major	Test	-			Suppliers TC	3/2	-			
		a) Dimension	Major	Measure	10%		'MANUF. STD / IS:4253	'MANUF. STD / IS:4253	QC Record.	2	-		
		b) Hardness	Major	Test	-			Suppliers TC	3/2	1			
		c) Tensile strength	Major	Test	-			Suppliers TC	3/2	-			
		d) Compressibility	Major	Test	-			Suppliers TC	3/2	1			
e) Recovery	Major	Test	-			Suppliers TC	3/2	-					
f) Compression set	Major	Test	-			Suppliers TC	3/2	-					
g) Flexibility	Major	Test	-			Suppliers TC	3/2	-					
h) Fluid resistance test	Major	Test	-			Suppliers TC	3/2	-					
i) Chloride/Sulphate content of water extract	Major	Test	-			Suppliers TC	3/2	-					
j) Density	Major	Test	-			Suppliers TC	3/2	-					
1.8	Nitrile Rubber Cord and "O" Ring (if applicable)	a) Dimension	Major	MEASURE	10%	'MANUF. STD / IS:4253	'MANUF. STD / IS:4253	Suppliers TC	2	-			
		b) Shore Hardness	Major	Test	-			Suppliers TC	3/2	-			
		c) Tensile strength	Major	Test	-			Suppliers TC	3/2	-			
		d) Elongation at break	Major	Test	-			Suppliers TC	3/2	-			
		e) Compression set	Major	Test	-			Suppliers TC	3/2	-			
		f) Accelerated Ageing in oil	Major	Test	-			Suppliers TC	3/2	-			
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME		SIGNATURE									
		DATE											

<div></div>		QUALITY PLAN	CUSTOMER :		PROJECT		SPECIFICATION : PE-TS-381-302-E001					
			BIDDER/ VENDOR	BIDDER/ VENDOR	TITLE	NUMBER :						
						SPECIFICATION AUXILIARY SERVICE						
						TRANSFORMER						
SL. NO.	COMPONENT/OPERATION	SHEET 5 OF 10 CHARACTERISTICS CHECK	SYSTEM CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.8	Gun Metal / Cast Iron Valves Gate/globe/ Butterfly)	a) Dimensional check	Major	Measure	100%	Manf. Std./IS:778 Class 1	Manf. Std./IS:778 Class 1	QC Record	2			-
		b) Type, size & make	Major	Visual	100%			QC Record	2			-
		c) Leakage test(hydraulic test for Body & Seat)	Major	Test	-			Supplier's TC	3/2			2,1
		d) Operational test (close & open)	Major	Test	-			Supplier's TC	3/2			2
2.9	Bushing CT	a) Visual check/Dimensional check	Major	Measure/Visual test	100%	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	2			-
		b) Routin test	Major	Test	-	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	3/2			2,1
2.10	Marshaling box/TRCC	a) Visual check for wiring	Major	Test	100%	Drq./Manf. Std./IS:5/IS:13947	Drq./Manf. Std./IS:5/IS:13947	Supplier's TC	3/2			-
		b) Dimensional check	Major	Measure/Test	100%			Supplier's TC	3/2			-
		c) Check for make of components	Major	Measure/Test	100%			Supplier's TC	3/2			-
		d) 2 kV insulation test on auxiliary wiring	Major	Measure/Test	100%			Supplier's TC	3/2			-
		e) Check for paint, shade & thickness	Major	Measure/Test	100%			Supplier's TC	3/2			-
		f) Degree of Prot. By paper insertion	Major	Measure/Test	100%			Supplier's TC	3/2			-
2.11	OTI&WTI	a) Type size & make	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2			1
		b) HV test	Major	Test	-			Supplier's TC	3/2			2,1
		c) Temperature calibration	Major	Test	-			Supplier's TC	3/2			2,1
		d) Switch setting & switch deferential	Major	Test	-			Supplier's TC	3/2			2,1
		e) Calibration & operation of switch	Major	Test	-			Supplier's TC	3/2			2,1
2.12	Radiator	a) Type, Model, Rating	Major	Visual	100%	Drq./Manf. Std./IS:101	Drq./Manf. Std./IS:101	QC records	3/2			1
		b) Dimensions & No. of elements	Major	Measure	100%			QC records	3/2			2
		c) Paint shade, Finish & film thickness	Major	Measure/test	100%			QC records	3/2			2
		d) Pressure test	Major	Test	100%			Supplier's TC	3/2			1
		e) Adhesion test on paint	Major	Test	100%			Supplier's TC	3/2			1
		f) Welding quality	Major	Visual/ DPTest	100%	Relevant code	Relevant code	Supplier's TC	3/2			1
2.13	Hardware	a) Dimensional check	Major	Measure	100%	Manf. Std.	Manf. Std.	QC records	2			-
		b) Tensile strength	Major	Test	-			Supplier's TC	3/2			-
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
											BIDDER/SVENDORS COMPANY SEAL	

