

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**

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TITLE :

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

CONTENTS

S. NO	DESCRIPTION	NO. OF SHEETS
1.	INSTRUCTIONS TO BIDDERS	01
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	PE-TS-381-302-E001, REV-00	
	ANNEXURE-I : DOCUMENT DISTRIBUTION SCHEDULE (1 page)	
	ANNEXURE-II: QUALITY PLAN *: PED-302-00-Q-001 rev. 3 (12 pages)	
7.	SPECIFICATION NO.- PE-RC-999-302-E001,REV-0 DATED 28/05/2010	47
	TOTAL NO. OF SHEETS (INCLUDING COVER/SEPARATOR SHEETS) =	71

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

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

BIDDER'S STAMP & SIGNATURE
(REFER INSTRUCTION NO. 1 OF 'INSTRUCTIONS 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 submittal such as copies of data sheets, drawings, write up, type test certificates, 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 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)

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	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
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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 Mancheri and 4.6 km from State Highway. Distance from NH-16 is 500 M.
6.	District	Adilabad (Andhra Pradesh)
7.	Nearest Major Town	Mancheri
8.	Nearest Railway station	The nearest railway station is Mancheri 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.	Meteorological Data	Refer Annexure-II (section-B)

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CLAUSE NO.

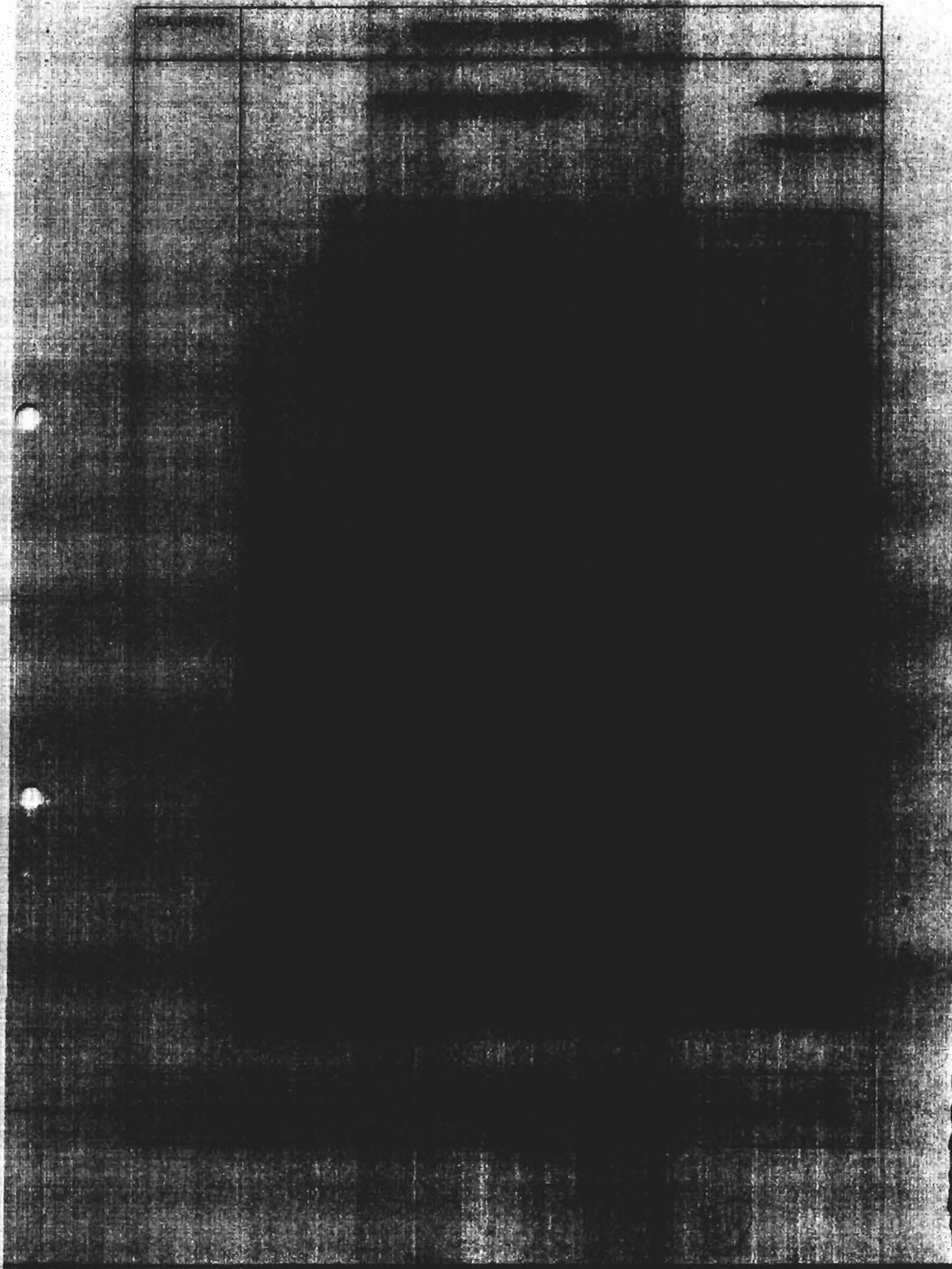
ANNEXURE I

SINGAREN THERMAL POWER PLANT
(2X600 MW)
BOILER TURBINE GENERATOR

SUB-SECTION I
PROJECT INFORMATION

PAGE
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TITLE :

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

SECTION - C

SPECIFIC TECHNICAL REQUIREMENTS

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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.)	

- ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN RATING AND QUANTITY MAY BE TO THE EXTENT OF +30% OF THE TOTAL ORDER VALUE.
- BIDDERS TO NOTE THAT ALL ROUTINE AND SPECIAL TESTS AS PER CLAUSE NO. 10.05 OF TECHNICAL SPECIFICATION NO. PE-RC-999-302-E001 AND AS AMENDED BY THIS SPECIFICATION IN ADDITION TO THOSE SPECIFIED IN IEC 60076 SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. ALL ROUTINE TESTS IN ACCORDANCE WITH IEC 60076 SHALL BE CARRIED OUT IN ALL THE TRANSFORMERS. BIDDERS SHALL QUOTE ACCORDINGLY.
