

2X800 MW YERMARUS THERMAL POWER STATION

VOLUME: II B & III

**TECHNICAL SPECIFICATION
FOR
OZONE GENERATION PLANT
REV 01**

SPECIFICATION NO.: PE-TS-362-174-14000A-A001



BHARAT HEAVY ELECTRICALS LIMITED

**POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



TITLE:

**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT.
2X800 MW YERMARUS THERMAL POWER STATION**

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

REV. NO. 01

DATE: 04/12/2014

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VOLUME **II-B**

SECTION -A

REV. NO. 01

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SECTION - A

(SCOPE OF ENQUIRY)



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SECTION -A

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1.0 SCOPE:

- 1.1 This specification is intended cover design, engineering, manufacturing, painting, inspection & testing, supply, delivery, installation, packing and forwarding of equipments to site, loading, unloading, storage and handling at site, in site transportation, complete with all accessories including start up and commissioning spares, essential spares, site testing, erection, testing & commissioning, trial run, demonstration test and handing over to customer the **OZONE GENERATION PLANT** for **2X800 MW YERMARUS THERMAL POWER STATION**. The scope of supply shall fully cover the requirement of the Design Criteria and Technical Specification of this specification.
- 1.2 It is not the intent to specify all the details of the design & manufacturer. However, the equipment shall conform in all respect to high standard of design, engineering, & workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Owner, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith. The system supplied must have backup service & spares available in India.
- 1.3 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be included in the specification unless otherwise specifically excluded.
- 1.4 The omission of specific reference to any component/accessory necessary for the proper performance of Ozone Generation Plant shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.
- 1.5 BHEL's / Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.
- 1.6 In case of any deviation, the Bidder shall indicate the same clause by clause in the deviation schedule attached with the specification duly filling all the information as per deviation schedule. In the absence of the same it will be construed that the bid conform strictly to the specification.
- 1.7 In case of any contradiction between two clauses / requirements of the specification, bidder to point out those contradictions during pre-bid clarification stage else BHEL / Customer interpretation shall be followed without any commercial & delivery implication to BHEL/Customer after award of contract.
- 1.8 General terms & conditions instructions to the bidder and other attachments referred to elsewhere, make part of tender specification. The bidder shall be responsible for all governed by requirements stipulated hereinafter.
- 1.9 In case of any data/requirement stipulated in the drawings but not in the specification and vice-versa, such data/requirement shall be deemed to be contained in the both. Contradictions between drawings and specification, if any, shall be brought to the attention of the BHEL by the bidder during pre-bid and the correct requirement shall be obtained else BHEL interpretation shall prevail without any commercial & delivery implication to BHEL/Customer.
- 1.10 The equipments covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.
- 1.11 Un priced copy of the price bid in BHEL format only shall be furnished along with the technical bid.



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SECTION -B

REV. NO. 01

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**SECTION - B
(PROJECT INFORMATION)**



TITLE:
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SECTION -B

REV. NO. 01

DATE :04/12/2014

- 1.0 Owner/Customer : Raichur Power Corporation Ltd(RPCL)
22/23, Sudarshan Complex,
IInd floor, Sheshadri Road,
Bangalore-560 009
Karnataka, India
- 2.0 Consultant : M/s STEAG 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° C
- ii. minimum temperature : 6° C
- iii. Design Temperature : 50° C Ambient
for all
Electrical/
Mechanical
Equipment
- (b) Relative Humidity
- i. Maximum during monsoon : 85%
- ii. Minimum : 20%
- iii. Average : 65%



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- (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



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- (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 $\pm 10\%$
 Frequency variation $\pm 5\%$
 Combined voltage & frequency variation $\pm 10\%$
 - ii. DC supply : Voltage variation +10% -20%



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SECTION -C

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SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

C1: SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL

C2: SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL

C3: SPECIFIC TECHNICAL REQUIREMENTS FOR C&I



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SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS-MECHANICAL

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1.0 GENERAL

The Ozone generation plant and associated accessories shall conform to the technical specification.

2.0 SCOPE OF SUPPLY

Broad scope of work of this package includes all equipment and accessories as listed under. Please refer Electrical and C&I sections also for respective scopes.

The Ozone generation plant, as specified in Technical specification, Data sheets, P&ID, and shall consist of at least the followings and shall be in the scope of the bidder:

- 2.1 Entire Ozone generation plant of 38 Kg/Hr capacity as per P&ID (PE-DG-362-174-14000A-A001 Rev 01), Data Sheet-A and technical specification requirements.
- 2.2 Oxygen generation plant consist of at least the following:
 - 2.2.1 Five numbers (5) nos. (4 working + 1 standby) Screw type air cooled compressors complete with drive motors, silencer, Intake filters, inter coolers, after coolers, step up gear box, moisture separator, ducting arrangement and other accessories.
 - 2.2.2 One (01) no. unit air receiver of 8 M³ capacity (minimum) with all accessories.
 - 2.2.3 Two nos (2x100%) Air driers unit per stream (Total 4 numbers for two streams) with all accessories.
 - 2.2.4 Two nos (2x100%) Oxygen generators/concentrator per stream (Total 4 numbers for two streams) with all accessories.
 - 2.2.5 Two nos (2x50%) Oxygen receiver of 6 M³ capacity (minimum) each (One number per stream) with all accessories.
- 2.3 Ozone generator with N (working) + 1 (standby) configuration with all accessories along with transformers, rectifiers, VFD etc. Total capacity of Ozone generators = 38 Kg/hr.
- 2.4 Cooling water plant consist of at least the following:
 - 2.4.1 Two nos (2X100%) chilled water re circulation pumps complete with drive motors along with strainers, instruments, isolation valves, piping, flanges, pipe fittings etc.
 - 2.4.2 Two numbers (2X100%) air cooled chillers with all accessories.
 - 2.4.3 One number potable water storage tanks of 15M³ capacity (minimum) with all accessories.
- 2.5 Ozone dosing system consist of two numbers (2X100%) Ozone dosing pumps complete with drive motors along with strainers, instruments, injector, isolation valves, piping, Ozone static mixtures as required in the pipe line, flanges, pipe fittings alongwith accessories as required.
- 2.6 Ozonated water dosing line of 600 meters piping length for dosing at condenser inlet & outlet.
- 2.7 All tanks complete with inlet and outlet connections, all fittings, flanges and appurtenances etc. as specified and as required.
- 2.8 PLC based control system.
- 2.9 Electrical scope shall be as per "Electrical scope between BHEL and Vendor" enclosed with the technical specification.
- 2.10 All necessary drains, vents, and sampling points, with valves, as specified and as required.
- 2.11 Hangers and supports as per the requirement.
- 2.12 All Instrumentation (minimum) as per the enclosed P&ID (PE-DG-362-174-14000A-A001 Rev01) including the electronic on line dew point transmitter, Ozone analyzer, Oxygen purity analyzer, Ozone leak detector, residual ozone analyser, Ozone destructor (if applicable) etc. with suitable sampling connection and isolation valve
- 2.13 Safety requirement as applicable.
- 2.14 Air conditioning and ventilation system.
- 2.15 Commissioning spares as required.
- 2.16 Essential spares as indicated in Annexure – XI.
- 2.17 All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- 2.18 Oil & lubricants for consumption during the commissioning, trial operation.
- 2.19 Painting as per enclosed painting schedule (Annexure-V). However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication.
- 2.20 Finish paints for touch up painting of equipments after erection at site in sealed container.
- 2.21 Initial charge of all lubricants and grease.
- 2.22 Monitoring gadgets, instruments, and equipments required for maintenance (till demonstration test and plant handover).
- 2.23 All blank flanges/counter flanges, isolations valves, tees etc. to interconnect the pipes and all terminal points.

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- 2.24 All handling facilities including electric hoist.
- 2.25 Water Softeners if required.
- 2.26 All the arrangements for instrument air.
- 2.27 All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with Ozone generation Plant.
- 2.28 Permanent ladder (not rungs) for approaching the top of tanks & valves. All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipments being supplied under this specification for opening/maintenance purpose.
- 2.29 All auxiliary steel structures (U-clamps, nuts, bolts, channels etc.) for fixing the pipe on the pedestal or trestles.
- 2.30 Wrapping, coating and protection of the buried piping (as required).

3.0 SCOPE OF SERVICE

The bidder's scope also includes following services for scope under this specification:

- 1) Transportation of equipments, packing & forwarding, Erection and commissioning, unloading, storage and handling at site.
- 2) In site transportation.
- 3) Arrangement of all instruments and lab facilities to carry out trial run/commissioning and demonstration test.
- 4) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- 5) All personnel required during commissioning, trial run and demonstration testing.
- 6) Final touch up paint at site.

4.0 TERMINAL POINT

- 4.1 Service water line: At 20 meters from Ozone generation plant building. Further distribution of service water is in bidder's scope.
- 4.2 Potable water (RO water) line: At 20 meters from Ozone generation plant building. Further distribution of potable water is in bidder's scope. The Potable water analysis (Annexure – III) has been attached elsewhere in the specification.
- 4.3 Motive water line: At 10 meters from Ozone generation plant building. Further distribution of motive water line is in bidder's scope. The Coordinate of the terminal point of the motive water has been indicated in the Annexure – X, Key plan of Ozone Generation Plant (Dwg. No. PE-DG-362-174-14000A- A003 REV 00).
- 4.4 Instrument air line: At 20 meters from Ozone generation plant building. Further distribution of instrument air is in bidder's scope. The pressure of instrument air shall be 5-8 kg/cm² (g).
- 4.5 Ozonated water dosing line from each dosing pump in Ozone generation plant upto each Condenser inlet and outlet dosing point is also in bidder' scope. The piping distance from Ozone generation building to dosing point in the Condenser inlet and outlet dosing point is 600 mts & in bidder's scope. Further all the piping inside the building as per system requirement shall be in bidder's scope also.
- 4.6 All drains: Drains from all the systems shall be terminated at one point.

5.0 QP AND SUB VENDOR APPROVAL

- 5.1 Minimum QP requirements part of section-C1 shall be as per the enclosed QP (Annexure – IX) subject to BHEL/CUSTOMER approval. However, any additional comments as given by BHEL/CUSTOMER shall be adhered by the bidder without any commercial and delivery implication to BHEL. The cost of third party inspection for all imported components shall also be in bidder's scope.
- 5.2 The sub vendor list (Annexure- IV) enclosed is indicative only and is subject to approval / acceptance by customer. Bidder to propose his sub vendor list with back up documents (experience list, end user performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

6.0 DESIGN/CONSTRUCTION

In addition to the requirements of Section-C & D the following shall also be complied under scope of this specification:

The P&ID is enclosed herein in this section for bidder's compliance.

The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to customer approval during detailed engineering.