CUSTOMER :		PROJECT		SPECIFICATION : PE-TS-381-302-E001							
BIDDER/ VENDOR		TITLE		NUMBER :							
QUALITY PLAN		QUALITY PLAN		SPECIFICATION AUXILIARY SERVICE							
SHEET 6 OF 10		NUMBER PED-302-00-Q-001 Rev. 03		TRANSFORMER							
SL. NO.	COMPONENT/OPERATING CHARACTERISTICS CHECK	SYSTEM CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III REMARKS
								AGENCY	P	W	
1	2	3	4	5	6	7	8	9	10	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 f) 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	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.	Manf.	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		
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
						BIDDER'S/VENDORS COMPANY SEAL					

SPECIFICATION : PE-TS-381-302-E001		PROJECT		TITLE		NUMBER :	
QUALITY PLAN		QUALITY PLAN		NUMBER PED-302-00-Q-001 Rev. 03		SPECIFICATION AUXILIARY SERVICE TRANSFORMER	
BIDDER/ VENDOR :		BIDDER/ VENDOR :		BIDDER/ VENDOR :		BIDDER/ VENDOR :	
SYSTEM		SYSTEM		SYSTEM		SYSTEM	
CAT.		CAT.		CAT.		CAT.	
TYPE/ METHOD OF CHECK		TYPE/ METHOD OF CHECK		TYPE/ METHOD OF CHECK		TYPE/ METHOD OF CHECK	
EXTENT OF CHECK		EXTENT OF CHECK		EXTENT OF CHECK		EXTENT OF CHECK	
REFERENCE DOCUMENT		REFERENCE DOCUMENT		REFERENCE DOCUMENT		REFERENCE DOCUMENT	
ACCEPTANCE NORM		ACCEPTANCE NORM		ACCEPTANCE NORM		ACCEPTANCE NORM	
FORMAT OF RECORD		FORMAT OF RECORD		FORMAT OF RECORD		FORMAT OF RECORD	
SECTION		SECTION		SECTION		SECTION	
AGENCY		AGENCY		AGENCY		AGENCY	
P		P		P		P	
W		W		W		W	
V		V		V		V	
REMARKS		REMARKS		REMARKS		REMARKS	
VOLUME III		VOLUME III		VOLUME III		VOLUME III	
11		11		11		11	
1		1		1		1	
2		2		2		2	
3		3		3		3	
3.1		3.1		3.1		3.1	
Fabrication of Tank, Conservator, Radiator, HV&LV CABLE BOX and welding requirement		Fabrication of Tank, Conservator, Radiator, HV&LV CABLE BOX and welding requirement		Fabrication of Tank, Conservator, Radiator, HV&LV CABLE BOX and welding requirement		Fabrication of Tank, Conservator, Radiator, HV&LV CABLE BOX and welding requirement	
a) Welding procedure specification		a) Welding procedure specification		a) Welding procedure specification		a) Welding procedure specification	
b) Process qualification record		b) Process qualification record		b) Process qualification record		b) Process qualification record	
c) Welder qualification		c) Welder qualification		c) Welder qualification		c) Welder qualification	
d) Welding electrodes-Mechanical Properties		d) Welding electrodes-Mechanical Properties		d) Welding electrodes-Mechanical Properties		d) Welding electrodes-Mechanical Properties	
e) Fitup for butt weld joints of tank and cover		e) Fitup for butt weld joints of tank and cover		e) Fitup for butt weld joints of tank and cover		e) Fitup for butt weld joints of tank and cover	
f) Visual check on weldment & any foreign particle in the entire tank with conservator, pipes etc. and blanking of ends with bolted plates		f) Visual check on weldment & any foreign particle in the entire tank with conservator, pipes etc. and blanking of ends with bolted plates		f) Visual check on weldment & any foreign particle in the entire tank with conservator, pipes etc. and blanking of ends with bolted plates		f) Visual check on weldment & any foreign particle in the entire tank with conservator, pipes etc. and blanking of ends with bolted plates	
g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes	
h) DP test on welded joints		h) DP test on welded joints		h) DP test on welded joints		h) DP test on welded joints	
i) Check for flatness gasket surface		i) Check for flatness gasket surface		i) Check for flatness gasket surface		i) Check for flatness gasket surface	
j) Rim flatness		j) Rim flatness		j) Rim flatness		j) Rim flatness	
k) Surface cleaning by sand/ shot blasting		k) Surface cleaning by sand/ shot blasting		k) Surface cleaning by sand/ shot blasting		k) Surface cleaning by sand/ shot blasting	
l) Primer coating, paint shade thickness inside & outside		l) Primer coating, paint shade thickness inside & outside		l) Primer coating, paint shade thickness inside & outside		l) Primer coating, paint shade thickness inside & outside	
m) Paint film adhesion test		m) Paint film adhesion test		m) Paint film adhesion test		m) Paint film adhesion test	
n) Vacuum Test (Tank)		n) Vacuum Test (Tank)		n) Vacuum Test (Tank)		n) Vacuum Test (Tank)	
o) Pressure test (Tank)		o) Pressure test (Tank)		o) Pressure test (Tank)		o) Pressure test (Tank)	
a) Burr & Bow		a) Burr & Bow		a) Burr & Bow		a) Burr & Bow	
b) Dimensional check		b) Dimensional check		b) Dimensional check		b) Dimensional check	
a) Dimensional check		a) Dimensional check		a) Dimensional check		a) Dimensional check	
b) Assembly of limb insulation and limb plates.		b) Assembly of limb insulation and limb plates.		b) Assembly of limb insulation and limb plates.		b) Assembly of limb insulation and limb plates.	
c) Rectangularity of core assembly		c) Rectangularity of core assembly		c) Rectangularity of core assembly		c) Rectangularity of core assembly	
d) Freedom from overlaps & air gap at joints		d) Freedom from overlaps & air gap at joints		d) Freedom from overlaps & air gap at joints		d) Freedom from overlaps & air gap at joints	
e) Leaning of cor(t.e core verticality)		e) Leaning of cor(t.e core verticality)		e) Leaning of cor(t.e core verticality)		e) Leaning of cor(t.e core verticality)	
f) Limb & stack thickness		f) Limb & stack thickness		f) Limb & stack thickness		f) Limb & stack thickness	
g) Limb clamping & binding		g) Limb clamping & binding		g) Limb clamping & binding		g) Limb clamping & binding	
h) Core diameter		h) Core diameter		h) Core diameter		h) Core diameter	
i) Earthing of core		i) Earthing of core		i) Earthing of core		i) Earthing of core	
BHEL		BHEL		BHEL		BHEL	
PARTICULARS		PARTICULARS		PARTICULARS		PARTICULARS	
NAME		NAME		NAME		NAME	
SIGNATURE		SIGNATURE		SIGNATURE		SIGNATURE	
DATE		DATE		DATE		DATE	
BIDDER'S/VENDORS COMPANY SEAL		BIDDER'S/VENDORS COMPANY SEAL		BIDDER'S/VENDORS COMPANY SEAL		BIDDER'S/VENDORS COMPANY SEAL	