- NOS. OF DRAWINGS/ DOCUMENTS REQUIRED FROM VENDOR SHALL BE AS PER ANNEXURE-I
- STANDARD QUALITY PLAN SHALL BE AS PER ANNEXURE-II.
- SCHEDULE OF PRICES IS ENCLOSED (ANNEXURE-A, B, C, D, E, F).
- SCHEDULE OF PRICES – TRANSFORMERS (ANNEXURE-A), EXTRA OIL (ANNEXURE-B), TYPE TEST (ANNEXURE-C) AND MANDATORY SPARES (ANNEXURE-D) SHALL BE CONSIDERED FOR PRICE EVALUATION PURPOSE.
- PROJECT INFORMATION IS ENCLOSED (3 SHEETS).



TITLE :

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

9. 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. 10.

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

- I) 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.

- II) 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 FOR THE APPROVAL OF CUSTOMER:

(i) ALL THE TYPE TESTS SPECIFIED IN ANNEXURE-II OF TECHNICAL SPECIFICATION NO.: PE-RC-999-302-E001.

(ii) ALL TYPE TEST AS PER IEC 60076.

THE TYPE TEST CERTIFICATES 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 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.

- B) BIDDERS TO INDICATE UNIT CHARGES FOR TYPE TESTS AT SCHEDULE OF PRICES ANNEXURE F. THESE CHARGES SHALL BE PAYABLE IN CASE THE VENDOR IS ASKED TO CARRY OUT THESE TESTS AT CONTRACT STAGE.

- 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 ARE TO BE CARRIED OUT AS ROUTINE TESTS ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST.

a) DIELECTRIC TESTS SHALL BE CARRIED OUT AS PER IEC 60076-3

- 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 AS PART OF SPEC. NO.- PE-TS-381-302-E002, REV.-00".



TITLE :

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

- V) 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.)

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TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS
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11. Bidder/ sub-vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled transformers which must be in successful operation for a period of at least two (2) years as on date of bid opening.

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

16 MVA, 11 KV or higher rated oil filled transformer manufactured by bidder should have been successfully short circuit tested.



