RAICHUR POWER CORPORATION LIMITED

2 x 800 MW YERAMARUS SUPER CRITICAL TPP

TECHNICAL SPECIFICATION OF OIL FILLED TRANSFORMERS

DOC. NO. PE-TS-362-302-E001

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

CONTENTS

TOTAL NO. OF SHEETS = 68 (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)

INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFER

1. Signed and stamped copies of the following shall be furnished by all bidders as technical offer :

    a. Unpriced Price Schedule with "QUOTED" words against each item (Annexure-A, Annexure-B and Annexure-C : Main BOQ-Cum-Price Schedule, Extra Oil and Type test charges as enclosed with the specification)
    b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer").
    c. A copy of previous sheet ("Contents").
    d. Datasheet-B duly filled, with bidder's signature and company stamp
    e. ("Deviation Schedule"), with "NO DEVIATION" and bidder's signature and company stamp

2. No other technical submittal such as copies of type test certificates, data sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.

3. No comments/ additions/ deletions shall be made by the bidder on the signed & stamped copy of the specification. Any such changes made by the bidder shall not be considered.

4. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference in the technical offer / covering letter shall not be considered by BHEL.

5. 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.

6. Any changes made by the bidder in the price schedule with respect to the item description/ quantities, notes etc. from those given in Annexure-A of specification [Bill Of Quantities] shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

PREAMBLE

1.0 The tender document contains two (2) volumes. The bidder shall meet the requirements of all the two 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 vendor is 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 SPECIFICATIONS)

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

Volume-IIA	:	General Technical Conditions
Volume-IIB	:	Technical Specification including Drawings, if any.

1.2.1 Volume-IIB

This volume is sub-divided into following sections:-

Section-A	:	This section outlines the scope of enquiry.
Section-B	:	This section provides "Project Information".
Section-C	:	This section indicates technical requirements specific to the contract, not covered in Section-D.
Section-D	:	This section comprises of technical specifications of equipments complete with data sheet A.

Data Sheet – A: - specifies data and other requirements pertaining to the Equipment.

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).

SECTION – A

SCOPE OF ENQUIRY

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 2x800 MW YERAMARUS TPS, UNIT#1&2

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 at site conditions.

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 bidder shall be responsible for and governed by all requirements stipulated hereinafter.

5.0 Bidder shall confirm total compliance to the specification without any deviations from technical/quality assurance requirements stipulated.

6.0 Deviations, if any should be brought at very clearly on deviation sheet enclosed with specification only, Otherwise it will be presumed that the bidder’s offer is in line with what has been stated/ asked for in this specification.

7.0 The documents shall be in English Language and MKS system of units.

SECTION - B

PROJECT INFORMATION

	RAICHUR POWER CORPORATION LTD	
	TITLE **PROJECT INFORMATION**	SHEET 1

1.0	Owner	:	Raichur Power Corporation Ltd 22/23, Sudarshan Complex, IInd floor, Sheshadri Road, Bangalore–560 009 Karnataka, India
2.0	Consultant	:	M/s Evonik Energy Services (I) Pvt. Ltd.,A-29, Sector 16 Noida-201301(UP), India
3.0	Project Title	:	2x800 MW Yermarus Thermal Power Station
4.0	Location	:	Yermarus Raichur Dist Karnataka State, INDIA It is situated at about 8 Kms from Raichur on the Raichur-Hyderabad State Highway-13 and 12 kms away from Bank of river Krishna and about 5 kms from Raichur Thermal Power Station
5.0	Nearest Railway	:	Chicksugur Railway Station which is about 2 kms from site.
6.0	Nearest Airport	:	Hyderabad around 200 kms
7.0	Nearest Port		Chennai around at about 470 kms from site.
8.0	Latitude and Longitude	:	Latitude – 16° 16’ 55.9”N Longitude – 77° 20’ 38.6”E
9.0	Elevation above mean sea level	:	350-375 meters
10.0	Climatic Conditions		
	(a) Ambient Temperature		
	i. maximum temperature	:	45^{o} C
	ii. minimum temperature	:	6^{o} C

iii. Design Temperature for all Electrical/ Mechanical Equipment : 50° C Ambient

(b) Relative Humidity

i. Maximum during monsoon : 85%

ii. Minimum : 20%

iii. Average : 65%

(c) Rainfall

Annual average rain : 720 mm
Max. for one day : 115 mm
Max. intensity : 38 mm/hr
Period : June to September

(d) Wind Speed

i. Prevailing wind direction : West, South-East, North-West, South-West

ii. Maximum mean wind speed : 15.9 Kms / hr (4.42 m/s)

iii. Average : 9.61 Km/hr (2.67 m/s)

11.0 Wind Load

Calculations for wind effect shall be in accordance with IS:875- (Part-3) latest revision taking into account the following :

(a) Basic wind speed of 39 m/sec as given in Fig.1 of the code.

(b) Factor K1 shall be taken as 1.06

(c) Terrain category shall be 2 and corresponding values shall be taken for K2

(d) Factor K3 shall be taken as 1.0

12.0 Wind Loading for Stack

(a) For wind pressure as per clause 11.0 above
(b) For RC stacks as per IS: 4998

13.0	Seismic data (as per IS:1893 latest issue)		
	(a) Zone	:	Zone III (as per IS:1893- latest)
	(b) Importance factor (I)	:	1.75
14.0	Auxiliary power supply	:	Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following supply system.
	(a) For motors rated above 1500 kW	:	11000V, 3 phase, 3 wire, 50Hz medium earthed AC
	(b) For motors rated 175KW and above and below 1499KW.		3300V, 3 phase, 3 wire, 50Hz medium earthed AC
	(c) For motor rated 174 kW and below	:	415, 3 phase, 3 wire solidly earthed AC
	(d) For motor control centre	:	415V, 3 phase, 3 wire solidly earthed AC
	(e) DC. motor starters, DC solenoids, DC alarm, control and protections	:	220 V DC, 2 wire, unearthed DC
	(f) AC control & protective devices	:	110 V 1 phase, 50Hz, 2 wire AC supply. The single-phase 110V AC supply shall be derived by Contractor by providing 415V/110V control transformers of adequate rating with MCCB /MCB on both the primary and secondary sides.
	(g) Uninterrupted power supply	:	240 V, 1 phase, 50Hz, 2 wire AC supply from UPS system for I&C (including indicator recorders) and UCMS only

(h)	AC solenoids, indicators/recorders, space heaters (for motors rated 30KW and above)	:	240V 1 phase, 2 wire, 50Hz AC system with effectively earthed neutral. The power supply shall be derived by CONTRACTOR by providing 415V/ 240V transformer of adequate rating with MCCB/MCB on primary/secondary sides.
(i)	Winding heating of motors below 30kW	:	24 V 1 phase,50Hz, AC with one point earthed. This shall be derived by CONTRACTOR by providing 415V 3 phase, 3 wire, AC supply through an adequately rated step-down transformer of adequate rating with MCCB / MCB on primary/secondary sides.
(j)	Solid state controls (including solenoid valves)	:	24 V DC, 2 wire, supply from Battery chargers for instrumentation system only.
(k)	Lighting fixtures	:	240 V, 1 phase, 2 wire, 50Hz system.
(l)	Lighting fixtures and space heaters in panels	:	240 V, 1 phase, 2 wire, 50Hz system.
(m)	Construction supply	:	415 V, 3 phase, 4 wire, 50 Hz AC supply with neutral lead solidly earthed.