The technical specification requirement for items which are not included shall be subject to customer/BHEL approval during detailed engineering stage. Vendor will submit all the back up documents for proveness of the technical details selected.

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7.0 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI/LOA, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL. For the Drawings/Documents Submission Procedure, please refer following Annexure-I. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-VI.

Every revised submission incorporating comments shall be resubmitted within 7 days.

BHEL shall provide observation / approval within 15 days from the date of document submission by bidder.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fortnightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

ANNEXURE - I

SL. NO.	BHEL DRAWING/ DOCUMENT NUMBER	DRAWING/ DOCUMENT TITLE	NO. OF WEEKS FOR DRAWING/ DOCUMENT SUBMISSION AFTER PLACING LOI/LOA	SIZE OF DRAWING/ DOCUMENT
1.	PE-V13-362-174-14000A-A001	PIPING & INSTRUMENTATION DIAGRAM	4	A0
2.	PE-V13-362-174-14000A-A002	PROCESS DESIGN BASIS AND SIZING CALCULATION	4	A4
3.	PE-V13-362-174-14000A-A003	EQUIPMENT LAYOUT	6	A0
4.	PE-V13-362-174-14000A-A004	SUB VENDOR LIST & INSPECTION CRITERIA	4	A4
5.	PE-V13-362-174-14000A-A005	CONTROL PHILOSOPHY WITH PLC SYSTEM CONFIGURATION DIAGRAM	4	A4
6.	PE-V13-362-174-14000A-A006	CIVIL ASSIGNMENT DRAWING	8	A0
7.	PE-V13-362-174-14000A-A007	ELECTRICAL LOAD LIST	8	A4
8.	PE-V13-362-174-14000A-A008	PIPING LAYOUT	8	A0
9.	PE-V13-362-174-14000A-A009	DATASHEET & SLD FOR UPS, UPS SIZING CALCULATIONS, BATTERY SIZING CALCULATIONS	10	A4
10.	PE-V13-362-174-14000A-A010	TECHNICAL DATA SHEET OF HORIZONTAL PUMPS	8	A4
11.	PE-V13-362-174-14000A-A011	TECHNICAL DATA SHEET OF COMPRESSORS	8	A4
12.	PE-V13-362-174-14000A-A012	GA & DATA SHEET OF MOTORS	8	A4
13.	PE-V13-362-174-14000A-A013	QAP FOR HORIZONTAL PUMPS WITH MOTOR	4	A4
14.	PE-V13-362-174-14000A-A014	QAP FOR COMPRESSORS WITH MOTOR	4	A4
15.	PE-V13-362-174-14000A-A015	DATA SHEET FOR INSTRUMENTS AND ANALYSER ALONG WITH INSTRUMENT HOOK UP DRAWING	8	A4



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18.	PE-V13-362-174-14000A-A018	GA OF ATMOSPHERIC TANKS	8	A2
19.	PE-V13-362-174-14000A-A019	GA OF PRESSURE VESSELS	4	A2
20.	PE-V13-362-174-14000A-A020	MECHANICAL DATASHEET & GA FOR AIR DRIER, OXYGEN GENERATOR, CHILLER, VENTURI INJECTOR ETC.	8	DATASHEET -A4, GA- A2
21.	PE-V13-362-174-14000A-A021	MECHANICAL DATASHEET & GA FOR STRAINERS & VALVES	10	A4
22.	PE-V13-362-174-14000A-A022	DATASHEET FOR SAFETY ITEMS	10	A4
23.	PE-V13-362-174-14000A-A023	INSTRUMENT SCHEDULE	10	A4
24.	PE-V13-362-174-14000A-A024	VALVE SCHEDULE	10	A4
25.	PE-V13-362-174-14000A-A025	PLC DOCUMENTS , GA & WIRING DETAILS OF PLC PANEL, I/O LIST, BOM, MIMIC DIAGRAM, PLC CONTROL SCHEMES (BLOCK LOGIC), CONTROL DESK LAYOUT / GA DRAWING, PLC HEAT DISSIPATION DATA ALONG WITH PROCESS GRAPHIC MANUSCRIPTS, PANEL & ELECTRONIC EARTHING REQUIREMENT, PLC CATALOGUE, PLC PROGRAMMING, LADDER SCHEME, PLC OWS/PRINTER FURNITURE BOM	12	A4 & A2 AS REQUIRED.
26.	PE-V13-362-174-14000A-A026	LIST OF SOFT SIGNAL EXCHANGE WITH DDCMIS & FIELD JB TERMINATIONS	12	A4
27.	PE-V13-362-174-14000A-A027	QAP AND FAT PROCEDURE FOR PLC	4	A4
28.	PE-V13-362-174-14000A-A028	CABLE TRAY LAYOUT	10	A1
29.	PE-V13-362-174-14000A-A029	QAP / ICL OF OZONE GENERATION PLANT (BALANCE OF ITEMS)	4	A4
30.	PE-V13-362-174-14000A-A030	DESIGN CALCULATION AND DATASHEET OF VENTILATION FANS.	8	A4
31.	PE-V13-362-174-14000A-A031	DESIGN CALCULATION AND DATASHEET OF AIR CONDITIONERS	8	A4
32.	PE-V13-362-174-14000A-A032	QUALITY PLAN FOR ELECTRIC HOIST	8	A4
33.	PE-V13-362-174-14000A-A033	GA DRAWING FOR ELECTRIC HOIST	8	A2
34.	PE-V13-362-174-14000A-A034	ELECTRIC CIRCUIT DIAGRAM FOR ELECTRIC HOIST	8	A4
35.	PE-V13-362-174-14000A-A035	SIZING CALCULATIONS FOR ELECTRIC HOIST	8	A4
36.	PE-V13-362-174-14000A-A036	DOWN SHOP LEAD ARRANGEMENT OF ELECTRIC HOIST FOR STRAIGHT PATH	8	A4
37.	PE-V13-362-174-14000A-A037	ERECTION PROCEDURE	8	A4
38.	PE-V13-362-174-14000A-A038	CABLE SCHEDULE, SUBMISSION OF CABLE INTERCONNECTION DIAGRAM ALONG WITH FIELD JUNCTION BOX TERMINATIONS	10	A4
39.	PE-V13-362-174-	PAINTING SCHEDULE	8	A4

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	14000A-A039			
40	PE-V13-362-174-14000A-A040	ENGINEERING BOQ	10	A4
41	PE-V13-362-174-14000A-A041	DEMONSTRATION TEST PROCEDURE	12	A4
42	PE-V13-362-174-14000A-A042	O&M MANUAL	12	A4,A2,A1,A0 AS REQUIRED.

8.0 DRAWING/DOCUMENTS REQUIRED ALONG WITH THE BID (Please also refer Electrical and C&I portion also).

- Deviation schedule (in strictly BHEL Format only) duly fill for deviation, if any.
- Equipment lay out (for information only).
- Un Price Schedule duly filled.
- Compliance cum confirmation schedule.

Documents other than above shall not be reviewed and the same shall be considered as null and void.

9.0 EXCLUSIONS

9.1 Potable water, service water and motive water.

9.2 All Civil works at site. However the civil assignment drawing/civil input shall be submitted by the bidder.

NOTE-1: - Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

NOTE-2: All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful vendor shall comply with the comment of the customer/BHEL without price & delivery implication.

NOTE-3: Site facility as available or as extended by Owner shall only be provided.

NOTE-4: Bidder shall demonstrate the parameters as per the specification requirement to the satisfaction of Owner. The exact modalities of verifying testing of the parameters indicated in the specification shall be finally as agreed with the BHEL/ Customer during detailed engineering & mutually agreed.

NOTE-5: Bidder to note that drg/doc submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link

<http://124.124.36.198/wrenchwebaccess/login.aspx>

10.0 ADDITIONAL TECHNICAL REQUIREMENTS

10.1 In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

10.2 KKS numbering as per BHEL/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to BHEL.

10.3 Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

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- 10.4 Final Electrical Load list will be submitted by the successful bidder as per drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- 10.5 Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor.
- 10.6 The system supplied must have backup service & spares available in India.



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DESIGN CLARIFIED WATER ANALYSIS

ANNEXURE -II

Sl. No.	Description	Unit	Water quality Considered for Design
Physical parameters			
1.	pH (design, range)		8.1-8.7
2.	Temperature des/min/max.	Deg.C	30/25/35
3.	Conductivity	Mic. Mhos/ cm	1800
4.	Total dissolved solids	Mg/l	1300
5.	Turbidity	NTU	2
6.	OIL & Grease	Mg/l	Nil
Chemical Parameters			
7.	Calcium (as Ca)	Mg/l	50
8.	Magnesium (as Mg)	Mg/l	28
9.	Sodium (as Na)	Mg/l	159.4
10.	Potassium (as K)	Mg/l	Nil
11.	Iron -Total (as Fe)	Mg/l	0.1
12.	Alkalinity-m (as CaCO ₃)	Mg/l	215
13.	Alkalinity-p (as CaCO ₃)	Mg/l	10
14.	Bicarbonates (as HCO ₃)	Mg/l	195
15.	Carbonates (as CO ₃)	Mg/l	10
16.	Sulphate (as CaCO ₃)	Mg/l	145
17.	Chloride (as CaCO ₃)	Mg/l	178
18.	Silica Reactive (as SiO ₂)	Mg/l	25
19.	COD	Mg/l	17-43*
20.	Colloidal Silica	Mg/l	1-6
Bacteriological parameters			
21.	Coliforms (e-coli)	cfu/ml	13
22.	Feacal Coliforms	cfu/100ml	01
23.	Total Viable Count at 48hrs	cfu/100ml	29X12

*All the COD is assumed to be in suspended form.

NOTE:

A. THE CYCLE OF CONCENTRATION (COC) SHALL BE CONSIDERED AS 5.

Bidder to derive the cooling water analysis accordingly.

B. DATA FOR COOLING TOWER:

- Total CW Flow of Condenser = 1,88,116 Cum/hr (Unit #1 + Unit #2).
- Storage/Holdup volume of cooling tower basin=32000 m³ (Unit #1 + Unit #2).
- Temperature difference across cooling tower is 9.0 Deg C.
- MOC of Condenser tube is SS 316.
- Cooling Water System metallurgy shall be as per P&ID CW/ACW System (enclosed in Technical Specification).
- Cooling Tower blow down= 397 M3/Hr per Unit. Total = 794 M3/Hr (Unit #1 + Unit #2).