<div></div>			CUSTOMER :	PROJECT TITLE		SPECIFICATION : PE-TS-381-302-E001					
						NUMBER :					
						SPECIFICATION AUXILIARY SERVICE					
						TRANSFORMER					
SL. NO.	COMPONENT/OPERATION	QUALITY PLAN		QUALITY PLAN		QUALITY PLAN		QUALITY PLAN		QUALITY PLAN	
		SHEET 8 OF 10	CHARACTERISTICS CHECK	BIDDER/ VENDOR	SYSTEM CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY
1	2	3	4	5	6	7	8	9	10	11	
3.4	Test on Core	a) Dimensional check	Major	Measure	100%			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%	Manf. Drg./stand.	Manf. Drg./stand.	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	Major	Visual	100%			QC Records	2	-	
		h) Core verticality	Major	Visual	100%			QC Records	2	-	
3.5	Winding	a) Brazing procedure & Brazer qualification	Major	Review	100%			QC Records	2	-	
		b) Conductor size.	Major	Measure	100%			QC Records	2	-	
		c) Radial 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%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2	-	
		g) Dimensional check (OD, ID & axial length)	Major	Measure	100%			QC Records	2	-	
		h) Insulation arrangement & alignmnt.	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	1	
		n) Turn to Turn Insulation	Major	Measure	100%			QC Records	2	1	
		o) Measure. Of Resistance	Major	Measure	100%			QC Records	2	-	
3.6	Core coil assembly	a) Cleanliness of core	Major	Visual	100%			QC Records	2	-	
		b) Alignment of spacers/blocks	Major	Visual	100%			QC Records	2	-	
		c) Elect. Clearance & Insp. Of core & coil assly after completion of terminal gear	Major	Visual/measure	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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%			QC Records	2	1	
		b) Lead disposition.	Major	Visual	100%			QC Records	2	-	
		c) Brazing of joints	Major	Visual	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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	Overning and Tanking	a) Cleanliness of tank	Major	Visual	100%			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%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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	-	
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									

[illegible]

[illegible]



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001

PRICE SCHEDULES



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001**ANNEXURE-A****AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)**
2 X 600 MW SINGARENI, ADILABAD TPP**SCHEDULE OF PRICES – TRANSFORMERS**