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 :

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

ANNEXURE – II

STANDARD QUALITY PLAN

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

CUSTOMER :			PROJECT :			SPECIFICATION : PE-TS-381-302-E001		
BIDDER/ VENDOR :			TITLE :			NUMBER :		
SYSTEM :			QUALITY PLAN :			SPECIFICATION AUXILIARY SERVICE :		
CAT :			ITEM : OIL FILLED TRANSFORMER			TRANSFORMER		
SHEET 1 OF 10			REFERENCE DOCUMENT			SECTION VOLUME III		
CHARACTERISTICS CHECK			ACCEPTANCE NORM			AGENCY REMARKS		
TYPE/ METHOD OF CHECK			FORMAT OF RECORD			P W V		
EXTENT OF CHECK			8			9		
4			7			10		
3			6			11		
2			5					
1								
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	MEASURE VISUAL TEST TEST	10% 100% - -	BHEL SPECIFICATION/ 'MANUF. STD / IS:2082 / IS:1239	QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC	1 2 - 2 2
1.2	CRGO Steel	a) Thickness Dimension & Finish b) Grade of CRGO c) Cutting & burr d) scratches, surface finish e) Wariness & 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	MEASURE MEASURE MEASURE VISUAL MEASURE TEST TEST TEST TEST MEASURE	10% - 10% 10% 10% - - - -	DRG/DATA SHEET/ 'MANUF. STD / IS:3024 / IS:849	QC Record. QC Record. QC Record. QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	1 2 2 2 1 2 2 2 2 2
1.3	Paper Insulated Copper Conductor	a) Dimensions b) Resistance/Conductivity c) Elongation d) Tensile Strength e) Proof stress if applicable f) Inter-strand test between strands for bunched conductors g) Cu purity of CC rod h) Chemical composition i) Surface Finish	Major Major Major Major Major Major Major Major Major	MEASURE TEST TEST TEST TEST TEST TEST TEST VISUAL	100% 10% - - - - - - 100%	'MANUF. STD / IS:13730-P-27/IEC 80554	QC Record. Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC	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	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	1 2 2 2 2 2 2 2 2 2
BHEL			BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL		
			PARTICULARS					
			NAME					
			SIGNATURE					
			DATE					

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[illegible]

CUSTOMER		PROJECT		SPECIFICATION : PE-TS-381-302-E001	
BIDDER/ VENDOR		TITLE		NUMBER :	
SYSTEM		QUALITY PLAN		SPECIFICATION AUXILIARY SERVICE TRANSFORMER	
CAT.		ITEM OIL FILLED TRANSFORMER		VOLUME III	
TYPE/ METHOD OF CHECK		REFERENCE DOCUMENT		SECTION	
EXTENT OF CHECK		ACCEPTANCE NORM		REMARKS	
5		7		10	
6		8		11	
9		10		11	
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PROJECT		CUSTOMER :		QUALITY PLAN		BIDDER/ VENDOR		SPECIFICATION : PE-TS-381-302-E001	
TITLE		NUMBER :		SPECIFICATION AUXILIARY SERVICE		TRANSFORMER		TRANSFORMER	
NUMBER PED-302-00-Q-001 Rev. 03		ITEM OIL FILLED TRANSFORMER		VOLUME III		SECTION		REMARKS	
REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		P W V			
EXTENT OF CHECK		TYPE/ METHOD OF CHECK		5		6		7	
CAT.		3		4		5		6	
1		2		3		4		5	
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	100% 100% - -	Manf. Std./IS:778 Class 1	QC Record QC Record Supplier's TC Supplier's TC	2 2 3/2 3/2	10 - 2.1 2
2.9	Bushing CT	a) Visual check/Dimensional check b) Routine test	Major Major	Measure/Visual test Test	100% -	Manf. Std./IS:2705 Manf. Std./IS:2705	Supplier's TC Supplier's TC	2 3/2	11 2.1
2.10	Marshaling box/TRCC	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 Visual	100% 100% 100% 100% 100% 100%	Drg./Manf. Std./IS:5/IS:13947	Supplier's TC Supplier's TC Supplier's TC Supplier's TC Supplier's TC QC records	3/2 3/2 3/2 3/2 3/2 2	2 2 2 2 2 1
2.11	OT&WTI	a) Type size & make b) HV test c) Temperature calibration d) Switch setting & switch differential e) Calibration & operation of switch	Major Major Major Major Major	Test Test Test Test Test	- - - - -	Manf. Std.	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	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	Visual Measure Measure/test Test Test Visual/ DPT test	100% 100% 100% 100% 100% 100%	Drg./Manf. Std./IS:101	QC records QC records QC records Supplier's TC Supplier's TC QC records	3/2 3/2 3/2 3/2 3/2 2	2 2 2 2 2 1
2.13	Hardware	a) Dimensional check b) Tensile strength	Major Major	Measure Test	100% -	Relevant code Manf. Std.	Supplier's TC Supplier's TC	3/2 3/2	2 -
BHEL		PARTICULARS		BIDDER/VENDOR		NAME		SIGNATURE	
		DATE						BIDDER'S/VENDORS COMPANY SEAL	