POTABLE WATER ANALYSIS

ANNEXURE - III

GE Water

Winflows Version 3.1.2

DataBase Version 3.04

Results Summary

Flow Data	m3/hr	Analytical Data	mg/L
Raw Feed:	140.00	Raw Feed TDS	1300.79
Product:	104.97	Product TDS	16.97
Concentrate:	35.03	Concentrate TDS	5141.01

System Data

Single Pass Design

Temperature:	C	RO-1: 30.00	System Rec.	75.00%
--------------	---	-------------	-------------	--------

Average Flux (lmh), Pass and Stage

Pass	Average	Stage 1	Stage 2
Pass 1	19.62	21.25	16.35

Array Data

Pass 1

Recovery %:	75.00	Conc. TDS(mg/l):	5141.01	Conc. Flow:	35.03 m3/hr
-------------	-------	------------------	---------	-------------	-------------

Stage	Total		Element Type	Flow, m3/hr		Pressure, bar		Perm TDS mg/l
	Housing	Element		Feed	Perm	Feed	DP	
1	16	96 AG-400		140.00	75.81	10.81	0.66	10.79
2	8	48 AG-400		64.19	29.16	10.15	0.63	33.13
Total	24	144						

Analytical data

mg/l				mg/l			
Cation	Product	Feed	Conc	Anion	Product	Feed	Conc
Ca	0.15	50.00	199.39	SO4	0.28	145.00	578.68
Mg	0.05	28.00	111.75	Cl	6.00	441.42	1746.26
Na	5.41	344.00	1358.68	F	0.00	0.00	0.00
K	0.00	0.00	0.00	NO3	0.00	0.00	0.00
NH4	0.00	0.00	0.00	Br	0.00	0.00	0.00
Ba	0.00	0.00	0.00	PO4	0.00	0.00	0.00
Sr	0.00	0.00	0.00	B	0.00	0.00	0.00
Fe	0.00	0.10	0.40	SiO2	0.57	31.00	122.20
Mn	0.00	0.00	0.00	H2S	0.00	0.00	0.00
TDS mg/l	16.97	1300.79	5141.01	HCO3	4.51	260.62	1015.16
pH	5.78	7.50	7.90	CO2	11.19	10.55	13.66
				CO3	0.00	0.65	8.50
Saturation Data							
BaSO4 %	0.00	0.00	0.00	CaF2 %	0.00	0.00	0.00
CaSO4 %	0.00	1.90	10.58	SiO2 %	0.35	24.66	96.20
SrSO4 %	0.00	0.00	0.00	LSI	-5.59	0.12	1.36
Struvite %	0.00	0.00	0.00	Pi bar	0.02	0.86	3.28

Design Error(s) and Warning(s)

Disclaimer: This design does not guarantee the same performance & is provided solely as a service. The data contained herein should be used with good engineering judgment.



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**INDICATIVE SUB VENDOR LIST
ANNEXURE - IV**

SL NO.	ITEM	SUPPLIERS	PLACE
1.	OIL FREE SCREW COMPRESSOR	ATLAS COPCO	PUNE
		KOBELCO (KPC)	PUNE
		ELGI	COIMBTORE
		INGERSOLL RAND	AHMADABAD
2.	AIR RELEASE VALVES	H.SARKER & COMPANY	
		LEADER VALVES LTD.	
		R&D MULTIPLES (METAL CAST) PVT. LTD.	
		A.V. VALVES LIMITED	
		G.M.DALUI & SONS PVT.LTD.	
3.	MS ROD FOR BELOW GROUND EARTHING	STEEL AUTHORITY OF INDIA LIMITED	
		RASHTRIYA ISPAT NIGAM LIMITED	
4.	CHAIN PULLEY BLOCK	HERCULES HOISTS LTD	
		LIFTING EQUIPMENTS & ACCESSORIES	
		ARMSEL MHE PVT. LTD., BANGALORE	
5.	ELECTRIC HOISTS	AVON CRANES PVT.LTD.	
		EDDYCRANES PVT.LTD.	
		LIFTING EQUIPMENTS & ACCESSORIES	
		REVA INDUSTRIES LTD.	
		CONSOLIDTED HOIST PVT LTD	
		HERCULES HOISTS LTD	
		ARMSEL MHE PVT. LTD.,BANGALORE	
6.	BALL VALVES	AKAY INDUSTRIES PVT.LTD.	
		FLOW CHEM INDUSTRIES	
		FISHER SANMAR LIMITED	
		KIRLOSKAR BROS. LTD.	
		LEADER VALVES LTD.	
		KSB PUMPS LTD.	
		MICROFINISH VALVES PVT LTD.	
		MICON VALVES (INDIA) PVT.LTD	
		PEC VALVES PVT.LTD.	
		VIRGO ENGINEERS LTD.	
		A.V. VALVES LIMITED	
		FLUIDLINE VALVES COMPANY PRIVATE MUMBAI	
		STEELSTRONG VALVES (I) PVT.LTD.,MUMBAI	
		B.D.K. ENGINEERING INDUSTRIES LTD.	
		SURYA VALVES &INSTRUMENTS MANUFACTURING COMPANY, CHENNAI	
		VAL TECH INDUSTRIES ,MUMBAI	
		FEDERAL HARDWARE ENGINEERING CO PTE LTD., SINGAPORE	
		CRESCENT VALVES MFG. CO. PVT. LTD.	
7.	CONTROL VALVE	DEZURIK -COPES VULCAN LTD., U.K	
		CONTROL COMPONENT INC., USA	
		DRESSER VALVE INDIA PVT. LTD UP TO 45KSC ONLY	
		FOURESS ENGG.INDIA LTD.UP TO 45KSC ONLY	
		FISHER SANMAR LTD	
		INSTRUMENTATION LTD. UP TO 45KSC ONLY	



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		MIL. CONTROLS LTD.	
8.	STEEL GATE /GLOBE/NRV VALVES	A.V. VALVES LTD NITON VALVE INDUSTRIES PRIVATE LTD WEIR VALVES & CONTROLS M.E. BABCOCK BORSIG ESPANA, S.A. B.D.K. ENGINEERING INDUSTRIES LTD. KIRLOSKAR BROTHERS LTD. LEADER VALVES LTD. KSB PUMPS LTD. MICON VALVES (INDIA) PVT. LTD OSWAL INDUSTRIES LTD. PETROL VALVES S.R.L. ITALY FOURESS ENGG. INDIA LTD. FLUIDLINE VALVES COMPANY PRIVATE LTD., MUMBAI STEEL STRONG VALVES (I) PVT. LTD., MUMBAI VALTECH INDUSTRIES ,MUMBAI SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY, CHENNAI FEDERAL HARDWARE ENGINEERING CO PTE LTD.,SINGAPORE CRESCENT VALVES MFG. CO. PVT. LTD.	
9.	CAST IRON/ GATE/GLOBE/NRV/SAFETY RELIEF VALVES	A.V. VALVES LTD H.SARKER & COMPANY G.M. DALUI & SONS PVT. LTD. KIRLOSKAR BROS. LTD. LEADER VALVES LTD. MICON VALVES (INDIA) PVT. LTD FLUIDLINE VALVES COMPANY PRIVATE FEDERAL HARDWARE ENGINEERING CO PTE LTD., SINGAPORE CRESCENT VALVES MFG. CO. PVT. LTD. SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY, CHENNAI	
10.	BF VALVES (WATER SERVICE)	ADVANCE VALVES PVT. LTD B.D.K. ENGINEERING INDUSTRIES LTD. INTER VALVE (INDIA) LTD. FOURESS ENGG. INDIA LTD. INSTRUMENTATION LTD. LARSEN & TOUBRO LTD. KIRLOSKAR BROS. LTD. MICON VALVES (INDIA) PVT. LTD R&D MULTIPLES (METAL CAST) PVT. LTD. SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY, CHENNAI STAFFORD CONTROLS LIMITED, PUNE FLUIDLINE VALVES COMPANY PRIVATE LTD., MUMBAI TYCO VALVES & CONTROLS INDIA PVT.LTD.,HALOL	
11.	A/C SYSTEM	ABB,LTD. BLUE STAR LTD. VOLTAS LTD.	
12.	VENTILATION SYSTEM	ASEA BROWN BOVERI LTD. ALSTOM LTD. BLUE STAR LTD.	



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		HYDERABAD POLLUTION CONTROLS LTD.	
		VOLTAS LTD.	
		C. DOCTOR & CO. PVT. LTD.	
13.	FLOW ELEMENT	ENGINEERING SPECIALTIES PRIVATE LTD	
		INSTRUMENTATION LTD.	
		MICRO PRECISION PRODUCTS	
		STAR-MECH CONTROLS (I) PVT.LTD	
14.	PUMPS (HORIZONTAL)	BEST & CROMPTON ENGG. LTD.	
		FLOWMORE LTD.	
		JYOTI LTD.	
		KIRLOSKAR BROS. LTD.	
		MATHER & PLAN PUMPS LTD.	
		KSB PUMPS LTD.	
		SULZER PUMPS INDIA LTD.	
		WPIL LIMITED	
		SAM TURBO INDUSTRY LTD.	
15.	PROGRAMMABLE LOGIC CONTROLS	SIEMENS LTD	
		ABB LIMITED	
		SCHNEIDER ELECTRIC INDIA PVT. LTD., NEW DELHI	
16.	CHECK VALVES (FLAT TYPE SIZE UPTO 50 NB)	B BDK VALVES –HUBLI	
		H SARKAR-HOWRAH	
		LEADER-JALANDHAR	
		MAJESTIC WORKS, MUMBAI	
17.	DUAL PLATE NON RETURN VALVES (SS & CI UPTO 100 NB CLASS 150)	ADVANCE VALVES-NOIDA	
		R&D MULTIPLES-VALSAD	
		B BDK VALVES –HUBLI	
18.	SOLENOID VALVES	ROTEX AUTOMATION-BARODA	
		ASCO - CHENNAI	
19.	Y-TYPE STRAINER	OTOKLIN-MUMBAI	
		GRAND PRIX-NEW DELHI	
		JAYPEE-NEW DELHI	
		GREAVES COTTON-MUMBAI	
		MULTITEX- NEW DELHI	
20.	MS PIPES (IS: 1239 & 3589)	SAIL-ROUR KELA	
		JINDAL (UPTO 350 NB)-GHAZIABAD	
		TISCO (UPTO 150 NB)-JAMSHEDPUR	
		MSL (FOR IS 3589-200 NB TO 500 NB)-RAIGAD	
21.	MS PLATES	SAIL	
22.	LEVEL GAUGES	SIGMA INSTRUMENTS	MUMBAI
		LEVCON	KOLKATA
		SBEM	PUNE
		V. AUTOMAT	NEW DELHI
23.	LEVEL TRANSMITTER (FOR ULTRA SONIC TYPE)	EMERSON PROCESS MANAGEMENT (I) LTD	
		SIEMENS	
24.	ANALYSERS	POLYTRON	FRANCE
		HACH ULTRA	FRANCE
		ABB	UK
		ORION	USA