S. No	DESCRIPTION	TOTAL (Nos)	UNIT PRICE Rs.	TOTAL PRICE Rs.
1	1600kVA, 11kV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 8.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	16		
2	1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	2		
3	1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination) [Max. losses at 50% loading – 3.0 KW, Max. losses at 100% loading – 9.8 KW. For Green Building as per ECBC table 8.2]	2		

NOTES

1. ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN QUANTITY MAY BE TO THE EXTENT OF +30% OF THE TOTAL ORDER VALUE.
2. ALL ROUTINE AND ACCEPTANCE TESTS AS PER CLAUSE NO. 10.04 AND 10.05 OF TECHNICAL SPECIFICATION NO. PE-RC-999-302-E001 SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. CHARGES FOR ALL ROUTINE AND ACCEPTANCE TESTS SHALL BE DEEMED TO BE INCLUDED IN BID PRICE. BIDDERS SHALL QUOTE ACCORDINGLY.

TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001

ANNEXURE-B

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)

2 x 600 MW SINGARENI, ADILABAD TPP

SCHEDULE OF PRICE - EXTRA OIL

S. NO.	DESCRIPTION	QTY. OF TRANSFORMERS	COST OF 10% EXTRA OIL PER TRANSFORMER	TOTAL COST OF 10% EXTRA OIL
1	<p>10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR :</p> <p>(A) 1600kVA, 11kV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 8.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)</p> <p>(B) 1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)</p> <p>(C) 1000KVA, 11KV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 6.0%, Dyn1, OFF Circuit taps $\pm 5\%$ in steps of 2.5% (with cable box type HV and with bus-duct type LV termination) [Max. losses at 50% loading – 3.0 KW, Max. losses at 100% loading – 9.8 KW For Green Building as per ECBC table 8.2]</p>	<p>16</p> <p>2</p> <p>2</p>		

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-381-302-E001

ANNEXURE-C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)

2 x 600 MW SINGARENI, ADILABAD TPP

SCHEDULE OF PRICES

TYPE TESTS/ SPECIAL TESTS ON TRANSFORMERS

SL. No.	DESCRIPTION	PRICE Rs.	PRICE Rs.	PRICE Rs.
		11.0/0.433kV	11.0/0.433kV	11.0/0.433kV
		1600kVA	1000kVA	1000kVA (Energy efficient transformer)
1	TANK PRESSURE TEST			
2	TANK VACUUM TEST			
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1			
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES.			
5	DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES			

NOTE:-

- A) TYPE TESTS AS INDICATED SHALL BE CONDUCTED / CARRIED OUT ON ONE TRANSFORMER OF EACH RATING & TYPE.
- B) 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



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001**ANNEXURE – D****AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)****2 X 600 MW SINGARENI, ADILABAD TPP****SCHEDULE OF PRICES – MANDATORY SPARES**

S. NO.	DESCRIPTION	QTY.	UNIT PRICE Rs.	TOTAL PRICE Rs.	REMARKS
1	HV bushing with metal parts & gaskets a) 11.0/0.433kV, 1600KVA b) 11.0/0.433kV, 1000KVA	1 no. 1 no.			
2	LV bushing with metal parts & gaskets a) 11.0/0.433kV, 1600KVA b) 11.0/0.433kV, 1000KVA	1 no. 1 no.			
3	Neutral bushing with metal parts & gaskets a) 11.0/0.433kV, 1600KVA b) 11.0/0.433kV, 1000KVA	1 no. 1 no.			
4	WTI with contacts	1 no.			
5	OTI with contacts	1 no.			
6	Pressure relief device	1 no.			
7	Magnetic oil gauge	1 no.			
8	Buchholz relay complete	1 no.			
9	Set of gaskets	1 set			
10	Set of valves	1 set			
11	Air cell for conservator (if applicable)	1 no.			

NOTES

SET CONSISTS OF QUANTITIES REQUIRED FOR 1 COMPLETE TRANSFORMER.
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-381-302-E001

ANNEXURE- E

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 600 MW SINGARENI, ADILABAD TPP

O & M SPARES

NOTES:

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



TITLE :

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
SPECIFICATION NO. PE-TS-381-302-E001**ANNEXURE - F****AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)**
2 X 600 MW SINGARENI, ADILABAD TPP**LIST OF TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS**

SL. NO.	DESCRIPTION	11.0/0.433kV	11.0/0.433kV	11.0/0.433kV
		1600 KVA	1000 KVA	1000 KVA (Energy efficient transformer)
1	Capacitance & Tan Delta of windings	APPLICABLE	APPLICABLE	APPLICABLE
2	Measurement of Harmonic current in no load current	APPLICABLE	APPLICABLE	APPLICABLE
3	PRD operation test (for 2MVA and above rating)	APPLICABLE	APPLICABLE	APPLICABLE
4	Degree of Protection (IP 55) tests on Marshalling box	APPLICABLE	APPLICABLE	APPLICABLE
5	Degree of Protection (IP 55) tests on cable box	APPLICABLE	APPLICABLE	APPLICABLE
6	Zero Sequence Impedance	APPLICABLE	APPLICABLE	APPLICABLE
7	Short Circuit Test as per IEC 60076-5**	APPLICABLE	APPLICABLE	APPLICABLE
8	Lighting impulse (Full & Chopped Wave) test on HV & LV winding as per cl 14 of IEC 60076-3)	APPLICABLE	APPLICABLE	APPLICABLE
9	DGA shall be conducted on oil sample taken before & immediately after Temp. Rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599).	APPLICABLE	APPLICABLE	APPLICABLE