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CUSTOMER :		PROJECT TITLE		SPECIFICATION : PE-TS-381-302-E001	
BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-302-00-Q-001 Rev. 03		SPECIFICATION AUXILIARY SERVICE TRANSFORMER	
SYSTEM CAT.		ITEM OIL FILLED TRANSFORMER		SECTION VOLUME III	
SHEET 6 OF 10		REFERENCE DOCUMENT		AGENCY	
CHARACTERISTICS CHECK		EXTENT OF CHECK		P W V	
SL. NO.	COMPONENT/OPERATING CHARACTERISTICS	TYPE/METHOD OF CHECK	7	8	9
1	2	3	4	5	6
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 (IP, O/P, DISCH, NO LOAD, Locked Rotor test)	Major Major Major Major Major	Visual Measure Test Test Test Test	100% 100% - - -
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% - - - -
2.16	Roller Assembly	a) Dimensions b) Mechanical & Chemical properties of Raw material used for Shaft & Roller	Major Major	Measure Measure	100% -
2.17	Terminal Connector (if applicable)	a) Dimensional check b) Surface finish c) Acceptance test	Major Major Major	Measure Visual Test	100% - -
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%
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% 100%
2.20	Silicagel Breather	a) Type, Size, Model b) Pressure/ Leakage test c) Colour of silica gel	Major Major Major	Visual Test Visual	100% - -
BHEL		PARTICULARS		BIDDER/VENDOR	
		NAME			
		SIGNATURE			
		DATE			
				BIDDER'S/VENDORS COMPANY SEAL	

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CUSTOMER		PROJECT		SPECIFICATION : PE-TS-381-302-E001					
BIDDER/ VENDOR		TITLE		NUMBER :					
QUALITY PLAN		QUALITY PLAN		SPECIFICATION AUXILIARY SERVICE					
SHEET 7 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 AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10
3	IN-PROCESS								11
3.1	Fabrication of Tank, Conservator, Radiator, HV/LV CABLE BOX and welding requirement	Major	Verify/Review	100%		Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2
	a) Welding procedure specification	Major	Verify/Review	100%				QC Records	2
	b) Process qualification record	Major	Verify/Review	100%				QC Records	2
	c) Welder qualification	Major	Verify/Review	100%				QC Records	2
	d) Welding electrodes-Mechanical Properties	Major	Visual	100%				QC Records	2
	e) Filup for butt weld joints of tank and cover	Major	Visual	100%				QC Records	2
	f) Visual check on weldment & any foreign particle in the entire tank with conservator, pipes etc. and blanking of ends with bolted plates	Major	Measure	100%		Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2
	g) Dimensional check after final welding incl. foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes	Major	Test	100%				QC Records	2.1
	h) DP test on welded joints	Major	Visual	100%				QC Records	2.1
	i) Check for flatness gasket surface	Major	Measure	100%				QC Records	2.1
	J) Rim flatness	Major	Visual	100%				QC Records	2.1
	k) Surface cleaning by sand/shot blasting	Major	Measure	100%				QC Records	2.1
	l) Primer coating, paint shade thickness inside & outside	Major	Test	100%				QC Records	2.1
	m) Paint film adhesion test	Major	Vacuum test	100%		Appd. Doc./BHEL SPEC./CBIP	Appd. Doc./BHEL SPEC./CBIP	QC format	2.1
	n) Vacuum Test (Tank)	CR	Pressure test	1 unit each type				QC format	1
	o) Pressure test (Tank)	CR	Visual	1 unit each type				QC Records	2
3.2	Core Stamping	Major	Measure	100%		Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2
	a) Burr & Bow	Major	Measure	100%				QC Records	2
	b) Dimensional check	Major	Measure	100%				QC Records	2
3.3	Core Building	Major	Visual	100%				QC Records	2
	a) Dimensional check and limb plates.	Major	Visual	100%				QC Records	2
	b) Assembly of limb insulation	Major	Visual	100%				QC Records	2
	c) Rectangularity of core assembly	Major	Visual	100%				QC Records	2
	d) Freedom from overlaps & air gap at joints	Major	Visual	100%		Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2
	e) Learning of cor(ie core vertically)	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
	i) Earthing of core	Major	Visual	100%				QC Records	2
BHEL		PARTICULARS		BIDDER/VENDOR					
		NAME		SIGNATURE					
		DATE							
								BIDDER'S/VENDORS COMPANY SEAL	