(n) The above voltages may vary as follows :

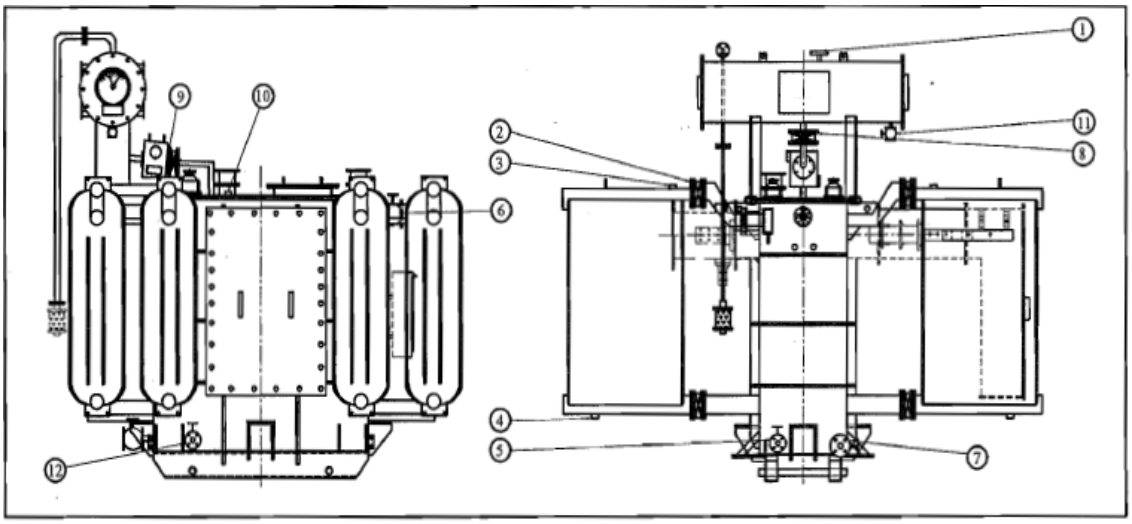
All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.

i.	AC supply	:	Voltage variation ±10% Frequency variation ± 5% Combined voltage & frequency variation ± 10%
ii.	DC supply	:	Voltage variation +10% -20%

SECTION – C

1. Minimum rating of the HV bushing shall be 2000Amps (17.5kV class). HV Bushing shall be of Porcelain type.

2. Indicative (minimum) List of valves shall be as per the following diagram



ITEM	FUNCTION	SIZE	QTY.
1	CONSERVATOR OIL FILLING HOLE WITH DUMMY FLANGE	25 mm	
2	RADIATOR VALVE (BUTTER FLY TYPE)	80 mm	
3	RADIATOR AIR RELEASE PLUG	15 mm	
4	RADIATOR OIL DRAIN PLUG	15 mm	
5	BOTTOM OIL FILTER VALVE	32 mm	
6	TOP OIL FILTER VALVE	32 mm	
7	BOTTOM DRAIN VALVE	32 mm	
8	SHUT OFF VALVE CONSERVATOR SIDE	50 mm	
9	SHUT OFF VALVE TRANSFORMER SIDE	50 mm	
10	AIR RELEASE PLUG	15 mm	
11	CONSERVATOR DRAIN VALVE	15 mm	
12	SAMPLING VALVE	15 mm	

3. WTI and OTI shall take input from Capillaries and CT input (For WTI) independent of Current converter Unit. Current converter Units shall take Temperature inputs from separate RTDs mounted on transformer Tank.

ANNEXURE-A

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 800 MW YERAMARUS SUPER CRITICAL TPP

SCHEDULE OF PRICES – TRANSFORMERS

S. No.	ITEM CODE	DESCRIPTION	TOTAL (Nos)	UNIT PRICE Rs.	TOTAL PRICE Rs.
1	302-110009-A	2000kVA, 11.0kV/433V, 3 phase, 2 winding, outdoor, ONAN, Z= 10.0%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV and with bus-duct type LV termination)	2		

NOTES

1. 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. BIDDERS SHALL QUOTE ACCORDINGLY.

ANNEXURE-B

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 800 MW YERAMARUS SUPER CRITICAL TPP

SCHEDULE OF PRICE - EXTRA OIL

S. NO.	ITEM CODE	DESCRIPTION	QTY. OF TRANSFORMERS	COST OF 10% EXTRA OIL PER TRANSFORMER	TOTAL COST OF 10% EXTRA OIL
1	302-11045-A	10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR A) 2000kVA TRANSFORMER	2		

NOTE:

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

ANNEXURE-C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
2 X 800 MW YERAMARUS SUPER CRITICAL TPP

SCHEDULE OF PRICES
TYPE TESTS ON TRANSFORMERS

S. No.	ITEM CODE	DESCRIPTION	PRICE Rs.
			11.0/0.433kV
			2000kVA
1	302-11051-A	TANK PRESSURE TEST	
2		TANK VACUUM TEST	
3		NOISE LEVEL	
4		TEMPERATURE RISE TEST	
5		CAPACITANCE & TAN DELTA OF WINDINGS	
6		MEASUREMENT OF HARMONIC CURRENT IN NO LOAD CURRENT	
7		DGA TEST ON OIL BEFORE AND AFTER TEMPERATURE RISE TEST	

NOTE:-

1. **SUCCESSFUL BIDDER TO OFFER TYPE TEST CERTIFICATES INCLUDING SHORT CIRCUIT TEST REPORT OF SIMILAR TRANSFORMER (AS PER THE GUIDANCE FOR IDENTIFICATION OF A SIMILAR TRANSFORMER AS DEFINED IN ANNEX-B OF IEC 60076-5) FOR EVALUATION BY BHEL/CUSTOMER.**
2. BIDDERS TO NOTE THAT ALL ROUTINE/ SPECIAL TESTS AS PER THE TECHNICAL SPECIFICATION SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST.
3. THE CHARGES INDICATED IN THE PRICE SCHEDULE SHALL ALSO BE APPLICABLE IN CASE OF WAIVAL OF ANY TYPE TEST BY THE PURCHASER AT A LATER DATE.
4. THE FOLLOWING ADDITIONAL TESTS SHALL ALSO BE CARRIED OUT AS ROUTINE TESTS ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST;
   1) MAGNETIC BALANCE TEST,
   2) NO LOAD LOSS & EXCITING CURRENT AT 415V AT LV SIDE AND AT 90%,100%,110% OF RATED VOLTAGE BEFORE AND AFTER DI-ELECTRIC TESTS.
   3) MEASUREMENT OF CAPACITANCE AND TAN-DELTA OF EACH WINDING.
   4) LOAD LOSS & PERCENTAGE IMPEDANCE AT ALL TAPS.