NOTE:

- 1 THE TYPE TEST CERTIFICATES TO BE SUBMITTED BY BIDDER 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 (EXCEPT SHORT CIRCUIT TEST) UNDER THIS CONTRACT AT NO ADDITIONAL COST TO THE EMPLOYER EITHER AT THIRD PARTY LAB OR IN PRESENCE OF CLIENT/ EMPLOYER'S REPRESENTATIVE AND SUBMIT THE REPORTS FOR APPROVAL.

- 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.).



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-381-302-E001**

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



TITLE :

**TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-381-302-E001**

11/0.433kV

<u>S. No.</u>	<u>Description</u>	<u>Unit</u>	<u>Particulars</u>
1.0	Quantity	As per Requirement	1000kVA 1600 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	0.433
10.0	No Load transformation ratio		11/0.433
11.0	Vector group		
	a) 11/0.433 KV		Dyn1
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	1600 kVA : 8% 1000kVA : 6%
13.0	Total range of tappings 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	457 V



TITLE :

**TECHNICAL SPECIFICATION FOR
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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) 0.433 KV Winding	kV (rms) 3
18.2	Impulse withstand voltage	
	a) 11 KV Winding	kVp 75
	b) 0.433 Winding	kVp NA
19.0	Terminal details	
	a) HV Line	Cable box /
	b) LV Line	Flange throat for TPN non-segregated Al Busduct / Cable box (as applicable)
	c) LV Neutral on Star	One neutral as part of busduct throat /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	40 kA RMS
	b) 0.433 KV Winding	50 kA RMS
21.0	Method of System Earthing	
	a) 11 KV System	low resistance earthed to limit earth fault current to 300A
	b) 415V System	Solidly grounded
	c) Through fault withstand time	2 Sec.
22.0	Details of Cooling Equipment	Detachable tank mounted radiators



TITLE :

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- | | | |
|------|---|--|
| 23.0 | CTs Details (Tentative) : | 1 Core PS CLASS or 5P20. CT particulars shall be given to successful bidder |
| | (Final details after award of contract) | |
| 23.1 | Provision/ accommodation of CTs in Neutral on Star side | during detail engineering. There shall be no commercial implication to BHEL on this account. |
| 24.0 | Colour Shade : | |
| | a) Interior (For M. Box) | As required |
| | b) Exterior | As required |
| 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,
240 Sq. mm (armoured) |
| | iv) No. of cores & runs | Three core, one run |
| | b) LV side | Non segregated Bus-Duct (NSPB) for 0.433kV |
| 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.31.0 of this data sheet. |
| | ii) B' (for load losses) | Losses not to be exceed maximum losses as per cl. no.31.0 of this data sheet. |
| | c) Rates for penalty | |
| | i) 'A' (for no load loss) | Rs. 1.95 lacs per kW |
| | ii) 'B' (for load loss) | Rs. 1.95 Lacs per kW |
| 28.0 | Type of winding | |
| | a) HV Winding | Cont. disc |
| | b) LV Winding | Spiral |
| 29.0 | Voltage & Frequency variations (11KV/415V) | |



TITLE :

**TECHNICAL SPECIFICATION FOR
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- a) Voltage (11KV : +/- 6% , 415V : +/- 10%)
 - b) Frequency (f +3% & -5%)
 - c) V & f (10% sum of absolute value)
- 30.0 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.
- 31.0 TRANSFORMER LOSSES

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

11KV/433V TRANSFORMERS

	<u>1.6MVA</u>	<u>1.0MVA</u>
Maximum No-Load losses at rated frequency and 100%voltage	2.1kW	1.5kW
Maximum Load losses at normal ratio, rated current and 75 deg. C	19.0kW	12.0kW

For 1.0 MVA (Energy efficient transformer for Green Building as per ECBC table 8.2) :
[item no. 3 of price schedule Annexure –A]

Max Losses at 50% loading - 3.0 KW
Max Losses at 100% loading – 9.8 KW

- 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) 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:

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

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



SHEET : - OF -

SECTION ‘D’ GENERAL TECHNICAL REQUIREMENTS

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-RC-999-302-E001
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 28/05/10
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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