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		SWAN	USA
		EMERSON PROCESS MANAGEMENT	CHENNAI
25.	PRESSURE / DP TRANSMITTER	EMERSON PROCESS MANAGEMENT	USA/DAMAN
		FUJI ELECTRIC	JAPAN
		HONEYWELL	USA
		YOKOGAWA	JAPAN
		ABB	ITALY/FARIDABAD/BANGALORE
26.	PRESSURE AND DIFFERENTIAL PRESSURE GAUGE	A.N.INST	KOLKATTA
		WAREE	MUMBAI
		SWITZER INSTRUMENTS	CHENNAI
		GENERAL INSTRUMENTS CONSORTIUM	GOA / MUMBAI
		MANOMETER	MUMBAI
27.	TEMPERATURE GAUGE	A.N.INST	KOLKATTA
		H.GURU (SI) P LTD	BANGALORE
		GIC	GOA/MUMBAI
		PYRO ELECTRIC INSTRUMENTS P LTD	GOA
28.	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM	NEW DELHI
		PYRO ELECTRIC	GOA
		TOSHINWAL BROS	NEW DELHI
29.	PNEUMATIC ACTUATORS (POWER CYLINDER)	INSTRUMENTATION LTD	
		KELTRON CONTROLS	
		ROTEX MANUFACTURERS & ENGINEERS PVT LTD	
30.	LT MOTORS	BBL	MUMBAI
		CGL	MUMBAI/AHEMDABAD
		KEC	BANGALORE/HUBLI
		SEIMENS	MUMBAI
		ABB	FARIDABAD
31.	UPS	HITACHI	GANDHI NAGAR
		EMERSON PROCESS MANAGEMENT	CHENNAI
32.	AGITATOR/STIRRER	FIBRE & FIBRE	MUMBAI
33.	FITTINGS	BHARAT FORGE	PUNE
		RELIANCE FORGE	PUNE
34.	FLANGES	BHARAT FORGE	PUNE
		RELIANCE FORGE	PUNE
35.	220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE)	EXIDE INDUSTRIES LTD	
		HBL NIFE POWER SYSTEMS LTD.	
36.	PAINT	ASIAN PAINTS (I) LTD.	
		BERGER PAINTS INDIA LTD	
		GOODLASS NEROLAC	
		JENSON & NICHOLSON (I) LTD	
		CDC CARBOLINE (I) LTD	
		SHALIMAR PAINTS LTD.	
		ADDISON PAINTS LTD.	
		GRAND POLYCOAT	
		BOMBAY PAINTS	



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37.	CABLE TRAYS & ACCESSORIES	JAMNA METAL COMPANY	
		UNITECH FABRICATORS & ENGINEERS PVT. LTD., KOLKATA	
		PATNY SYSTEMS (P) LTD., SECUNDERABAD	
		RUKMANI ELECTRICAL & COMPONENTS PRIVATE LTD.	
		INDUSTRIAL PERFORATION (INDIA) PRIVATE LTD.	
		PREMIER POWER PRODUCTS (CALCUTTA) PRIVATE LTD.	
		RABI ENGINEERING WORKS PRIVATE LTD.	
		INAR PROFILES PRIVATE LTD.	
		RATAN PROJECTS AND ENGINEERING CO. PRIVATE LIMITED	
		ASSOCIATED POWER STRUCTURES PRIVATE LIMITED	
38.	CABLE TRAY SUPPORT SYSTEM	JAMNA METAL COMPANY	
		UNITECH FABRICATORS & ENGINEERS PVT. LTD., KOLKATA	
		PATNY SYSTEMS (P) LTD., SECUNDERABAD	
		RUKMANI ELECTRICAL & COMPONENTS PRIVATE LTD.	
		INDUSTRIAL PERFORATION (INDIA) PRIVATE LTD.	
		PREMIER POWER PRODUCTS (CALCUTTA) PRIVATE LTD.	
		RABI ENGINEERING WORKS PRIVATE LTD.	
		RATAN PROJECTS AND ENGINEERING CO. PRIVATE LIMITED	
		ASSOCIATED POWER STRUCTURES PRIVATE LIMITED	
39.	GALVANISERS FOR CABLE TRAYS/ TRAY SUPPORT SYSTEM	JENCO INDUSTRIAL CORPORATION	
		NATIONAL GALVANISING COMPANY	
		SIGMA GALVANISING PVT.LTD	
		B.P. PROJECTS PVT LTD	
		STANDARD GALVANISERS	
		STEEL PRODUCTS	
		UNITECH FABRICATORS & ENGINEERS PVT. LTD.	
		M/S SHIVAM ENGINEERS & FABRICATORS	

NOTE: - THE SUB VENDOR LIST ENCLOSED IS INDICATIVE ONLY AND IS SUBJECT TO APPROVAL / ACCEPTANCE BY CUSTOMER BIDDER TO PROPOSE HIS SUB VENDOR LIST WITH BACK UP DOCUMENTS (EXPERIENCE LIST, END USER CERTIFICATE AS APPLICABLE) ETC. THE SAME SHALL SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

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**PAINTING SCHEME DETAILS
ANNEXURE – V****1.0 SCOPE**

1.1 This section covers the painting requirements for the Ozone generation plant as applicable.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:3140	:	Code of practice for painting asbestos cement building products
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) finishing

3.0 PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale , dust , rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER REPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required Bidder shall carry out the same to get a smooth finish.

4.0 PRIMER PAINT

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied. After this first coat is dried up completely, second coat of primer shall be applied. Primer shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Annexure-A enclosed. Insulated surfaces will have only primer coating and no finish painting.

5.0 FINISH PAINT

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Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by BHEL/Customer. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

6.0 PAINTING AND CORROSION PROTECTION FOR PIPES & FITTINGS

- 6.1 All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by BHEL/Customer. Service of the pipeline designations shall be painted on all pipes at visible locations.
- 6.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.
- 6.3 All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.
- 6.4 Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.

7.0 PAINTING AND CORROSION PROTECTION FOR VALVES & SPECIALTIES

Two coats of primer of thickness as indicated in Annexure-A shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all valves shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

8.0 Suggested Colour Codes for Painting

Suggested colour codes has been enclosed for adherence. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.

9 PAINTING SCHEDULES

- 9.1 Painting schedules for various systems/ items are furnished as per enclosed Annexures-A. Vendors will furnish detailed painting schedule for customer approval during detail engineering stage as per specification.



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ANNEXURE - A

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in microns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Microns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment /valve, etc. (Temp. upto 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	HB Zinc Phosphate (alkyd Medium) as per IS:2074	2	35-45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140
LP Piping/structurals/ Vessels, etc. (Temp. upto 90°)	- do -	HB Zinc Phosphate as per IS:2074 (alkyd medium)	2	35 – 45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110-140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	NA	Insulated	NA	40
Equipment in corrosive areas.	Blast clean to Sa 2 ¹ /2	HB Epoxy resin based zinc phosphate primer	1	50 per coat	Epoxy based MIO pigmented paint	1	50 per coat	Polyamide cured Epoxy finish coat	2	25 – 35 per coat	150 - 170
Elect. / Control Panels, etc.	Seven tank process	HB Zinc phosphate (alkyd Medium) as per IS:2074	2	35 – 45 per coat	-NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140

Notes:

- Surface preparation shown is as per Swedish Standards SIS 05-5900 or equivalent Indian std. Degreasing will be as per Standard SSPC-SP1.
- Incase of insulated surfaces, only primer coats shall be applied.
- GM/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
- All instruments shall be painted as per manufacturer standard practice.
- All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site. Equipment shall be finish painted at shop.
- Method of painting application shall be as per paint manufacturer's recommendation.
- Based on above detailed painting schedule will be prepared by Ozone Generation plant supplier and will be submitted to BHEL for their approval.
- The above mentioned painting requirements are bare minimum. Any variation as required by BHEL/customer during detailed engineering stage shall be adhered by the bidder without any delivery/commercial implication to BHEL.



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SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Crane				
2.1	Crane structure	Golden Yellow	356	-	-
2.2	Trolley and hook	Crimson	540	-	-
3.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
4.0	Tanks (without insulation and cladding)				
4.1	Outdoor	Aluminium	-	-	-
4.2	Indoor	Light grey	631	-	-
5.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Aluminium	-	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping				
9.1	Potable, Service water & Ozonated water	Sea green	217	French blue	166
9.2	Compressed air, Oxygen, Ozone, instrument air	Sky blue	101	White	-
9.3	Vacuum pipes	Sky blue	101	Black	-
9.4	Drainage	Black	-	-	-

Notes:

1. This colour code basically refers to IS:2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.
3. The above mentioned painting requirements are bare minimum. Any variation as required by BHEL/customer during detailed engineering stage shall be adhered to the bidder without any delivery/commercial implication to BHEL.



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DRAWING / DOCUMENT DISTRIBUTION SCHEDULE
ANNEXURE - VI

S. NO.	DESCRIPTION	CONSULTANT	RPCL HEAD OFFICE	RPCL SITE	BHEL UNIT	BHEL SITE
A	POST CONTRACT CORRESPONDENCE	1	S	1	1	0
		0	1	S	1	1
		0	1	1	S	1
		0	1	1	1	S
B	DRAWINGS/DOCUMENT SUBMISSION					
	A) SUBMISSION	2	11	2	S	2
	B) RETURN OF SUBMISSION WITH COMMENTS/APPROVAL BY RPCL	1	S	1	2	0
	C) RFC ISSUE	2	11	2	S	4
	D) AS BUILT	2	11	2	S	4
	E) ERECTION DRAWINGS	2	11	3	S	5
C	PROGRESS REPORT (MONTHLY)					
	EPC CONTRACTOR'S REPORT	2	11	5	S	4
D	INSTRUCTION MANUALS					
	ERECTION & COMMISSIONING	2	11	3	S	3
	O & M MANUAL	2	1 + 8CD	5 + 11CD	S	2 + 5CD

RPCL-RAICHUR POWER CORPORATION LIMITED (CUSTOMER)

CONSULTANT –STEAG

S- SOURCE

CD- SOFT COPY

Note:

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- Initial submission of drawings / documents will be in soft format (pdf only) through email followed by Thirteen (13) hard copies.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required. Vendor to come for meeting with the concerned dealing persons as per BHEL or customer (RPCL) requirement in a short notice.
- Bidder to also furnish the auto cad copy of the following documents after award of contract. However any other auto cad copy of any other document as per the insistence of BHEL / customer will also be submitted by the bidder without any delivery/commercial implication to BHEL.
 - Equipment lay out.
 - Cable tray lay out.
 - Civil scope drawings.
 - Piping lay out drawing.
- Cable schedule in BHEL format (shall be provided during detailed engineering stage).