SECTION – D

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).

2. Special Tools & Tackles required for erection, commissioning and proper maintenance of equipment. — One Lot
(Bidder to furnish list along with offer)

3. Commissioning spares for each transformer. — One Lot
(Bidder to furnish list along with offer)

4. O & M spares — As specified in Annexure-I

5. Type Tests — As specified in Annexure-II

Note:
Extra 10% of total oil quantity shall be supplied along with the first lot of transformers in sealed non returnable drums.

4.00 SERVICES & EQUIPMENT TO BE EXCLUDED

4.01 Civil work such as transformer foundation, cable trenches etc.
4.02 Erection, testing, commissioning of transformer at site.
4.03 External power connection for HV & LV side of transformer by means of busduct/ cables, as applicable.
4.04 HV termination kits.
4.05 Connection to Station Earth.

5.00 TERMINAL POINTS

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

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

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

V. Transformer earthing pads.

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

6.00 TECHNICAL REQUIREMENTS

6.01 Technical particulars of transformers 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.

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** Tank shall be of welded construction & 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. Guides shall be welded on inner

side of Tank to facilitate tanking and untanking of transformer core and coil assembly.
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, haulage holes 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.

6.08.05 **Radiators** Tank mounted with shut off valves at each point of connection to tank, drain plug/ valve at bottom, air release plug at top.

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 as per data sheet-A.

g) Minimum rated current for bushings shall be as under. However, same shall comply with IS-2099 and HV/LV system fault current mentioned in Clause No. 20.00 of Datasheet A:

1) H V Bushing for 11kV

2.0 MVA = * Refer Section-C

2) L V Bushing for 433V

2.0 MVA = 4000A

h) LV Bushing Palms shall be silver/ Tin Plated.

i) No arching horns shall be provided in the bushing.

j) Terminal Bushing shall be oriented for minimum phase to phase and phase to earth clearance as per CBIP.

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. The cable box shall also be provided with a suitable canopy. Suitable cable glands (double

compression type) and lugs shall be provided for cable termination. Cable Box shall be provided with drain plug/ relief vent.

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.

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. Degree of protection of LV busduct flange enclosure shall be IP:55.

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. The Neutral CT box shall also be provided with a suitable canopy. CTs shall be cast resin type. CT mounted inside the tank shall not be acceptable. All CT Terminals shall be provided as fixed type terminals on the marshalling box to avoid any hazard due to loose connection leading to CT opening, In no circumstances plugin type connectors shall be used in CT.

6.10 Voltage control (off circuit type)

a) 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.

b) 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.

c) 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.

d) 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.

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

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 2.5mm^2 .

d) The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 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. The marshalling box shall also be provided with a suitable canopy.

f) CT terminals shall be with shorting and disconnecting facility. Separate Terminal Blocks shall be provided for Power and control terminals.

6.12 Flux density

Flux density in any part of the core & yoke on any tap position with ±10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 Wb/m^2. Transformer shall also withstand following conditions due to combined voltage and frequency variations:

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

6.13 Winding

For 11KV & 3.5KVwinding, type of winding shall be continuous disc & for 433V winding, type of winding shall be spiral type. The conductors shall be of electrolytic grade copper.

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.

6.15 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds. Calculation shall be furnished by the bidder during contract engineering stage to substantiate the adequacy of support system to withstand short circuit forces.

6.16 Maximum Transformer losses including tolerances shall be as per annexure – III.

6.17 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 valve and oil filling hole.
b) Magnetic oil level gauge with low-level alarm contact.
c) Prismatic & toughened glass oil level gauge.
d) Gaskets
e) Gasket protection covers.
f) Silica gel breather with oil seal.
g) Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.
h) Diaphragm type explosion vent for transformers of rating less than 2MVA
i) Pocket on tank cover for thermometer.
j) Protected type mercury in glass thermometer.
k) 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.

l) 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.

m) Drain Valves.

n) Sampling devices.

o) Filter valves.

p) Earthing terminals – 2 Nos.

q) Rating & Diagram plates.

s) Valve schedule plate.

t) Two sets of lifting lugs (one for transformer with oil and other for tank cover).

u) Jacking pads.

v) Skids and pulling eyes on both sides.

w) Air release devices.

x) Inspection cover.

y) Oil filling hole and cap.

z) Tank mounted marshalling box.

aa) Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.

bb) Clamping arrangement for rollers.

cc) Ground support for cable box.

dd) Neutral CT secondary box.

ee) Haulage facilities.

ff) 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.

gg) 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 $\pm$ 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.

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 (PE-QP-999-302-E001 Rev. 00) 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-I of QAP. 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 waival 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.

10.08 Charges for all type tests and special test as per Annexure-I of QAP 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 In case any of the type and special tests are required to be repeated the same shall be carried out by the vendor without any commercial / delivery implication to BHEL.

10.11 For acceptance of short circuit reports for tests carried out earlier on similar transformers, successful bidder shall furnish the following documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL

a) Calculations and design considerations to prove ability to withstand the dynamic effects of short circuit.

b) Short circuit test report of previously tested similar transformer for validation by comparison. Criteria for similarity of transformer for acceptance of Short circuit test report shall be as given in the Annexure-B of IEC-60076-5.

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.

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.6.15 & cl 10.11)
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.