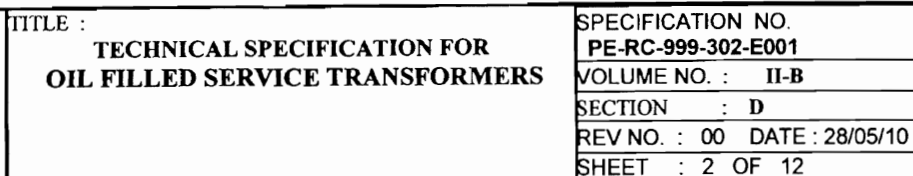
Bidder shall quote for mineral oil filled LT Service Transformers including 10% spare oil in accordance with various sections of this specification. The transformer shall be provided with all fittings & accessories (including foundation hardware) & shall be complete in all aspects, for satisfactory operation, 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).



- Note:**

4.00 SERVICES & EQUIPMENT TO BE EXCLUDED


- ## 5.00 TERMINAL POINTS


- ## 6.00 TECHNICAL REQUIREMENTS


~~6.01 Technical particulars of transformers are specified in Data Sheet A~~


Refer datasheet-A
as specified in Data Sheet-A of section


- 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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	<p>6.04 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.</p> <p>6.05 Internal design of transformer shall ensure that air is not trapped in any location.</p> <p>6.06 Underbase of tank shall be fixed type.</p> <p>6.07 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts</p> <p>6.08 Specific technical requirements are as follows:</p> <p>6.08.01 Tank</p> <p>6.08.02 Tank mounting</p> <p>6.08.03 Tank openings</p> <p>6.08.04 Oil preservation</p>	<p>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.</p> <p>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.</p> <p>At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections.</p> <p>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.</p>


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	<p>6.08.05 Radiators Tank mounted with shut off valves.</p> <p>6.08.06 Insulating Oil As per IS: 335. No external inhibitors are permitted.</p> <p>6.08.07 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A.</p> <p>6.08.09 Bushings/ Insulators</p> <p>a) 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 .</p> <p>b) For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.</p> <p>c) The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.</p> <p>d) Clamps and fittings of steel or malleable cast iron shall be galvanised.</p> <p>e) 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.</p> <p>f) Creepage distance shall be minimum 25mm/ kV per unit of system phase to phase voltage.</p> <p>g) Minimum rated current for bushings shall be as under:</p> <p>1) H V Bushing for 11kV & 6.6kV</p> <p style="margin-left: 40px;">10.0MVA= 1000A</p> <p style="margin-left: 40px;">8.0MVA = 1000A</p> <p style="margin-left: 40px;">6.3MVA = 800A</p> <p style="margin-left: 40px;">5.0MVA = 630A</p> <p style="margin-left: 40px;">3.5MVA = 250A</p> <p style="margin-left: 40px;">2.5 MVA = 250A</p> <p style="margin-left: 40px;">2.0 MVA = 250A</p> <p style="margin-left: 40px;">1.6 MVA = 250A</p> <p style="margin-left: 40px;">1.0 MVA = 100A</p> <p style="margin-left: 40px;">630 kVA = 100A</p> <p>2) H V Bushing for 3.3kV</p> <p style="margin-left: 40px;">2.5 MVA = 630A</p>	


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	<p>2.0 MVA = 500A 1.6 MVA = 400A 1.0 MVA = 250A 630 kVA = 250A</p> <p>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</p> <p>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</p> <p>6.08.10 Cable Box</p> <p>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.</p> <p>b) Dimensions of cable box shall be subject to purchaser's approval.</p> <p>c) Inspection cover for fixed portion of cable box shall be provided. Handles for lifting cable box shall be provided.</p> <p>d) Creepage distance and clearances in air shall be as per CBIP manual.</p> <p>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.</p> <p>f) Gland plate for single core cable termination shall be of Aluminium.</p> <p>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.</p>	

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	<p>6.08.11 Busduct Termination</p> <p>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.</p> <p>6.08.12 Neutral Terminals</p> <p>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.</p> <p>6.09 Neutral CT</p> <p>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.</p> <p>6.10 Voltage control (off circuit type)</p> <ol style="list-style-type: none"> 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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	<p>6.11 Marshalling box</p> <p>a) Tank mounted vermin and dust proof marshalling box shall be provided.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>e) The marshalling box shall be provided with thermostatically controlled space heaters and shall have IP:55 degree of protection.</p> <p>f) CT terminals shall be with shorting and disconnecting facility.</p> <p>6.12 Flux density</p> <p>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:</p> <p style="padding-left: 40px;">Continuous operation for 110% flux density At least 1 minute operation for 125% flux density At least 5 sec. operation for 140% flux density</p> <p>6.13 Winding</p> <p>For 11KV & 3.5KV winding, type of winding shall be continuous disc & for 433 winding, type of winding shall be spiral type.</p> <p>6.14 Noise & Vibration</p> <p>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.</p> <p>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.</p>	