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**DATASHEET -A
ANNEXURE - VIII**



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DATA SHEET-A

SL NO.	DESCRIPTION	PARAMETERS
1.0	OXYGEN GENERATION PLANT	
1.1	COMPRESSORS	
1.1.1	No. of Compressors	5 Nos (4 Working +1 Standby)
1.1.2	Type	Multi stage , Screw type air cooled, oil free compressors
1.1.3	Capacity & Head	As per system requirements
1.1.4	Material of construction	
1.1.4.1	Casing	Cast Iron
1.1.4.2	Rotors	Carbon steel
1.1.5	Medium to be handled	Air
1.1.6	Suction temperature	Ambient
1.1.7	Accessories	Intake air filters, drive motor, intake silencer, step up gear box, moisture separator, ducting etc.
1.1.8	Dive motor	Electric drive motor
1.1.9	Installation	Outdoor under industrial shed
1.2	AIR RECEIVER	
1.2.1	Numbers	1 No.
1.2.2	Capacity	8.0 M ³ (minimum) or as per system requirement whichever is higher
1.2.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.2.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.2.5	Type	Vertical self-supporting cylindrical vessel
1.2.6	Installation	Outdoor under industrial shed
1.3	AIR DRYERS	
1.3.1	Numbers	2 Nos (2 x 100%) per stream. Total 4 nos for both the streams.
1.3.2	Capacity	As per system requirements
1.3.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.3.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.3.5	Desiccant	
1.3.5.1	Type	Activated alumina or equivalent material
1.3.6	Installation	In door
1.4	OXYGEN GENERATORS	
1.4.1	Numbers	2 Nos (2 x 100%) per stream. Total 4 nos for both the streams.
1.4.2	Capacity	As per system requirements
1.4.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.4.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.4.5	Installation	In door
1.5	OXYGEN RECEIVER	
1.5.1	Numbers	2 Nos (2 x 50%)
1.5.2	Capacity	6 M3 each (minimum) or as per system requirement whichever is higher
1.5.3	Material of construction	Carbon Steel to IS 2062/IS 2002
1.5.4	Design Code	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.5.5	Type	Vertical self-supporting cylindrical vessel
1.5.6	Installation	Outdoor under industrial shed
2.0	OZONE GENERATION PLANT	Total Capacity 38 Kg/hr
2.1	OZONE GENERATORS	
2.1.1	Numbers	N (Working)+1(Standby)
2.1.2	Capacity of each ozone generator	Supplier Specific
2.1.3	Type	Vertical/Horizontal tubular
2.1.4	Material of construction	SS316 Ti
2.1.4.1	Material of Tube	SS316 Ti
2.1.4.2	Material of construction of Electrode	SS316 Ti



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2.2	DI ELECTRIC GLASS TUBE	
2.2.1	Type	Cylindrical
2.2.2	Material of construction	Borosilicate glass tube/ equivalent based on supplier recommendations
2.2.3	Construction	Close at one end or based on supplier recommendations
3.0	OZONE DOSING PUMPS	
3.1	Number	2 Nos (2 x 100%)
3.2	Location	Indoor.
3.3	Fluid to be handled	Ozone with water
3.4	Service	To dose ozonised water in the inlet & outlet of condensers.
3.5	Type of Pump	Horizontal Centrifugal
3.6	Rated Capacity	As per supplier recommendations
3.7	Head to be developed	As per system requirements
3.8	Operation	Continuous
3.9	Material of construction	
	• Casing	CI to IS 210 Gr. FG 260
	• Impeller	SS316
	• Shaft	SS 410
	• Shaft sleeve material	SS 410
3.10	Pressure gauge	One for each pump with teflon diaphragm seal.
3.11	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
3.12	Dive motor	Electric drive motor
4.0	COOLING WATER PLANT	
4.1	CHILLED WATER RECIRCULATION PUMPS	
4.1.1	Number	2 Nos (2 x 100%)
4.1.2	Location	Indoor
4.1.3	Fluid to be handled	Potable water
4.1.4	Type of Pump	Horizontal Centrifugal
4.1.5	Rated Capacity	As per supplier recommendations
4.1.6	Operation	Continuous
4.1.7	Head to be developed	As per system requirements
4.1.8	Material of construction	
	• Casing	SS316
	• Impeller	SS316
	• Shaft	SS 410
	• shaft sleeve material	SS 410
4.1.9	Pressure gauge	One for each pump with teflon diaphragm seal.
4.1.10	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers (SS316), pressure gauges, pulsation dampener.
4.1.11	Dive motor	Electric drive motor
4.2	CHILLER	
4.2.1	Numbers	2 Nos (2 x 100%)
4.2.2	Type	Air cooled
4.2.3	Capacity	As per system requirements based on supplier recommendations
4.2.4	Material of Construction	Carbon Steel



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4.2.5	Installation	Outdoor under industrial shed				
4.3	POTABLE WATER STORAGE TANK					
4.3.1	Numbers	One number				
4.3.2	Capacity	15 M3 (minimum).				
4.3.3	Material of construction	Carbon Steel Rubber Lined (Rubber lined shall be 4.5 mm thick in three layers)				
4.3.4	Thickness	6 mm (minimum).				
4.3.5	Type	Vertical cylindrical with dished bottom.				
4.3.6	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders , lifting lugs (4 nos minimum) etc.				
5.0	PIPING , FITTINGS & FLANGES					
5.1	Material of construction of piping, fittings and flanges handling Compressed air and instrument air.	Piping shall conform to Carbon steel to IS 1239 heavy grade /IS 3589 grade 410 galvanized to IS-4736. For pipe size> 150 NB the thickness shall be as indicated in the P&ID. The material of fittings and flanges shall be either same as the parent material or malleable iron to IS-1879 (galvanised).				
5.2	Material of construction of piping, fittings and flanges handling Oxygen and Ozone gas	Piping shall be of Stainless steel to ASTM A 312 TP 316 sch. 10S (minimum) seamless. The material of fittings and flanges shall be of SS316 class 150 (minimum).				
5.3	Material of construction of piping, fittings and flanges handling Ozonated water	Piping shall be of Stainless steel to ASTM A 312 TP 316 sch. 10 (minimum). The material of fittings and flanges shall be of SS316 class 150 (minimum).				
5.4	Material of construction of piping, fittings and flanges handling Motive water. Design pressure of Motive water line shall be 7.5 kg/cm2 (g) and design mechanical temperature shall be 60°C.	• Piping upto and including 150 NB shall be of Carbon Steel ERW, IS:1239 (HEAVY GRADE). The material of fittings and flanges shall be of Carbon steel class 150 (minimum). • Piping >150 NB shall be of Carbon steel (IS:2062) rolled and welded as per IS:3589. The thickness of pipe shall be as indicated in the P&ID The material of fittings and flanges shall be of Carbon steel class 150 (minimum).				
5.5	Material of construction of piping, fittings and flanges handling Potable water. Design pressure of portable water line shall be 10 kg/cm2 (g) and design mechanical temperature shall be 60°C.	Piping less than or equal to 150 NB shall be of carbon steel, ERW conforming to IS: 1239 (Heavy grade) and shall be galvanized as per IS 4736 or Equivalent. Pipe end connections shall be screwed. The material of fittings and flanges shall be of Carbon steel class 150 (minimum).				
6.0	VALVES					
6.1	Valves handling Compressed Air Services & Instrument air: Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	For compressed air application, valve material shall be galvanized cast carbon steel as mentioned below:				
SIZE		BODY BONNET	DISC/GATE	STEM	HAND WHEEL	VALVE ENDS
≥ 65 NB		ASTM A 216 Gr. WCB	ASTM A 216 Gr WCB	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	FLANGED RAISED FACE



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		≤50 NB	ASTM A 105	13% Cr Steel	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	SCREWED TYPE
6.2	Valves handling handling Oxygen, Ozone, Ozonated water: Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	GATE AND CHECK VALVES					
		Body & Bonnet		SS316			
		Seating surface		SS 316			
		Stem & Disc/Gate		SS 316			
		Hinge pin		SS 316			
		BUTTERFLY VALVES					
		Body & Disc/flange		SS316			
		Shaft		SS316			
		BALL VALVES (Full bore type)					
		Body & Bonnet		SS316			
		Seating surface		SS316			
		Stem & ball		SS316			
		Hinge pin		SS316			
6.3	Valves handling Motive water, Potable water: The Type of valves shall be inline with the P&ID. The material of all the safety relief valves shall be SS316.	SIZE	BODY BONNET	DISC/GATE	STEM	HAND WHEEL	VALVE ENDS
		≥ 65 NB	CI IS 210, Gr. FG 260	CI IS 210, Gr. FG 260	ASTM 312 Gr A/IS 320 HT2	ASTM A47 Gr. 32510	FLANGED RAISED FACE
		≤50 NB	ASTM B62/IS 318 Gr. LTB2	ASTM B62/IS 318 Gr. LTB2	ASTM B312 GR. A/IS 320 HT2	ASTM A47 Gr. 32510	SCREWED TYPE



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**QUALITY ASSURANCE PLAN
ANNEXURE- IX**



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QUALITY ASSURANCE PLAN FOR PRESSURE VESSELS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	Note 1
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	Note 1
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	Note 2 & 3
b	Surface Defects	Verification of Surface	Major	Visual	100%	No Pitting / Corrosion	No Pitting & Corrosion	SIR	P	V	V	
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	NDT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	RT	Major	Visual	100%	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	NDT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	RT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII ADIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Air Leak Test (Soap Bubble Test) for Nozzle RF Pads	Weld Soundness	Major	Visual	100%	App.Drg. / Relevant code	No Leakage / Bubbles	FIR	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

Contd...2



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR PRESSURE VESSELS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record				Remarks
									Bidder	BHEL	CUSTOMER	
V) Stage Inspection												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test / Water Fill Test (As Applicable)	With stand of Hydro Test / Water Fill Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seepage	FIR	P	W	W	
d	Painting	DFT	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
e	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
f	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International	TC V		V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL & CUSTOMER.

NOTE 3: All plates of pressure vessels shall be ultrasonically tested as follows:

(a) For nominal thickness 20 mm and higher when used for fabrication of dished ends

(b) For nominal thickness 40 mm and higher when used for fabrication of shells

(c) For nominal thickness 50 mm and higher when used for blind flanges

All thicknesses, when used for body flanges

NOTE 4: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 5: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness

SIR: Stage Inspection Report
App.Drg. Approved Drawing
V : Verify Documents

FIR: Final Inspection Report
P: Perform



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR ATMOSPHERIC TANKS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	Note 1
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	Note 1
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	Note 2 & 3
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	NDT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	NDT	Major	Visual	As per Appd. Drg	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	NDT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	NDT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Air Leak Test (Soap Bubble Test) for Nozzle RF Pads	Weld Soundness	Major	Visual	100%	App.Drg. / Relevant code	No Leakage / Bubbles	FIR	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

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TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR ATMOSPHERIC TANKS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
V) Stage Inspection before Rubber Lining :												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test / Water Fill Test (As Applicable)	With stand of Hydro Test / Water Fill Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seepage	FIR	P	W	W	
f	Painting	DFT	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
g	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
h	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International Standards	TC V		V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BGR & BHEL.