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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	TECHNICAL SPECIFICATION FOR	**PE-TS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II-B**
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		REV NO**.** : **00** DATE : 30/03/2015
		SHEET :

ANNEXURE-I
LIST OF O & M SPARES

■ **NOT ORDERDED FOR THIS PROJECT.**

ANNEXURE-II
TYPE/SPECIAL TESTS FOR OIL FILLED SERVICE TRANSFORMERS

- **REFER SECTION-C/ Annexure -1 of QAP**

ANNEXURE III

TRANSFORMER LOSSES

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

11KV/433V TRANSFORMERS

Ratings	Maximum No-Load losses at rated frequency and 100%voltage	Maximum Load losses at normal ratio, rated current and 75 deg. C
2.0MVA	2.4 kW	24.0kW

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:

PENALTY =Penalty Rate x [measured No-Load losses - maximum No-Load losses) + (measured Load losses – maximum Load losses)]

ANNEXURE- IV
DOCUMENTS/ DRAWINGS DISTRIBUTION SCHEDULE

CONTRACT COORDINATION PROCEDURE	Rev 03
PROJECT: 2 X 800 MW YERMARUS THERMAL POWER STATION	30/07/10

Annexure II

S no	Description	KPCL			Contractor (BHEL)				
	1	Bangalore (Thermal Design)	YTPS (site)	Consulting Engineer M/s EESI	PS-Marketing	Units/ PEM	Site	PMG	PSSR
A	**Correspondence - soft copy (email) & Hard copy as per requirement**								
1	Post Contract	1	Nil	Nil	S	1*	1*	1	1*
		1	Nil	S	Nil	Nil	Nil	Nil	Nil
		1	S	Nil	Nil	1*	1	1	1
		S	1	1	Nil	1	1*	1	1*
		1*	1*	Nil	Nil	1*	1*	1	S
		1	1	Nil	1*	1*	1*	S	1*
B (a)	**Contractor Drawings**								
1	Preliminary/ resubmission	PDF + 1 hard copy	Nil	PDF	Nil	S	Nil	P	Nil
2	Return preliminary with comments	PDF	Nil	S	Nil	PDF	Nil	P	Nil
3	Final approved drawings for stamping (Hard copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Return of stamped copies by EESI (Hard copy)	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution by contractor (Hard Copy)	4	4	Nil	Nil	S	4	P	Nil
6	As-Built drawings/ Erection Drawings	1CD + 1hard copy	1 CD + 4 hard copies	Nil	Nil	S	1	P	Nil
B (b)	**All design calculations/ design memorandum/ data sheet/ MQP**								
1	Preliminary/ resubmission	1	Nil	1	Nil	S	Nil	P	Nil
2	Return preliminary with comments	1	Nil	S	Nil	1	Nil	P	Nil
3	Final approved documents for stamping (Hard Copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Stamped copies	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution	2CD	Nil	Nil	Nil	S	1*	P	1*
C	**Progress Reports (Monthly)**								
1	Contractor	3	Nil	Nil	Nil	Nil	Nil	S	Nil
2	Consultant	3	Nil	S	Nil	Nil	Nil	1	Nil
D	**Manuals**								
1	Erection & Commissioning	3	5	Nil	Nil	Nil	3	P	S
2	Operation & Maintenance	3	5	Nil	Nil	S	3	P	P

Abbreviations:
RPCL: Raichur Power Corporation Limited
Consultant: M/s Evonik Energy Services (India) Pvt. Ltd. (EESI)
S: Source, T: Transparency, CD: Compact Disc, 1*: One copy case to case basis,
P: Only transmittal / covering letter, PDF: Soft copy in pdf format

Chief Engineer RPCL Thermal-Designs

ANNEXURE – V

STANDARD QUALITY PLAN

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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.

ANNEXURE -VII

COMMISSIONING SPARES FOR EACH TRANSFORMER

S. NO.	DESCRIPTION	QTY.	REMARKS
		2000 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.

ANNEXURE - VIII

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 No275(latest edition) [ ]		
Guide for loading of oil immersed transformers	IS: 6600 [ ]	IEC: 354 [ ]	BS: [ ]
Noise level	NEMA, STANDARD-TR1		

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		REV NO. : **00** DATE : 30/03/2015
		SHEET :

SPECIFIC TECHNICAL REQUIREMENTS

(DATA SHEET-A)

S. No.	Description	Unit	Particulars
1.0	Quantity	2 (Two)	2000KVA
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	11.0

	b) LV Winding	kV	0.433
10.0	No Load transformation ratio		11/0.433,
11.0	Vector group		Dyn11
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	2000 kVA : 10%
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	12.0kV
	b) LV Winding	V	415V + 10%
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) HV Winding	kV	28 (11kV),
	b) LV Winding	kV	3 (0.415kV)
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV),
	b) LV Winding	kVp	-
19.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		Flange throat for TPN non-segregated Al Busduct
	d) LV Neutral		One neutral as part of LV busduct throat and second neutral with copper earthing bar for system earthing brought near the base of the transformer.
20.0	System Fault Level		

	a) HV Winding	kA	50 kA RMS for 3 sec
	b) LV Winding	kA	50 kA RMS for 1 sec

21.0 Method of System Earthing

a)	HV System	low resistance earthed to limit earth fault current to 300A
b)	LV System	Solidly grounded
c)	Through fault withstand time	2 Sec.

22.0 Details of Cooling Equipment — Detachable tank mounted radiators

23.0 Provision/ accommodation of CTs

LV Neutral	2000KVA,11.0/0.433 KV
	a) CT Ratio 3200/1A, 1 Core
	5P20 Class, 10VA

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

a)	HV side	
i)	Type	XLPE

ii)	Voltage Grade	12kV Unearthed
iii)	Conductor material & size	Stranded Aluminium, 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 evalution	N.A.
b) 'A' (for no load loss)	Losses not to exceed max. losses as per annex-III to sec-D
ii) 'B' (for load losses)	- Do-

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 Creepage distance 25mm/kV

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DATA SHEET-B

(TO BE SUBMITTED ALONG WITH OFFER FOR EACH RATING)

FOR 11kV/0.433V

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

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GUARANTEED TECHNICAL PARTICULARS
(DATA SHEET-C)

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

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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 tappings (+/-)	%	
	b) Size of tapping step	%	
	c) For HV/LV variation		
13.0	Impulse voltage withstand level		
	a) HV Winding	kVp	
	b) LV Winding	kVp	
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 above ambient of 50 deg. C	deg. C
	b) Winding by resistance above ambient of 50 deg. C	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 & duration	MVA, sec
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	
25.0	Type of winding	

a) HV Winding
b) LV Winding

26.0 Type of insulation
a) HV winding
b) LV winding
c) Between core & adjacent winding
d) Between windings

27.0 HV terminal arrangement
a) Bushing with or without CTs
b) CT details (Ratio, ACC. Class, VA, Type)
c) Clearance between phases in air mm
d) Clearances to earth in air mm

28.0 LV terminal arrangement
a) Bushing with or without CTs
b) CT details (Ratio, ACC. Class, VA, Type)
c) Clearance between phases in air mm
d) Clearances to earth in air mm

29.0 Neutral terminal arrangement
a) No. of neutral terminals
b) Neutral CT provided or not
c) NCT details (Ratio, ACC. Class, VA, Type)