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<p>Calculation shall be furnished by the bidder during contract engineering stage to substantiate the adequacy of support system to withstand short circuit forces.</p> <p>6.15 Maximum Transformer losses including tolerances shall be as per annexure – III.</p> <p>6.16 LOADING CAPABILITY</p> <p>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.</p> <p>7.0 Fittings & accessories</p> <p>7.01 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:</p> <ul style="list-style-type: none"> 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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		VOLUME NO. : II-B
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	<p>u) Inspection cover.</p> <p>v) Oil filling hole and cap.</p> <p>w) Tank mounted marshalling box.</p> <p>x) Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.</p> <p>y) Clamping arrangement for rollers.</p> <p>z) Ground support for cable box.</p> <p>aa) Neutral CT secondary box.</p> <p>bb) Haulage facilities.</p> <p>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.</p> <p>dd) Gas collection device along with all accessories.</p> <p>7.02 Breather shall be fitted at a height not exceeding 1.5 M.</p> <p>7.03 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level.</p> <p>7.04 The WTI and OTI shall have accuracy class of ± 2 deg. C or better.</p> <p>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.</p> <p>8.00 PAINTING</p> <p>Paint shade shall be informed to successful bidder during detail engineering as applicable for specific project.</p> <p>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.</p> <p>9.00 COMMISSIONING, O & M SPARES AND SPECIAL TOOLS & TACKLES</p> <p>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</p> <p>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.</p>	

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	<p>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.</p> <p>10.00 QUALITY ASSURANCE, TESTING & INSPECTION</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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:</p> <ol style="list-style-type: none"> 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. <p>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.</p> <p>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.</p>	



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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	OIL 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:

11KV/433V, 6.6KV/433V & 3.3KV/433V TRANSFORMERS

	<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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ANNEXURE - V

STANDARD QUALITY PLAN



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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APPLICABLE STANDARDS & CODES FOR TRANSFORMERS

Specification for power transformers	IS: 2026 [] IS: 11171 [] IS: 6600 []	IEC: 76 [] IEC: 354 []	BS: 171 []
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 No 275 (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

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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					