NOTE 3: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 4: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leak shall be permitted.

NOTE 5: For Rubber Lining refer separate QAP. Rubber Lining shall be carried out after Hydro Test and clearance from BHEL.

NOTE 6: Hydro test will be conducted before Rubber Lining.

NOTE 7: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness

SIR: Stage Inspection Report
App.Drg. Approved Drawing
V : Verify Documents

FIR: Final Inspection Report
P: Perform



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR RUBBER LINING

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) RUBBER SHEET :												
a	Rubber Sheet Inspection	Surface and Thickness check	Major	Visual & Measurement	100%	App.Drg.	App.Drg	SIR	P	V	V	
b	Tensile Strength & % Elongation	Strength	Major	Mechanical Test	1 Sample per Batch	IS 3400 Part 1	TS > 120 kg/cm2 & Elongation > 350%	TC P		V	V	
c	Resistance to Bleeding Test	Resistivity	Major	Chemical Test	1 Sample per Batch	IS 3400 Part 1	No Discoloration & Weight gain limit -0% to +2%	TC P		V	V	Note 1
II) IN PROCESS INSPECTION												
a	Surface Preparation	Blast Clean Surface free from foreign matls.	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
b	Adhesive Coat I	--	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
c	Adhesive Coat II	--	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg / IS4682	SIR	P	V	V	
d	Continuity of Lining	Spark Test	Major	Visual Inspection	100%	App.Drg. / IS4682	No spark at 5KV / mm of lining thk	FIR	P	V	V	
e	Curing of Rubber Lining	Control of Pressure / Temperature / Time of Steam / Water	Major	Measurement & visual	100%	IS4682	IS4682 Part 1	Log book	P	V	V	
III) FINAL INSPECTION FOR LINED VESSELS												
a	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg / IS4682	FIR	P	V	W	
b	Adhesion Test	Adhesion Strength*	Critical	Measurement & visual	100%	App.Drg. / IS4682	IS 4682 Part 1	FIR	P	V	W	*1 test piece per lot
c	Thickness Verification	Thickness	Major	Measurement	Random	App.Drg.	Thk Tolerance = -10% to +15%	FIR	P	V	W	
d	Hardness Check	Hardness Shore A	Major	Visual Inspection	100%	App.Drg. / IS4682	App.Drg	FIR	P	V	W	
e	Continuity of Lining	Spark Test	Major	Visual Inspection	100%	App.Drg. / IS4682	No spark at 5KV / mm of lining thk	FIR	P	V	W	
f	Review of Testing and Measuring	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & Intl. Standards	TC	V	V	W	

NOTE 1: Sample to be kept in 33% HCl, 48% NaOH & DM Water for 72Hrs at 50 Deg C and shall pass as per Acceptance standard.

NOTE 2: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate

DFT: Dry Film Thickness

W: Witness

SIR: Stage Inspection Report

App.Drg. Approved Drawing

V: Verify Documents

FIR: Final Inspection Report

RW: Random Witness

P: Perform

R: Review



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR CENTRIFUGAL PUMPS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Raw Material Identification for Casing, Impeller, Shaft, Casing Wearing ring & Shaft sleeve.	Chemical Analysis & Mechanical Tests	Major	Chemical Analysis & Mechanical Tests	1 Per Heat / Lot	App.Drg. / Relevant code	App.Drg. / Relevant code	Mfr TC / IR	P	V	V	Note 1 & 3
b	Check for Surface defects and Dimensional conformity of the Raw materials.	Dimensional & Visual	Major	Visual & Measurement	100%	App.Drg. / Relevant code	App.Drg. / Relevant code	Mfr TC / IR	P	V	V	
c	Motors	Speed, Power, IP, Mounting Type	Major	Visual	100%	As Per IS 325	Relevant code	Routine Test Report	R	V	V	
II) In Process Inspection :												
a	Machining of Casings, Impeller	Dimensions & Alignment	Major	Visual & Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	SIR	P	V	V	
b	DP Check on Machined Surface	NDT	Major	Visual	100%	ASME SEC V	ASME SEC VIII & Appendix 8	SIR	P	V	V	
c	Hydro test for casings	With stand of Hydro Static	Critical	Hydro	100%	Appd. Drg & Data Sheet / IS 5120	Appd. Drg & Data Sheet / IS 5120 & No Leakage	SIR	P	W	V	
d	Dynamic Balancing of Impeller	Dynamic / Static Balancing	Critical	Visual & Measurement	100%	ISO 1940 Gr.6.3	Relevant code	SIR	P	V	V	
e	Assembly of Pump	Alignment, Fitment	Major	Visual & Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	--	P	V	V	
III) Final Inspection :												
a	Dimension Check	Dimensions	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg	FIR	P	W	V	NOTE 5
b	Performance Test (With Job Motor)	Capacity vs Head, Capacity vs Power and Capacity vs Efficiency	Major	Measurement	100%	Appd. Drg & Data Sheet / HIS	Appd. Drg & Data Sheet / HIS	PTR	P	W	W	
		Temperature raise in Oil & Bearing Hsg.	Critical	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet		P	W	W	
		Vibration & Noise Level	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet		P	W	W	
		c	Strip Down Test	Wear & Tear	Major	Visual / Strip test	100%		IS 5120	As per IS 5120	FIR	
d	Rotor Run out Test	Alignment	Major	Visual & Measurement	100%	IS 5120	As per IS 5120	FIR	P	W	V	
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TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR CENTRIFUGAL PUMPS

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
IV) Painting :												
a	Surface Preparation	Roughness / Free from foreign matts.	Major	Visual	100%	Approved Drg. & Data Sheet	Approved Drg. & Data Sheet	SIR	P	V	V	
V) Stamping / Stenciling :												
a	Identification	To identify the Equipment	Major	Visual	100%	Approved Drg. & Data Sheet	Approved Drg. & Data Sheet	SIR	P	V	V	
VI) Testing and Measuring Equipment :												
a	Calibration status of equipments	To ensure the accuracy	Major	Verification	100%	National & Intl Standards	National & Intl Standards	Calibration Certificates	P	V	V	

NOTE 1: UT shall be carried out for plates thickness 20mm and above & Forgings 50mm dia and above.

NOTE 3: MTC shall be provided for metallic parts.

NOTE 4: Hydro Test on casings shall be carried out at 2 times of rated head or 1.5 times of shut off head which ever is higher and the test pressure shall be maintained for 30 minutes & No Leakage shall be permitted.

NOTE 5: The duration of performance test shall be minimum 1 hour.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate

PTR: Performance Test Report

W: Witness

SIR: Stage Inspection Report

Appd. Drg. Approved Drawing

V : Verify Documents

FIR:

RW:

Mft's Std.

Final Inspection Report

Random Witness

Manufacturer's Standard

P: Perform

R: Review



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR CHECK VALVES

SI.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body, Plate Castings	Material Properties	Major	Chemical & Mechanical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Physical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Dimension & Surface Check	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Inspection Reports	P	V	V	
b	Hinge/ Stop Pin	Material Properties	Major	Chemaical Analysis	1 sampel per Heat number	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	MTC/COC	P	V	V	
			Major	Visual Inspection	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Inspection Report	P	V	V	
c	Spring	Material Properties	Major	Chemaical Analysis	1 sampel per Heat number	Relevant Mtrl.specs	Relevant Mtrl.specs	MTC/COC	P	V	V	
II) In Process Inspection :												
a	Body & Plate Machining	Dimensions	Major	Measurement	Sample	Manufacturing drng	Manufacturing drng	SIR	P	V	V	
		Finish	Major	Visual	100%	Manufacturing drng	Manufacturing drng	-	P	V	V	
		DPT	Major	Visual	100%	As per ASME Sec V.	As per ASME Sec V.	DPT Report	P	V	V	
b	Rubber Lining on body	Vulcanising Soundness	Major	Visual, Spark leak Test & Hardness	100%	As per Procudure for Rubber Linign	As per Procudure for Rubber Linign	Inspection Report	P	V	V	
III) Final Inspection :												
a	Assembly of Valve	Dimensions & Overall Finishing	Major	Measurement	100%	Appd.Drg/Datas sheet.	Appd.Drg/Dtas sheet.	FIR	W	V	V	
b	Hydrostatic Test	Body Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Datas sheet/No Leakage. API 598	Appd.Drg/Datas sheet/No Leakage. API 598	FIR	W	W	W	
		Seat Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Datas sheet/No Leakage. API 598	Appd.Drg/Datas sheet/No Leakage. API 598	FIR	W	W	W	
c	Performance Test	Smooth Operation of Plates	Critical	Operational(open-close)	100%	Appd. Drg & Data Sheet, API 594 / API 598	Appd. Drg & Data Sheet, API 594 / API 598	FIR	W	W	W	
d	Surface Preparation	Painting	Major	Visual	100%	Appd.Drg/Data sheet.	Appd.Drg/Data sheet.	Test Certificate	W	V	V	
IV) Documents Review & Release Note												
a	Document Review & Issue of Release note	Final document review	Critical	Document Review	100%	-	-	Inspection Reports,Test certificates,Issue of Release note	V	V	V	

NOTE 1: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate
W: Witness

SIR: Stage Inspection Report
Appd. Drg. Approved Drawing

FIR: Final Inspection Report
V : Verify Documents

P: Perform
COC: Certificate of Compliance



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR BUTTERFLY VALVES (MANUAL / ACTUATED)

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body, Disc & Wetted Parts	Mechanical & chemical Property Check	Major	Verification with respect stds	100%	Appd. drg., Appd. Data Sheet & Relevant code	Appd. drg., Appd. Data Sheet & Relevant code	Mfr. TC or Check Test Report	P	V	V	Note 1 & 2
b	Receiving Inspection of Bought outs	Visual Defects	Major	Verification with respect stds & Visual Check	100%	Appd. drg. & Relevant code	Appd. drg. & Relevant code	Receiving Inspection	P	V	V	
II) In Process Inspection :												
a	Machining of Body, Disc ,Components &Actuators.	Dimensions & Alignment	Major	Visual & Measurement	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	DP Check on Machined Surface & Actuators	Surface Defects	Major	Visual	100%	ASME SEC V	ASME SEC VIII	DP Report	P	V	V	
III B) Assembly Check :												
a	Assembly of Valves	Verification of all stages	Major	Verification with equipment drg	100%	Assy. Procedure, Equip. drg & Appd. Data Sheet	Assy. Procedure, Equip. drg & Appd. Data Sheet	--	P	V	V	
b	Assembly of Actuators	Verification of all stages	Major	Verification with Appd. Drg	100%	Assy. Procedure, Appd. drg & Appd. Data Sheet	Assy. Procedure, Appd. drg & Appd. Data Sheet	--	P	V	V	
IV) Final Inspection :												
a	Dimension Check	Dimensions	Major	Measurement	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	V	V	Note 3
b	Operational Check	Smooth Movement	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	
c	Pneumatic Test for Valve Seat	Leakage Proof	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	V	V	
d	Hydro Static Pressure Test on Seat & Body	With stand of Hydro Static & Leak Proof	Critical	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	Note 4
e	Actuator performance (Job Actuator)	Leak tightness,Accuracy& simulation(Air to open/close)	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	W	
V) Painting :												
a	Surface Preparation	Roughness / Free from foreign matls.	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	SIR	P	V	V	
VI) Stamping / Stenciling :												
a	Identification	To identify the Equipment	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	SIR	P	V	V	
VII) Testing and Measuring Equipment :												
a	Calibration status of equipments	To ensure the accuracy	Major	Verification	100%	National & Intl Standards	National & Intl Standards	Calibration Certificates	P	V	V	