30.0 HV Bushing
a) Rated voltage class kV
b) Rated current A

31.0 LV Bushing
a) Rated voltage class kV
b) Rated current A

32.0 LV Neutral Bushing
a) Rated voltage class kV
b) Rated current A

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.
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		%	
46.0	Paint Shade		:	
47.0	Voltage Variation		:	CFVV
48.0	Noise Level		:	
49.0	Degree of Protection			
	a) Marshalling Box		:	IP55
	b) HV Cable Box		:	IP55
	c) LV Flange Enclosure		:	IP55
50.0	Creepage Distance			
	a) HV Bushing	(mm/kV)	:	
	b) LV Bushing	(mm/kV)	:	
	c) Neutral Bushing	(mm/kV)	:	
51.0	Material of Winding			
	a) HV/LV		:	
52.0	Insulation level separate source			

power frequency voltage withstand

i) HV winding (kV RMS) :
ii) LV winding (kV RMS) :
iii) HV Bushing :
iv) LV Bushing :
v) Neutral Winding :

53.0 Temperature Class of Insulation :

54.0 Over Excitation withstand time (sec)

100% :
110% :
125% :
140% :

55.0 Thermal Time constant :

56.0 Magnetizing Inrush Current :

57.0 Radiator Details

a) No. of Radiators :
b) No. of Flutes :
c) Overall Dimensions :
d) Radiator sizing calculations furnished : (YES/NO)

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		REV NO**.** : **00** DATE : 30/03/2015
		SHEET :

SCHEDULE OF DEVIATIONS

`

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 reperesentative				
NAME	**Designation**	**Signature**	**Date**	**COMPANY SEAL**

	QUALITY PLAN	CUSTOMER : RPCL	PROJECT TITLE : 2 X 800MW YERAMARUS TPS	SPECIFICATION NO. : PE-TS-362-302-E001
		BIDDER/ VENDOR Esennar Transformers Private Limited	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS
	SHEET 1 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. : PE-V0-362-302-E314

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**											
1.1	Mild Steel plate, MS Pipe, Channels, MS Angles	a) Thickness	Major	MEASURE	10%			QC Record.	3/2		1	
		b) Surface defects	Major	VISUAL	100%			QC Record.	3/2		2	
		c) Chemical composition	Major	TEST	-			Supplier's TC	3/2		-	
		d) Mechanical Properties	Major	TEST	-	'MANFUF. STD /	'MANFUF. STD /	Supplier's TC	3/2		2	
		e) Hydraulic test of pipes	Major	TEST	-	IS:2062 / IS:1239	IS:2062 / IS:1239	Supplier's TC	3/2		2	
1.2	CRGO Steel	a) Thickness Dimension & Finish	Major	MEASURE	10%	DRG/DATA SHEET/	DRG/DATA SHEET/	QC Record.	2		1	
		b) Grade of CRGO	Major	MEASURE	-	'MANFUF. STD /	'MANFUF. STD /	TC	3/2		2	
		c) Cutting & burr	Major	MEASURE	10%	IS:3024 / IS:649	IS:3024 / IS:649	QC Record.	2		-	
		d) Scratches, surface finish	Major	VISUAL	10%			QC Record.	3/2		-	
		e) Waviness & edge camber	Major	MEASURE	10%			QC Record.	2		1	
		f) Specific core loss	Major	TEST	-			Supplier's TC	3/2		2	
		g) Surface resistivity	Major	TEST	-			Supplier's TC	3/2		2	
		h) Stacking factor	Major	TEST	-			Supplier's TC	3/2		2	
		i) Permeability	Major	TEST	-			Supplier's TC	3/2		2	
		j) Bend test/ Ductility	Major	MEASURE	-			Supplier's TC	3/2		2	
1.3	Paper Insulated Copper Conductor	a) Dimensions	Major	MEASURE	100%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Resistivity/Conductivity	Major	TEST	10%	IS:13730-P-27/IEC	IS:13730-P-27/IEC	Supplier's TC	3/2		1	
		c) Elongation	Major	TEST	-	60554	60554	Supplier's TC	3/2		2	
		d) Tensile Strength	Major	TEST	-			Supplier's TC	3/2		2	
		e) Proof stress if applicable	Major	TEST	-			Supplier's TC	3/2		2	
		f) Insulation test between strands for bunched conductors	Major	TEST	-			Supplier's TC	3/2		2	
		g) Cu purity of CC rod	Major	TEST	-			Supplier's TC	3/2		2	
		h) Chemical composition	Major	TEST	-			Supplier's TC	3/2		2	
		i) Surface Finish	Major	VISUAL	100%	Free from sharp edge,burr,scretch, cuts etc.	Free from sharp edge,burr,scretch, cuts etc.	QC Record.	2		2	
1.4	Insulating Paper	a) Dimensions	Major	MEASURE	10%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Density & substance	Major	TEST	-	IS:9335-P-2/IS:9335-	IS:9335-P-2/IS:9335-	Supplier's TC	3/2		2	
		c) Tensile Strength	Major	TEST	-	P-III/IEC 60554	P-III/IEC 60554	Supplier's TC	3/2		2	
		d) Elongation	Major	TEST	-			Supplier's TC	3/2		2	
		e) Water absorption	Major	TEST	-			Supplier's TC	3/2		2	
		f) Moisture content	Major	TEST	-			Supplier's TC	3/2		2	
		g) pH value & conductivity aqueous extract	Major	TEST	-			Supplier's TC	3/2		2	
		h) Ash content	Major	TEST	-			Supplier's TC	3/2		2	
		i) Electrical strength	Major	TEST	-			Supplier's TC	3/2		2	
		j) Air permeability	Major	TEST	-			Supplier's TC	3/2		2	
		k)Tear index	Major	TEST	-			Supplier's TC	3/2		2	
		l) Heat stability	Major	TEST	-			Supplier's TC	3/2		2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : RPCL	PROJECT TITLE : 2 X 800MW YERAMARUS TPS	SPECIFICATION NO. : PE-TS-362-302-E001	
		BIDDER/ VENDOR Esennar Transformers Private Limited	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	
	SHEET 2 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. : PE-V0-362-302-E314	