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CUSTOMER		PROJECT TITLE		SPECIFICATION : PE-15-381-302-E001	
BIDDER/ VENDOR		QUALITY PLAN		NUMBER...	
SYSTEM		ITEM OIL FILLED TRANSFORMER		TRANSFORMER	
CAT.		REFERENCE DOCUMENT		SECTION	
TYPE/ METHOD OF CHECK		ACCEPTANCE NORM		VOLUME III	
EXTENT OF CHECK		FORMAT OF RECORD		REMARKS	
CAT.		P		W	
3		8		10	
4		7		11	
5		6		5	
6		9		1	
7		10		11	
8		11		12	
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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 shets, 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
- Column 11- 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 by BHEL and all tests as per relevant 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 preserved 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 complied with.
7. Inspection reports, log sheets, test reports/certificate. etc. shall be furnished to BHEL at the appropriate 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.

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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

47



TITLE :

**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**SPECIFICATION NO.
PE-RC-999-302-E001VOLUME NO. : **II-B**SECTION : **A**REV NO. : **00** DATE : **28/05/10**

SHEET : - OF -

SECTION 'A'

SCOPE OF ENQUIRY



TITLE :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

SPECIFICATION NO.	PE-RC-999-302-E001
VOLUME NO. :	II-B
SECTION :	A
REV NO. :	00
DATE :	28/05/10
SHEET :	1 OF 1

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.

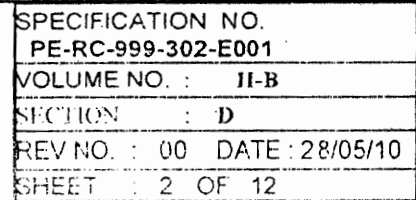
2.00 CODES AND STANDARDS

- 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).

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- | | |
|------|---|
| 6.01 | Technical particulars of transformer's are specified in Data Sheet --A |
| 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**

- 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.
- 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.
- c) The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.
- d) Clamps and fittings of steel or malleable cast iron shall be galvanised.
- 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.
- f) Creepage distance shall be minimum 25mm/ kV per unit of system phase to phase voltage.
- g) Minimum rated current for bushings shall be as under:
 - 1) 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
 - 2) 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/m^2 . Transformer shall also withstand following conditions due to combined voltage and frequency variations:

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

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 $\pm 10\%$ 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 :

Criteria for establishing similarity of transformer
for acceptance of Short circuit test report

Transformers similar to a reference transformer can be identified by comparison using the following list of critical features :

1. Same kVA rating as the reference unit.
2. Same voltage ratio as the reference unit.
3. Same % impedance as the reference unit.
4. The tested No load loss and load loss of the reference unit shall be in the range of 100% to 90% of the max. No load loss and load loss respectively being guaranteed for the unit proposed to be supplied.
5. Same type of operation i.e. aux. Service distribution as the reference unit.
6. Same conceptual design i.e oil-immersed type, core type with concentric windings, sandwich type, shell type, circular coils, non- circular coils as the reference unit.
7. Same arrangement of main windings and geometrical sequence as the reference unit.
8. Same type of winding conductors i.e annealed or hardened copper, continuously transposed conductors and epoxy bonding, if used, as the reference unit.
9. Same type of main windings e.g. helical, disc, layer, pancake, as the reference unit.
10. Same relative winding stresses (ratio of actual to critical stress) at short circuit not exceeding 110% of those as the reference unit.
11. Same manufacturing process as the reference unit.
12. Same clamping and supporting arrangement as the reference unit.