NOTE 1 : UT shall be carried out for plates thickness 20mm and above & Forgings 50mm dia and above (Only for Metallic).**NOTE 2 :** MTC shall be provided for metallic parts.**Note 3 :** Hydrostatic test for seat and body-1.1 X Maximum working pressure for seat and 1.5 X Maximum working pressure for shell& No Leakage will be permitted.**Note 4 :** Seat Leakage Test should be done in both the directions**Note 5 :** Proof of Design and Disc strength as per AWWAC-504 requirements needs to be conducted.**NOTE 6 :** The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHE**ABBREVIATIONS:**

TC: Test Certificate

W: Witness

SIR: Stage Inspection Report

Appd. Drg. Approved Drawing

FIR: Final Inspection Report

V: Verify Documents

P: Perform

UT: Ultrasonic Testing



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR BALL VALVES (MANUAL / ACTUATED)

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record	SCOPE OF CHECK			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Raw Material Inspection :												
a	Material identification for Body,Ball,&stem.	Material Properties	Major	Chemical+Mechanical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
			Major	Physical	100%	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	Appd. drg., Appd. Data Sheet & Relevant Mtrl.specs	FOUNDARY TC/COC	P	V	V	
II) In Process Inspection :												
a	Body,Ball & Stem	Dimensions	Major	Measurement	Sample	Manufacturing drng	Manufacturing drng	SIR	P	V	V	
		Finish	Major	Visual	100%	Manufacturing drng	Manufacturing drng	-	P	V	V	
		UT for shaft (Dia>50 mm)	Critical	Visual &Measurement	100%	ASTM A388	BE>80 & DE<20%	Test Report	P	V	V	
III) Final Inspection :												
a	Assembly of Valve	Dimensions	Major	Measurement	100%	Appd.Drg/Dtas sheet.	Appd.Drg/Dtas sheet.	FIR	W	V	V	
b	Operational Check	Smooth Movement	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
c	Pneumatic Test for Valve Seat	Leakage Proof	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
d	Hydro Static Pressure Test on Seat & Body	Body Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Dtas sheet/No Leakage.	Appd.Drg/Dtas sheet/No Leakage.	FIR	W	W	V	Note 1
		Seat Hydro Test	Major	Pr.Test Hydro	100%	Appd.Drg/Dtas sheet/No Leakage.	Appd.Drg/Dtas sheet/No Leakage.	FIR	W	W	V	Note 1
e	Actuator performance (Job Actuator)	Leak tightness,Accuracy& simulation(Air to	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	FIR	P	W	V	
f	Surface Preparation	Painting	Major	Visual	100%	Appd. Drg & Data Sheet	Appd. Drg & Data Sheet	Test Certificate	V	V	V	
III b	Document Review & Issue of Release note	Final document review	Critical	Document Review	100%	-	-	Inspection Reports,Test certificates,Issue of Release note	V	V	V	

Note 1: Hydrostatic test for seat and body-1.1 X Maximum working pressure for seat and 1.5 X Maximum working pressure for shell & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate

W: Witness

SIR: Stage Inspection Report

Appd. Drg. Approved Drawing

FIR:

Final Inspection Report

V :

Verify Documents

P: Perform

UT: Ultrasonic Testing



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR OZONE GENERATOR

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	Note 1
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	Note 1
II) Raw Material Inspection :												
a	Raw Material Identification for Shell, D/Ends, Pipes & Flanges	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	ASME SEC II Part A for D/ends & IS 2062 for Shell	Mfr TC / Check Test Report	P	V	V	Note 2 & 3
b	Surface Defects	Verification of Surface	Major	Visual	100%	No Pitting / Corrosion	No Pitting & Corrosion	SIR	P	V	V	
III) Inspection of Dished Ends :												
a	Dimension & Visual Check	Dimensional Conformance, Thinning after forming & Visual	Major	Measurement & Visual	100%	App.Drg.	ASME SEC VIII / IS 4049	SIR	P	V	V	Thickness Check by De meter
b	DP Check on KR, SF & Edge	NDT	Major	Visual	100%	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
c	RT on D/end cordial seam	RT	Major	Visual	100%	ASME SEC V	ASME SEC VIII DIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
IV) In Process Inspection :												
a	Shell Fabrication	Marking, Edge Preparation, rolling & Fit up	Major	Dimensional Conformance & Root Gap	100%	App.Drg.	App.Drg.	SIR	P	V	V	
b	Joint Preparation, Weld set-ups & Nozzles fittings	Alignment & Dimensions	Major	Measurement & Visual	100%	App.Drg.	App.Drg.	SIR	P	V	V	
c	Welding of shells, shell to D/ends & nozzles	Weld Parameter	Major	Visual	100%	AWPS & ASME SEC IX	AWPS & ASME SEC IX	Log Book	P	V	V	
d	DP Check on Butt Joints & Fillet Joints	NDT	Major	Visual	100% on Butt Joints & 10% on Fillet Joints	ASME SEC V	ASME SEC VIII Appendix 8	DP Report	P	V	V	
e	RT on T Joints & Butt Joints	RT	Major	Visual	As per Spec. / Drg	ASME SEC V	ASME SEC VIII ADIV I	RT Report	V	V	V	Review of RT Films by BHEL & CUSTOMER.
f	Pneumatic Test	Pressure Test	Major	Measurement	100%	App.Drg. / Relevant code	App.Drg. / Relevant code	Test Certificates, Inspection Reports	W	V	V	Bubble Test @ 1.05 kg/cm2 (g)

Contd...2



TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION
BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001
VOL-IIB, SECTION - C1,

QUALITY ASSURANCE PLAN FOR OZONE GENERATOR

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Ref.Document	Acceptance Standard	Format of Record				Remarks
									Bidder	BHEL	CUSTOMER	
V) Stage Inspection												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Hydro Static Pressure Test	With stand of Hydro Test	Critical	Visual Inspection	100%	App.Drg.	No Leakage or Seepage	FIR	P	W	W	
d	Stamping / Stenciling	To identify the Equipment	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	V	V	
e	Review of Testing and Measuring Instruments	To ensure the accuracy	Minor	Verification	100%	Calibration Certificate	National & International	TC V		V	V	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever corelation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL & CUSTOMER.

NOTE 3: All plates of pressure vessels shall be ultrasonically tested as follows:

- (a) For nominal thickness 20 mm and higher when used for fabrication of dished ends
- (b) For nominal thickness 40 mm and higher when used for fabrication of shells
- (c) For nominal thickness 50 mm and higher when used for blind flanges

All thicknesses, when used for body flanges

NOTE 4: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 5: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness

SIR: Stage Inspection Report
App.Drg. Approved Drawing
V: Verify Documents

FIR: Final Inspection Report
P: Perform



QUALITY ASSURANCE PLAN FOR CHILLER

Sl.No.	Component & Operation	Characteristics	Class of check	Type of check	Quantum / Frequency of Check	Reference Document	Acceptance Standard	Format of Record	Scope of Check			Remarks
									BIDDER	BHEL	CUSTOMER	
I) Initial Procedure Qualifications :												
a	Welding Procedure Qualification Tests	Procedure Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPS - QW 482 & PQR - QW 483	P	V	V	Note 1
b	Welder Performance Qualification Tests	Performance Qualification	Major	Visual & Mech Checks on Test Piece	100%	ASME SEC IX	ASME SEC IX	WPQ - QW 484	P	V	V	Note 1
II) Raw Material Inspection :												
a	Raw Material Identification for tubes,tube sheet Shell etc.	Verification of MTC & Chemical, Mechanical Properties	Major	Chemical & Mechanical Check	1 Per Heat / Lot	App.Drg. / Relevant code	App.Drg. / Relevant code	Mfr TC / Check Test Report	P	V	V	Note 2 & 3
b	Surface Defects	Verification of Surface	Major	Visual	100%	No Pitting / Corrosion	No Pitting & Corrosion	SIR	P	V	V	
III) In Process Inspection :												
a	Condenser Assembly	i. Pressure Test (Shell side)	Major	Pneumtic under water	100%	App.Drg.	No leakage	SIR	P	V	V	
		i. Pressure Test (Tube side)	Major	Hydraulic	100%	App.Drg.	No leakage	SIR	P	V	V	
b	Cooler Assembly	i. Pressure Test (Shell side)	Major	Pneumtic under water	100%	App.Drg.	No leakage	SIR	P	V	V	
		i. Pressure Test (Tube side)	Major	Hydraulic	100%	App.Drg.	No leakage	SIR	P	V	V	
IV) Stage Inspection												
a	Dimension Check	Dimensional	Major	Measurement	100%	App.Drg.	App.Drg.	FIR	P	W	V	
b	Visual Check	Visual	Major	Visual Inspection	100%	App.Drg.	App.Drg.	FIR	P	W	V	
c	Pressure Test of Refrigerant System	Pneumatic	Critical	Pneumatic	100%	App.Drg.	No Leakage	FIR	P	W	W	

NOTE 1: Only qualified welders & WPS to be used. In case welders are already qualified by customer / BHEL / LRIS / BVQI / DNV & doing similar jobs re-qualification is not required.

NOTE 2: Check Test shall be carried out on plates where ever correlation of TC with material is not available. Sample shall be identified & test Certificates shall be Verified by BHEL & CUSTOMER.

NOTE 3: All plates of pressure vessels shall be ultrasonically tested as follows:

(a) For nominal thickness 20 mm and higher when used for fabrication of dished ends

(b) For nominal thickness 40 mm and higher when used for fabrication of shells

(c) For nominal thickness 50 mm and higher when used for blind flanges

All thicknesses, when used for body flanges

NOTE 4: All test reports / Inspection reports related to the tank shall be furnished for BHEL / CUSTOMER review.

NOTE 5: Hydro test duration shall be 1hr at 1.5 times of design pressure or 2 times of working pressure whichever is higher & No Leakage will be permitted.

NOTE 6: The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.