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	Insulation & Press-Board moulding (stock items)	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:1576	'MANFUF. STD / IS:1576	QC Record.	2		1	
		b) Compressibility	Major	Test	-			Supplier's TC	3/2		2	
		c) Density	Major	Test	-			Supplier's TC	3/2		2	
		d) Tensile strength	Major	Test	-			Supplier's TC	3/2		2	
		e) pH value/Conductivity of water extract	Major	Test	-			Supplier's TC	3/2		2	
		f) Electrical strength in air & oil	Major	Test	-			Supplier's TC	3/2		2	
		g) Shrinkage in air	Major	Test	-			Supplier's TC	3/2		2	
		h) Flexibility	Major	Test	-			Supplier's TC	3/2		2	
		i) Ash content	Major	Test	-			Supplier's TC	3/2		2	
		j) Moisture content	Major	Test	-			Supplier's TC	3/2		2	
		k) Cohesion between plies	Major	Test	-			Supplier's TC	3/2		2	
		l) Elongation	Major	Test	-			Supplier's TC	3/2		2	
		m) Oil absorption	Major	Test	-			Supplier's TC	3/2		2	
1.6	Densified wood	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:3513	'MANFUF. STD / IS:3513	QC Record.	2		1	
		b) Surface finish	Major	Visual	10%			QC Record.	2		-	
		c) Electrical strength in oil	Major	Test	-			Supplier's TC	3/2		1	
		d) Oil absorption	Major	Test	-			Supplier's TC	3/2		-	
		e) Moisture content	Major	Test	-			Supplier's TC	3/2		-	
		f) Compression strength	Major	Test	-			Supplier's TC	3/2		-	
		g) Crossbreaking strength	Major	Test	-			Supplier's TC	3/2		-	
		h) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
		i) Specific gravity/ Density	Major	Test	-			Supplier's TC	3/2		-	
1.7	Gasket(Rubber Bonded Cork sheet (if applicable)	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	QC Record.	2		-	
		b) Hardness	Major	Test	-			Supplier's TC	3/2		1	
		c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
		d) Compressibility	Major	Test	-			Supplier's TC	3/2		1	
		e) Recovery	Major	Test	-			Supplier's TC	3/2		-	
		f) Compression set	Major	Test	-			Supplier's TC	3/2		-	
		g) Flexibility	Major	Test	-			Supplier's TC	3/2		-	
		h) Fluid resistence test	Major	Test	-			Supplier's TC	3/2		-	
		i) Chloride/Sulphate content of water extract	Major	Test	-			Supplier's TC	3/2		-	
		j) Density	Major	Test	-			Supplier's TC	3/2		-	
1.8	Nitrile Rubber Cord and "0" Ring (if applicable)	a) Dimension	Major	MEASURE	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	Supplier's TC	2		-	
		b) Shore Hardness	Major	Test	-			Supplier's TC	3/2		-	
		c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-	
		d) Elongation at break	Major	Test	-			Supplier's TC	3/2		-	
		e) Compression set	Major	Test	-			Supplier's TC	3/2		-	
		f) Accelerated Ageing in oil	Major	Test	-			Supplier's TC	3/2		-	

	PARTICULARS	BIDDER/VENDOR	
BHEL	**NAME**		
	SIGNATURE		
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LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN		CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001			
			BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS			
		SHEET 3 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.9	Insulating Oil	a) Appearance of oil	Major	Visual				Supplier's TC	3/2		2,1	
		b) Density at 29.5 deg C	Major	Test				Supplier's TC			2,1	
		c) Kinematic viscosity at 27 & 40 deg C	Major	Test				Supplier's TC			2,1	
		d) Interfacial tension at 27 deg C	Major	Test				Supplier's TC			2,1	
		e) Flash point	Major	Test				Supplier's TC			2,1	
		f) Pour point	Major	Test				Supplier's TC			2,1	
		g) Neutralization value	Major	Test				Supplier's TC			2,1	
		h) Corrosive sulphur	Major	Test				Supplier's TC			2,1	
		i) Dielectric dissipation factor	Major	Test				Supplier's TC			2,1	
		j) Specific resistance (resistivity)	Major	Test	One sample	MANFUF. STD / IS:335	MANFUF. STD / IS:335	Supplier's TC			2,1	
		k) Ageing characteristics after accelerated ageing	Major	Test				Supplier's TC			2,1	
		l) Oxidation stability	Major	Test				Supplier's TC			2,1	
		m) Presence of oxidation inhibitor	Major	Test				Supplier's TC			2,1	
		n) Electric strength(BDV, Tan-delta) i) As delivered ii) After treatment	Major	Test				Supplier's TC			2,1	
		o) Water content	Major	Test				Supplier's TC			2,1	
		p) S.K.value	Major	Test				Supplier's TC			2,1	
1.10	Paint &Varnish	Shelf Life	Major	VISUAL	100%	MANF.STD	MANF.STD	Supplier's TC	3/2		2,1	
2	**FITTING AND ACCESSORIES (MAKE SHALL BE AS PER ANNEXURE-1)**											
2.1	Porcelain Bushing (if applicable)	a) Dimension	Major	MEASURE	100%	IS:2099/IS:8603	IS:2099/IS:8603	QC records	2		-	
		b) Visual defects	Major	Visual	100%			QC records	2		-	
		c) routine testing	Major	Test	100%			Supplier's TC	3/2		2,1	
2.2	Condenser Bushing (if applicable)	a) Type, size & model	Major	Visual	100%	IS:2099 / IS:8603 / IEC 60137	IS:2099 / IS:8603 / IEC 60137	QC records	2		1	
		b) Dimensional check	Major	Measure	100%			QC records	2		1	
		c) Dry power frequency	Major	Test	-			Supplier's TC	3/2		2,1	
		voltage withstand test	Major	Test	-							
		d) HV Test for test tap	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Tan delta & capacitance test	Major	Test	-			Supplier's TC	3/2		2,1	
		f) Nitrogen Pressure Test	Major	Test	-			Supplier's TC	3/2		2,1	
		g) Routine Test	Major	Test	-			Supplier's TC	3/2		2,1	

	PARTICULARS	**BIDDER/VENDOR**
BHEL	**NAME**	
	SIGNATURE	
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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001				
		BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS				
	SHEET 4 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314				

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

	PARTICULARS	BIDDER/VENDOR
BHEL	**NAME**	
	SIGNATURE	
	DATE	

BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001					
		BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS					
	SHEET 5 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
2.8	Gun Metal / Cast Iron Valves Gate/globe/ Butterfly)	a) Dimensional check	Major	Measure	100%	Manf. Std./IS:778 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		
			Major	Test	-								
		d) Operational test (close & open)	Major	Test	-			Supplier's TC	3/2		2		
2.9	Bushing CT	a) Visual check/Dimensional check	Major	Measure/Visual test	100%	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	2		-		
		b) Routin test	Major	Test	-	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	3/2		2,1		
2.10	Marshaling box/RTCC	a) Visual check for wiring	Major	Test	100%	Drg./Manf. Std./IS:5/IS:13947	Drg./Manf. Std./IS:5/IS:13947	Supplier's TC	3/2	2	-		
		b) Dimensional check	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		c) Check for make of components	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		d) 2 kV insulation test on auxiliary wiring	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		e) Check for paint, shade & thickness	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		f) Degree of Prot. By paper insertion	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
2.11	OTI&WTI	a)Type size & make	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		1		
		b) HV test	Major	Test	-			Supplier's TC	3/2		2,1		
		C) Temperature calibration	Major	Test	-			Supplier's TC	3/2		2,1		
		d) Switch setting & switch deferential	Major	Test	-			Supplier's TC	3/2		2,1		
		e) Calibration & operation of switch	Major	Test	-			Supplier's TC	3/2		2,1		
2.12	Radiator	a) Type, Model, Rating	Major	Visual	100%	Drg./Manf. Std./IS:101	Drg./Manf. Std./IS:101	QC records	3/2	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	2	1		
		e) Adhesion test on paint	Major	Test	100%								
		f) Welding quality	Major	Visual/ DPTest	100%	Relevant code	Relevant code	Supplier's TC	3/2	2	1		
2.13	Hardware	a) Dimensional check	Major	Measure	100%	Manf. Std.	Manf. Std.	QC records	2		-		
		b) Tensile strength	Major	Test	-			Supplier's TC	3/2		-		
			PARTICULARS		**BIDDER/VENDOR**								
	BHEL		**NAME**										
			SIGNATURE										
			DATE									BIDDER'S/VENDORS COMPANY SEAL	