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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 calculation for short circuit withstands capability (refer cl. 6.14).
- 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:

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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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**

SHEET : **1** OF **1**

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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TITLE :

TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERSSPECIFICATION NO.
PE-RC-999-302-E001

VOLUME NO. : II-B

SECTION : D

REV NO. : 00 DATE : 28/05/10

SHEET : OF

ANNEXURE - VSTANDARD QUALITY PLAN

Please refer Annexure-II in
section - C



TITLE :

**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

SPECIFICATION NO.

PE-RC-999-302-E001VOLUME NO. : **II-B**SECTION : **D**REV NO. : **00** DATE : **28/05/10**SHEET : **1** OF **1****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.

(25)



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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ANNEXURE - VIII

APPLICABLE STANDARDS & CODES FOR TRANSFORMERS

Specification for power transformers	IS: 2026 [] IS: 14171 [] 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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TITLE :

**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**SPECIFICATION NO.
PE-RC-999-302-E001

VOLUME NO. : III

SECTION : D

REV NO. : 00 DATE : 28/05/10

SHEET : - OF -

**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

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TITLE :

TECHNICAL SPECIFICATION FOR
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-381-302-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) 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)
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.
- c) LV Neutral on Star
- 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
Solidly grounded
2 Sec.
- b) 415V System
- c) Through fault withstand time
- 22.0 Details of Cooling Equipment Detachable tank mounted radiators



TITLE :

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

- 23.0 CTs Details (Tentative) :
(Final details after award of contract)
- 23.1 Provision/ accommodation of CTs
in Neutral on Star side
- 24.0 Colour Shade :
a) Interior (For M. Box)
b) Exterior
- 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
LT TRANSFORMERS
(OIL FILLED)
SPECIFICATION NO. PE-TS-381-302-E001**

- 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:

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



TITLE :

**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**SPECIFICATION NO.
PE-RC-999-302-E001VOLUME NO. : **III**SECTION : **D**REV NO. : **00** DATE : **28/05/10**

SHEET : - OF -

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



TITLE :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

DATA SHEET-B

SPECIFICATION NO.
PE-RC-999-302-E001
VOLUME NO. : **III**
SECTION : **D**
REV NO. : **00** DATE : **28/05/10**
SHEET : **1 OF 1**

FOR 11kV, 433V

1.0 MVA

Energy Efficient transformer

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

FOR 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 :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

DATA SHEET-B

SPECIFICATION NO.
PE-RC-999-302-E001
VOLUME NO. : III
SECTION : D
REV NO. : 00 DATE : 28/05/10
SHEET : 1 OF 1

FOR 11kV/6.6kV

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					

FOR 11kV/3.3kV

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					



TITLE :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

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

**GUARANTEED TECHNICAL PARTICULARS
(DATA SHEET-C)**



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 : 1 OF 5

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

S. No.	Description	Unit	Particulars
1.0	Name of Manufacturer		
2.0	Reference Standards		
3.0	Installation		
4.0	Rated no load Voltage		
	a) HV Winding	kV	
	b) LV Winding	kV	
5.0	Type of cooling		
6.0	Rated kVA		
7.0	No. of phase	No(s)	
8.0	Rated Frequency	Hz	
9.0	Winding connections		
	a) HV Winding		
	b) LV Winding		
10.0	Vector group		
11.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	
12.0	Off-Circuit tap changer		
	a) Total range of tapplings (+/-)	%	
	b) Size of tapping step	%	
	c) For HV/LV variation		
13.0	Impulse voltage withstand level		
	a) HV Winding	kVp	
	b) LV Winding	kVp	

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

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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	
Vendor's Signature					VANDOR'S SEAL
Date					

	TITLE :	SPECIFICATION NO.
	TECHNICAL SPECIFICATION FOR	PE-RC-999-302-E001
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : III
	DATA SHEET-I	SECTION : D
		REV NO. : 00 DATE : 28/05/10
		SHEET : 4 OF 5