1.0 MVA Energy Efficient transformer

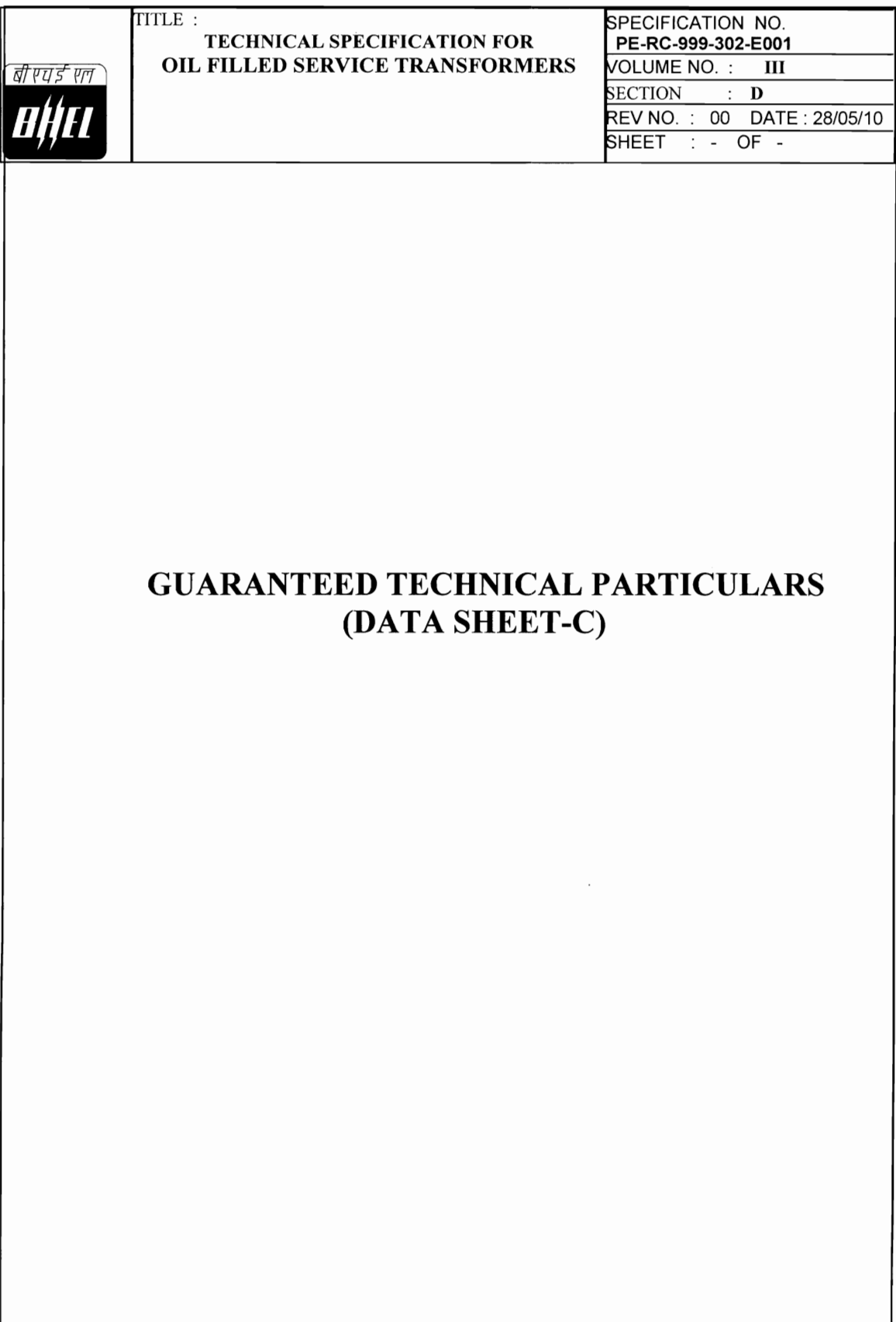
FOR 6.6kV/0.433V


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					

Not Required

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 : 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

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					VANDOR'S SEAL
Vendor's Signature					
Date					

	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 : 3 OF 5																						
Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract																								
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <p>25.0 Type of winding</p> <p>a) HV Winding</p> <p>b) LV Winding</p> <p>26.0 Type of insulation</p> <p>a) HV winding</p> <p>b) LV winding</p> <p>c) Between core & adjacent winding</p> <p>d) Between windings</p> <p>27.0 HV terminal arrangement</p> <p>a) Bushing with or without CTs</p> <p>b) CT details (Ratio, ACC. Class, VA, Type)</p> <p>c) Clearance between phases in air</p> <p>d) Clearances to earth in air</p> <p>28.0 LV terminal arrangement</p> <p>a) Bushing with or without CTs</p> <p>b) CT details (Ratio, ACC. Class, VA, Type)</p> <p>c) Clearance between phases in air</p> <p>d) Clearances to earth in air</p> <p>29.0 Neutral terminal arrangement</p> <p>a) No. of neutral terminals</p> <p>b) Neutral CT provided or not</p> <p>c) NCT details (Ratio, ACC. Class, VA, Type)</p> <p>30.0 HV Bushing</p> <p>a) Rated voltage class</p> <p>b) Rated current</p> <p>31.0 LV Bushing</p> <p>a) Rated voltage class</p> <p>b) Rated current</p> <p>32.0 LV Neutral Bushing</p> <p>a) Rated voltage class</p> <p>b) Rated current</p> </div> <div style="width: 75%;"> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> mm mm </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> mm mm </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> kV A </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> kV A </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> kV A </div> </div> </div>																								
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Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract		
33.0 Maximum flux density a) At rated voltage b) At 110% rated voltage 34.0 Maximum current density for a) HV Winding b) LV Winding 35.0 Magnetising current at rated voltage and frequency (% of full load current) 36.0 Rollers a) Type b) Unidirectional/ Bidirectional c) Quantity d) Gauges i) Longitudinal ii) Transverse 37.0 Pressure test withstand a) Tank b) Radiator and other fittings 38.0 Vacuum withstand a) Tank b) Radiator and other fittings 39.0 Approximate weight of a) Core b) Windings c) Tank, Fittings & Coolers etc. d) Oil e) Total weight with oil f) Untanking weight (core & winding) g) Shipping weight of the heaviest package 40.0 Quantity of Insulating Oil a) Oil in tank b) Oil in cooling equipment c) Total oil Quantity	Wb/M2 Wb/M2 Amp/mm2 Amp/mm2 mm mm Kg/M2 Kg/M2 mm of Hg mm of Hg Kg Kg Kg Kg Kg Kg Kg Kg Ltrs. Ltrs. Ltrs.	

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<div style="margin-left: 40px;"> <p>41.0 Dimensions</p> <p>42.1 Tank dimensions</p> <div style="margin-left: 20px;"> a) Length mm b) Breath mm c) Height mm </div> <p>42.2 Shipping dimensions of the largest package</p> <div style="margin-left: 20px;"> a) Length mm b) Breath mm c) Height mm </div> <p>42.3 Overall Dimensions (LxBxH) (mmXmmXmm)</p> <p>43.0 Details of tank and other material</p> <div style="margin-left: 20px;"> 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 </div> <p>44.0 Positive sequence impedance at</p> <div style="margin-left: 20px;"> a) Maximum voltage tap % b) Minimum voltage tap % </div> <p>45.0 Zero-sequence impedance at principal tap %</p> </div>																																
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