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001				
		BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS				
	SHEET 6 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314				

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.14	Oil Pump Motor set (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Hv test at 2 kV for one minute	Major	Test	-			Supplier's TC	3/2		2,1	
		d) Input power taken by pump	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Performance test (I/P,O/P,DISCH, NO LOAD, Locked Rotor te)	Major	Test	-			Supplier's TC	3/2		2,1	
2.15	Cooling Fan (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Approved drgs/docs/spec./ IS:2312	Approved drgs/docs/spec./ IS:2312	QC records	2		-	
		b) Dimensional check	Major	Measure	-			QC records	2		-	
		c) HV test at 2 KV for	Major	Test	-			Supplier's TC	3/2		2,1	
		one minute	Major	Test	-						-	
		d) IR test	Major	Test	-			Supplier's TC	3/2		-	
		e) Power consumption & RPM	Major	Test	-			Supplier's TC	3/2		2,1	
2.16	Roller Assembly	a)Dimensions	Major	Measure	100%	Manf. Drg./docs	Manf. Drg./docs	QC records	2		-	
		b) Mechanical & Chemical properties of Raw material used for Shaft & Roller	Major	Measure	-			Supplier's TC	3/2		2	
2.17	Terminal Connector (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/IS:5561	Manf. Drg./docs/IS:5561	QC records	2		-	
		b) Surface finish	Major	Visual	-			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	-			Supplier's TC	3/2		2,1	
2.18	Air Cell for Conservator (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/PO	Manf. Drg./docs/PO	QC records	2		-	
		b) Surface finish	Major	Visual	100%			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	100%			Supplier's TC	3/2		2,1	
2.19	Oil Flow Indicator (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Functional test	Major	Test	-			Supplier's TC	3/2		2,1	
2.20	Silicagel Breather	a) Type, Size, Model	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Pressure/ Leakage test	Major	Test	-			Supplier's TC	3/2		2	
		c) Colour of silica gel	Major	Visual	-			Supplier's TC	3/2		2,1	

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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

		QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001				
			BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS				
		SHEET 7 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
3	**IN-PROCESS**												
3.1	Fabrication of Tank, Conservator,Radiator, HV&LV CABLE BOX and welding requirement	a) Welding procedure specification	Major	Verify/Review	100%			QC Records	3/2		2		
		b) Process qualification record	Major	Verify/Review	100%			QC Records	3/2		2		
		c) Weider qualification	Major	Verify/Review	100%			QC Records	3/2		2		
		d) Welding electrodes-Mechanical Properties	Major	Verify/Review	100%			QC Records	3/2		2		
		e) Fitup for butt weld joints of tank and cover	Major	Visual	100%			QC Records	3/2		2		
		f) Visual check on weldment & any foregin particle in the entire tank with conservator, pipes etc.and blanking of ends with bolted plates	Major	Visual	100%			QC Records	3/2		2		
		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	3/2		2		
		h) DP test on welded joints	Major	Test	100%			QC Records	3/2		2,1		
		i) Check for flatness gasket surface	Major	Visual	100%			QC Records	3/2		2,1		
		J) Rim flatness	Major	Measure	100%			QC Records	3/2		2,1		
		k) Surface cleaning by sand/ shot blasting	Major	Visual	100%			QC Records	3/2		2,1		
		l) Primer coating, paint shade thickness inside & outside	Major	Measure	100%			QC Records	3/2		2,1		
		m) Paint film adhesion test	Major	Test	100%			QC Records	3/2		2,1		
		n) Vacuum Test (Tank)	CR	Vacuum test	1 unit each type	Appd. Doc./BHEL	Appd. Doc./BHEL	QC formate	3/2	1			
		o) Pressure test (Tank)	CR	Pressure test	1 unit each type	SPEC./CBIP	SPEC./CBIP	QC formate	3/2	1			
3.2	Core Stamping	a) Burr & Bow	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-		
		b) Dimensional check	Major	Measure	100%			QC Records	2		-		
3.3	Core Building	a) Dimensional check	Major	Measure	100%			QC Records	2		-		
		b) Assembly of limb insulation and limb plates.	Major	Visual	100%			QC Records	2		-		
		c) Rectangularity of core assembly	Major	Visual	100%			QC Records	2		-		
		d) Freedom from overlaps & air gap at joints	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-		
		e) Leaning of cor(i.e core verticality)	Major	Visual	100%			QC Records	2		-		
		f) Limb & stack thickness	Major	Visual	100%			QC Records	2		-		
		g) Limb clamping & binding	Major	Visual	100%			QC Records	2		-		
		h) Core diameter	Major	Visual	100%			QC Records	2		1		
		i) Earthing of core	Major	Visual	100%			QC Records	2		1		

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LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : RPCL	PROJECT TITLE : 2 X 800MW YERAMARUS TPS	SPECIFICATION NO. : PE-TS-362-302-E001
		BIDDER/ Esennar Transformers Private Limited VENDOR	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS
	SHEET 8 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. : PE-V0-362-302-E314