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 | Wb/M2 |
| | b) At 110% rated voltage | Wb/M2 |
| 34.0 | Maximum current density for | |
| | a) HV Winding | Amp/mm2 |
| | b) LV Winding | Amp/mm2 |
| 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 | mm |
| | ii) Transverse | mm |
| 37.0 | Pressure test withstand | |
| | a) Tank | Kg/M2 |
| | b) Radiator and other fittings | Kg/M2 |
| 38.0 | Vacuum withstand | |
| | a) Tank | mm of Hg |
| | b) Radiator and other fittings | mm of Hg |
| 39.0 | Approximate weight of | |
| | a) Core | Kg |
| | b) Windings | Kg |
| | c) Tank, Fittings & Coolers etc. | Kg |
| | d) Oil | Kg |
| | e) Total weight with oil | Kg |
| | f) Untanking weight (core & winding) | Kg |
| | g) Shipping weight of the heaviest package | Kg |
| 40.0 | Quantity of Insulating Oil | |
| | a) Oil in tank | Ltrs. |
| | b) Oil in cooling equipment | Ltrs. |
| | c) Total oil Quantity | Ltrs. |

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

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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 : 5 OF 5

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

- 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 %

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



TITLE :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

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

VOLUME NO. : **III**

SECTION : **D**

REV NO. : **00** DATE : **28/05/10**

SHEET : **-** OF **-**

SCHEDULE OF DEVIATIONS



TITLE :

**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**SPECIFICATION NO.
PE-RC-999-302-E001

VOLUME NO. : III

SECTION : D

REV NO. : 00 DATE : 28/05/10

SHEET : 1 OF 1

Sl. No	Specification Clause Ref.	Technical Deviation	Reason for Deviation
--------	---------------------------	---------------------	----------------------

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	

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TITLE :
**TECHNICAL SPECIFICATION FOR
OIL FILLED SERVICE TRANSFORMERS**

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

VOLUME NO. : **III**

SECTION :

REV NO. : **00** DATE : **28/05/10**

SHEET : - OF -

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 RATING AND QUANTITY MAY BE TO THE EXTENT OF +30% OF THE TOTAL ORDER VALUE.
2. BIDDERS TO NOTE THAT ALL ROUTINE AND SPECIAL TESTS AS PER THE TECHNICAL SPECIFICATION SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. ALL ROUTINE TESTS IN ACCORDANCE WITH IEC 60076 SHALL BE CARRIED OUT IN ALL THE TRANSFORMERS. BIDDERS SHALL QUOTE ACCORDINGLY.
3. BIDDERS TO NOTE THAT ALL ROUTINE AND SPECIAL TESTS AS PER CLAUSE NO. 10.05 OF TECHNICAL SPECIFICATION NO. PE-RC-999-302-E001 AND AS AMMENDED BY THIS SPECIFICATION IN ADDITION TO THOSE SPECIFIED IN IEC 60076 SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. ALL ROUTINE TESTS IN ACCORDANCE WITH IEC 60076 SHALL BE CARRIED OUT IN ALL THE TRANSFORMERS. BIDDERS SHALL QUOTE ACCORDINGLY.
4. 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 ARE TO BE CARRIED OUT AS ROUTINE TESTS ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST.
 - a) DIELECTRIC TESTS SHALL BE CARRIED OUT AS PER IEC 60076-3

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:-

1. TYPE TESTS AS INDICATED SHALL BE CONDUCTED / CARRIED OUT ON ONE TRANSFORMER OF EACH RATING & TYPE. CHARGES INDICATED SHALL ALSO BE APPLICABLE IN CASE OF WAIVAL OF ANY TYPE TEST BY THE PURCHASER AT A LATER DATE.



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**SCHEDULE OF UNIT PRICES**

SL. NO.	DESCRIPTION	QTY.	UNIT PRICE Rs.
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	WTI with alarm & trip contacts	1 no.	
4	OTI with alarm & trip contacts	1 no.	
5	Magnetic oil level gauge (MOG)	1 no.	
6	Diaphragm of explosion vent	1 no.	
7	Buchholz relay	1 no.	
8	Silica gel charge	3 charge	
9	Floats with contacts for Buchholz relay	1 set	
10	Set of gaskets	2 sets	
11	Contacts for tap changer	1 set	
12	Set of valves (1 no. of each size & type)	1 set	
13	Set of windings for one limb in a suitable oil container	1 no. each rating and type of transformer	
14	Hydraulic/ Screw Jack	4 no.	
15	Any other item considered essential by the bidder		

NOTES:

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



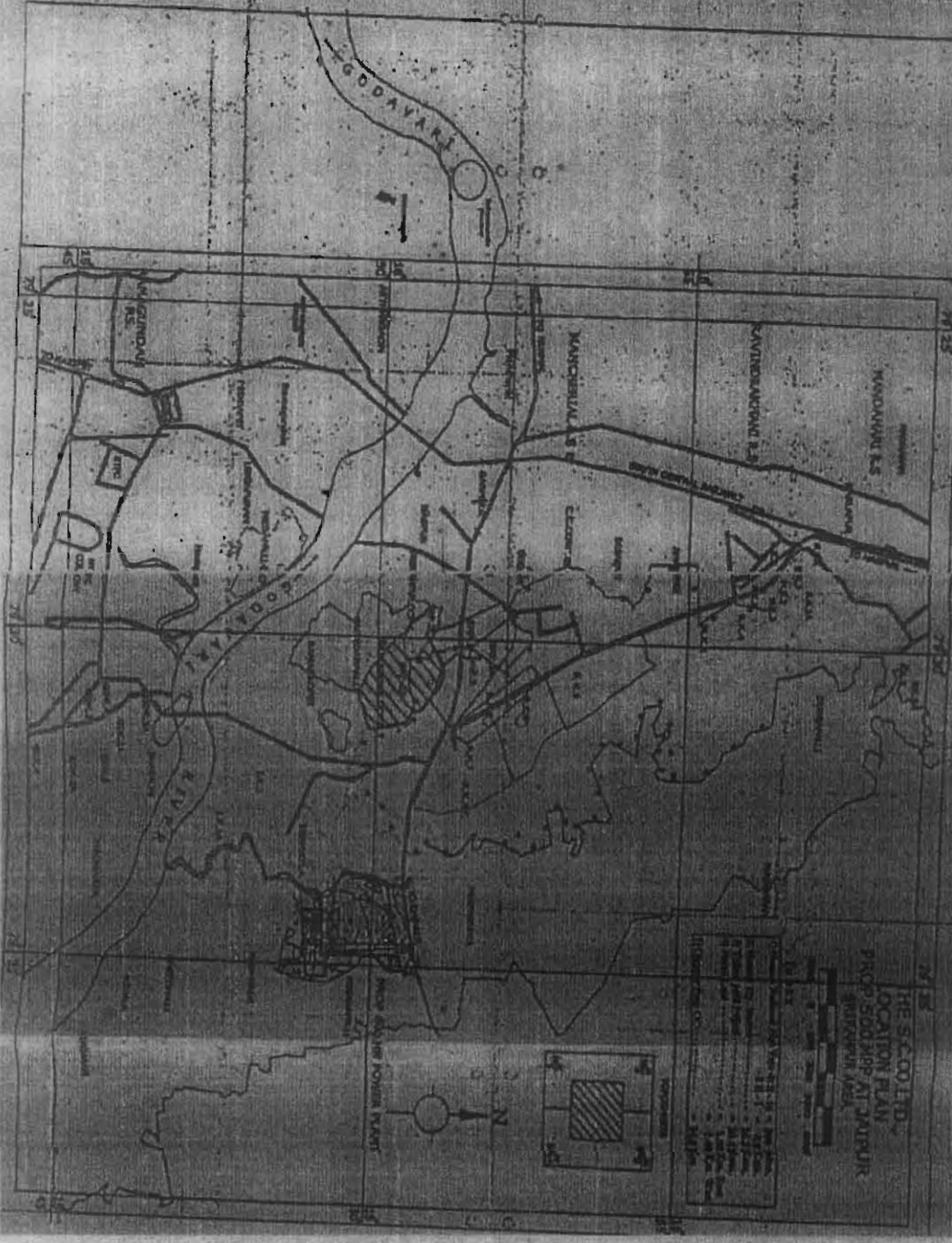
TITLE :

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

SL. NO.	DESCRIPTION	PRICE Rs.	PRICE Rs.	PRICE Rs.
		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			
2	Measurement of Harmonic current in no load current			
3	PRD operation test (for 2mva and above rating)			
4	Degree of Protection (IP 55) tests on Marshalling box			
5	Degree of Protection (IP 55) tests on cable box			
6	Zero Sequence Impedance			
7	Short Circuit Test as per IEC 60076-5**			
8	Lighting impulse (Full & Chopped Wave) test on HV & LV winding as per cl 14 of IEC 60076-3)			
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).			

NOTE:

1. All the type tests shall be conducted after short circuit test.
2. **charges for carrying out short circuit test shall be payable based on actual invoice from 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.).

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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