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.4	Test on Core	a) Dimensional check	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		b) Flux density measurement	Major	Measure	100%			QC Records	2		-	
		c) Isolation test between(core to core clamps)	Major	Test	100%			QC Records	2		-	
		d)Torque Tightness	Major	Measure	100%			QC Records	2		-	
		e) Core Insulation	Major	Electrical	100%			QC Records	2		-	
		f) Core Loss	Major	Electrical with dummy coil	100%			QC Records	2		1	
		g)Visual checks of core verticality	Major	Visual	100%			QC Records	2		-	
3.5	Winding	a) Brazing procedure & Brazer qualification	Major	Review	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Conductor size.	Major	Measure	100%			QC Records	2		-	
		c) Redial depth of winding	Major	Measure	100%			QC Records	2		-	
		d) Anchoring & binding at start & finish	Major	Measure	100%			QC Records	2		-	
		e) No. of turns	Major	Measure	100%			QC Records	2		-	
		f) Transposition of cross-overs	Major	Measure	100%			QC Records	2		-	
		g) Dimensional check (0D,ID & axial length)	Major	Measure	100%			QC Records	2		-	
		h) Insulation arrangement & alignmt.	Major	Measure	100%			QC Records	2		-	
		i) Winding length	Major	Measure	100%			QC Records	2		-	
		j) Brazed joints	Major	Measure	100%			QC Records	2		-	
		k) Lead & coil identification and marking	Major	Measure	100%			QC Records	2		-	
		l) Free from damages	Major	Measure	100%			QC Records	2		-	
		m) Continuity test for leads	Major	Measure	100%			QC Records	2		-	
		n) Turn to Turn Insulation	Major	Measure	100%			QC Records	2		1	
		o) Measure. Of Resistance	Major	Measure	100%			QC Records	2		1	
3.6	Core coil assembly	a) Cleanliness of core	Major	Visual	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Alignment of spacers/blocks	Major	Visual	100%			QC Records	2		-	
		c) Elect. Clearance & Insp. Of core & coil assly after completion of terminal gear	Major	Visual/measure	100%			QC Records	2		-	
		d) Check provision of core frame earthing	Major	Visual	100%			QC Records	2		-	
3.7	Connection and Tap switch assembly	a) Ratio test on all taps	Major	Test	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		1	
		b) Lead disposition.	Major	Visual	100%			QC Records	2		-	
		c) Brazing of joints	Major	Visual	100%			QC Records	2		-	
		d) Crimping of joints	Major	Visual	100%			QC Records	2		-	
		e) Insulation over joints	Major	Visual	100%			QC Records	2		-	
		f) Vector group	Major	Test	100%			QC Records	2		1	
3.8	Ovening and Tanking	a) Cleanliness of tank	Major	Visual	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		b) Drawing	Major	Physical	100%			QC Records	2		1	
		c) Check tightness of clamped blocks and measurements of winding height	Major	Measure	100%			QC Records	2		1	
		d) Electrical clearances	Major	Measure	100%			QC Records	2		1	
		e) Oil filling and air release	Major	Physical	100%			QC Records	2		-	
		f) Dryness (Tan-delta & I.R)	Major	Measure	100%			QC Records	2		-	

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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001					
		BIDDER/ Esennar Transformers Private Limited VENDOR			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS					
	SHEET 9 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
4	Type & Special Test on Transformer	a)Review of type test & special test report b) Review of all previous stage of insp. As per QR prior to final testing	Major	Verify	100%	Reports			2	1	-	Type test as per enclosed annexure-1 to be conducted.	
5	ROUTINE TEST Each Transformer Shall be completely assembled with all fittings and accessoriesmeant for particular transformerbefore offering for inspection & Test	a) Verification of completeness / Dimensional check	Major	Measure	100%				2	1			
		b) Measurement of Voltage Ratio at all taps,polarity & vector group verification	Major	Measure	100%				2	1			
		c) Measurement of winding resistance on HV & LV on all the Taps.	Major	Measure	100%				2	1			
		d) Vector group and polarity check	Major	Measure	100%				2	1			
		e) Magnetic balance Test	Major	Measure	100%				2	1			
		f) Induced overvoltage	Major	Measure	100%				2				
		g) Sepatate Source Voltage Withstand test	Major	Measure	100%				2	1			
		h)Measurementof capacitance & Tan delta to determine capacitance between winding & earth,	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026	As per APPROVED DATA SHEET/IS:2026	Manf. Test Records/QC Formats	2	1			
		i) Measurement of No-load losses & current at 90)%, 100% & 110% rated voltage.	Major	Measure	100%				2	1			
		j) .2 kV core Isolation (If Applicable),	Major	Measure	100%				2	1			
		k) Measurement of no load current with 415 V, 50 hZ AC supply.	Major	Measure	100%				2	1			
		l) IR & measurement of Insulation power factor & capacitance between winding and earth	Major	Measure	100%				2	1			
		m) Load loss & short circuit Impedence measurement on principal & extreme taps.	Major	Measure	100%				2	1			
		n) Repeat no load currents/loss measurement after completion of all dielectric test.	Major	Measure	100%				2	1			
		o) Test on OLTC/OCTC.	Major	Measure	100%				2	1			

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BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : RPCL			PROJECT TITLE : 2 X 800MW YERAMARUS TPS			SPECIFICATION NO. : PE-TS-362-302-E001				
		BIDDER/ VENDOR	Esennar Transformers Private Limited		STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS				
	SHEET 10 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. : PE-V0-362-302-E314				

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		p) Verification of oil leakage test with all fitting & accessories at normal presure plus 35KPA for 24 hours.	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	Manf. Test Records/QC Formats	2	1		
		q) Jacking Test followed by D.P. Test	Major	Measure	100%				2	1		
		r) Paint shade & adhession test	Major	Measure	100%				2	1		
		s) Protection on M. Box by paper insertion	Major	Measure	100%				2	1		
		t) 2 KV test on M.Box wiring & functional check for component of MB	Major	Measure	100%				2	1		
		u) Slope and alignment of Buchhoz relay	Major	visual	100%				2	1		
		v) DFT of paint	Major	Measure	100%				2	1		
6	Pre **Shipment** check &Despatch	a) Transformer- verification of final transportion.							2			
		b) Dew points measurement of N2/Dry gas tightness/ Pr reading (Only applicable for transformers dispatched with Gas Filling)							2			
		c) Packing of loose items							2			

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ANNEXURE-1 to QAP

TYPE TEST	APPLICABLE (Y/N)	REMARKS
a) Measurement of insulation resistance		
b) DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES		
c) Temperature-rise	Y	
d) DGA TEST ON OIL BEFORE AND AFTER TEMPERATURE TEST	Y	
e) Tests on on-load tap-changers, where appropriate		
SPECIAL TEST		
a) DIELECTRIC TYPE TEST INCLUDING CHOPPED WAVE IMPULSE TEST ON ALL THREE PHASES		
b) Measurement of zero-sequence impedance of three-phase transformers		
c) Short-circuit test		
d) Measurement of acoustic noise level	Y	(AS TYPE TEST)
e) Measurement of the harmonics of the no-load current	Y	(AS TYPE TEST)
f) Measurement of the power taken by the fans and oil pumps		
g) Degree of Protection on Cable Box		
h) Degree of Protection on Marshalling Box		
i) PRD operation test (if PRD is applicable)		
j) Tank Pressure Test	Y	
k) Tank Vacuum Test	Y	
l) Capacitance & Tan delta of all windings.	Y	