ABBREVIATIONS:

TC: Test Certificate
DFT: Dry Film Thickness
W: Witness

SIR: Stage Inspection Report
App.Drg. Approved Drawing
V: Verify Documents

FIR: Final Inspection Report
P: Perform

**THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)**

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
											M	C	N	
1	2	3	4	5	6		7	8	9	D	10			11
					M	C/N								
A. MATERIAL INSPECTION														
1.1	ROTOR	PHYSICAL PROPERTIES CHEMICAL COMPOSITION HARDNESS INTERNAL DEFECTS DIMENSION	MAJOR " " CRITICAL MAJOR	MECH. TEST CHEMICAL ANALYSIS HARDNESS CHECK ULTRASONIC TESTING MEASUREMENT	1/BATCH 100% 100%		APPD DRG/DATA SHEET " " AC STANDARD MFG DRG	IN COMPLIANCE WITH "7" " " AC STANDARD MFG DRG	EN 10204-CI-2.2 COC Log book	√ √ 	V V V	V V V	V V -	A- AIRPOWER A- AIRPOWER
1.2	COMPRESSOR CASING / ROTOR HOUSING	CHEMICAL COMPOSITION DIMENSION	MAJOR MAJOR	CHEMICAL ANALYSIS MEASUREMENT	1/BATCH 100%		APPD DRG/DATA SHEET MFG DRG	IN COMPLIANCE WITH "7" MFG DRG	EN 10204-CI-2.2 Log book	√ V	V V	V V	V -	A- AIRPOWER
1.3	TIMING GEARS	PHYSICAL PROPERTIES CHEMICAL COMPOSITION HARDNESS DIMENSION	MAJOR " " MAJOR	MECH. TEST CHEMICAL ANALYSIS HARDNESS CHECK MEASUREMENT	1/BATCH 100%		APPD DRG/DATA SHEET " " MFG DRG	IN COMPLIANCE WITH "7" " " MFG DRG	EN 10204-CI-2.2 Log book	√ V	V V	V V	V -	A- AIRPOWER
1.4	STEP UP GEARS	PHYSICAL PROPERTIES CHEMICAL COMPOSITION HARDNESS DIMENSION	MAJOR " " MAJOR	MECH. TEST ANALYSIS HARDNESS CHECK MEASUREMENT	1/BATCH 100%		APPD DRG/DATA SHEET " " MFG DRG	IN COMPLIANCE WITH "7" " " MFG DRG	EN 10204-CI-2.2 Log book	√ V	V V	V V	V -	A- AIRPOWER
1.5	DRIVE SHAFT	PHYSICAL PROPERTIES CHEMICAL COMPOSITION HARDNESS INTERNAL DEFECTS DIMENSION	MAJOR " " CRITICAL MAJOR	MECH. TEST CHEMICAL ANALYSIS HARDNESS CHECK ULTRASONIC TESTING MEASUREMENT	1/BATCH 100% 100%		APPD DRG/DATA SHEET " " AC STANDARD MFG DRG	IN COMPLIANCE WITH "7" " " AC STANDARD MFG DRG	EN 10204-CI-2.2 COC Log book	√ √ 	V V V	V V V	V V -	A- AIRPOWER A- AIRPOWER
1.6	INTERCOOLER TUBES AFTER COOLER TUBES INTERCOOLER SHELL AFTER COOLER SHELL	MATERIAL CHECK	MAJOR	COMPOSITION TENSILE STRENGTH	1/BATCH		APPD DRG/DATA SHEET	IN COMPLIANCE WITH "7"	COC	√	V	V	V	A- AIRPOWER
1.7	OIL COOLER PLATE TYPE	MATERIAL CHECK DIMENSION CHECK	MAJOR MAJOR	COMPOSITION TENSILE STRENGTH MEASUREMENT	1/BATCH 100%		APPD DRG/DATA SHEET MFG DRG	IN COMPLIANCE WITH "7" MFG DRG	COC Log book	√ 	V V	V V	V -	A- AIRPOWER
LEGEND: * Records identified with " Tick" () shall be essentially included by supplier in QA documentation ** M : Manufacturer / Sub Supplier C : Supplier nominated inspection agency, N : RPCL , P : Perform, W : Witness and V : Verification As appropriate CHP : RPCL : Shall identify in column "N"														

**THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)**

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
										D	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
					M	C/N								
B INPROCESS INSPECTION														
2.1	OIL COOLERS INTERCOOLER AFTERCOOLER	TIGHTNESS	MAJOR	HYDROSTATIC	100%		1.5 X DESIGN PRESSURE FOR 5 MIN.	NO LEAKAGE	COC (SEE NOTE2)	√	V	V	V	A- AIRPOWER
2.2	SAFETY VALVE	SET PRESSURE	MAJOR	MEASUREMENT	100%		AC STANDARD	AC STANDARD	COC	√	V	V	V	A- AIRPOWER
2.3	ROTOR ELEMENT	SURFACE FINISH	MAJOR	VISUAL	100%		AC STANDARD	AC STANDARD	COC	√	P/V	V	V	A- AIRPOWER
		COATING QUALITY	MAJOR	MEASUREMENT	100%		AC STANDARD	AC STANDARD	COC	√	P/V	V	V	A- AIRPOWER
		DYNAMIC BALANCING	MAJOR	BALANCING	100%		ISO 1940	ISO 1940 (grade 6.3 OR BETTER)	COC (SEE NOTE 3)	√	P/V	V	V	A- AIRPOWER
2.4	COMPRESSOR CASING / ROTOR HOUSING LP & HP.	DIMENSION CHECK	MAJOR	MEASUREMENT	100%		APPROVED DRG/ MFG DRG	IN COMPLIANCE WITH "I"	COC	√	P/V	V	V	A- AIRPOWER
		TIGHTNESS	MAJOR	HYDROTEST	100%		HYDROTEST	NO LEAKAGE	COC (SEE NOTE2)	√	P/V	V	V	A- AIRPOWER
2.5	AIR ENDS [HP & LP MODULE	RUN TEST- FAD, LEAKAGE, ABNORMAL NOISE	MAJOR	FAD LEAKAGE ABNORMAL NOISE	100%		1.5 X DESIGN PR AIRPOWER STDS. / ISO 1217	IN COMPLIANCE WITH "I"	COC	√	P	V	V	A- AIRPOWER
2.6A	ELECTRONIKON MICROPROCESSOR MODULE	FUNCTIONAL INTERLOCKS ALARMS	MAJOR	FUNCTIONAL TEST	100%		INT. DRAWING	IN COMPLIANCE WITH "I"	COC	√	V	V	V	A- AIRPOWER
2.6B	CONTROL PANEL (ELECTRONIKON + ** CONTACTORS + ** WIRING HARNESS)	FUNCTIONAL CHECK : DISPLAY, INTERLOCKS, ALARMS ETC HV & IR	MAJOR	MEASUREMENT	100%		APPRD DRG/ INT. DRAWING	APPRD DRG/ INT. DRAWING	INSP REPORT	√	P	V	V	** B - AC INDIA
2.7	OIL FILTER, AIR FILTER, THROTTLE VALVE, OIL PUMP	FITMENT /	MAJOR	VISUAL	1/BATCH		INT. DRAWING	INT. DRAWING	COC	√	V	V	V	A- AIRPOWER
		APPEARANCE		VERIFICATION	1/BATCH				COC	√	V	V	V	A- AIRPOWER
		PERFORMANCE		VERIFICATION	100%				COC	√	V	V	V	A- AIRPOWER
2.8	CANOPY, BASE FRAME, VENTILATION FAN	COMPLETENESS	MAJOR	VISUAL	100%		APPRD DRG/ INT. DRAWING	APPRD DRG/ INT. DRAWING	INSP REPORT	√	P	V	V	B - AC INDIA
		DIMENSIONS		MEASUREMENT	100%		"	"						
		FUNCTIONAL CHECK					INT. DRAWING	PROPER MOUNTING						
LEGEND : * Records identified with " Tick" () shall be essentially included by supplier in QA documentation. ** M: Manufacturer / Sub Supplier, C: Supplier nominated inspection agency, N: RPCL, P: Perform, W: Witness and V: Verification. As appropriate CHP, RPCL : Shall identify in column "N"														

**THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)**

QUALITY ASSURANCE PLAN FOR COMPRESSORS

SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
										D	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
					M	C/N								
C FINAL INSPECTION														
3.0	OVERALL ASSLY. ALONG WITH MOTOR, CONTROL PANEL AND OTHER ACC	DIMENSION COMPLETENESS	MAJOR	MEASUREMENT VISUAL	100%	100%	APPROVED DRG	APPROVED DRG	INSP. REPORT	√	P	W	W	B-AC INDIA
		TIGHTNESS OF AIR/OIL/WATER LINE	MAJOR	VISUAL	100%	100%	NO LEAKAGE	NO LEAKAGE	INSP. REPORT	√	P	W	W	B- AC INDIA
3.1	RUN TEST AND PERFORMANCE TEST	FREE AIR DELIVERY AIR OUTLET PRESSURE SPECIFIC POWER NOISE & VIBRATIONS (SEE NOTE 5)	CRITICAL	OPERATION & CONFORMANCE	100%	100%	APPD. DATA SHEETS / DRGS & ISO 1217	APPD. DATA SHEETS / DRGS	INSP. REPORT	√	P	W	W	CHP- TESTING WITH CONTRACT MOTOR AND CONTROL PANEL AT AC INDIA Sveanagar, Dapodi Pune 411012
D PACKING AND DESPATCH														
4	PACKING SHIPPING	PACKING AND TRANSPORTATION	MAJOR	VERIFICATION	100%		AS PER PACKING PROCEDURE	AS PER PACKING PROCEDURE	ALL SHIPPING DOCUMENTS		P/V	V	-	B - AC INDIA
REMARKS A- PERFORMED / ISSUED BY BIDDER B- PERFORMED / ISSUED BY BIDDER NOTE 1 MATERIAL SHALL BE AS PER APPROVED DRG/TDS. INCASE NOT MENTIONED IN APPROVED DRG/TDS THEN AC STANDARDS SHALL BE APPLICABLE NOTE 2 SPECIFIC CONFIRMATION FROM AIRPOWER REGARDING THE HYDROTEST PRESSURE NOTE 3 SPECIFIC CONFIRMATION FROM AIRPOWER REGARDING THE BALANCING STD AND THE GRADE OF BALANCING NOTE 4 EN 10204 CL 2.2 CERTIFICATE ; DOCUMENT IN WHICH MANUFACTURER DECLARES THAT THE PRODUCTS SUPPLIED ARE IN COMPLIANCE WITH THE REQUIREMENTS OF THE ORDER AND IN WHICH HE SUPPLIES TEST RESULTS BASED ON NON SPECIFIC INSPECTION NOTE 5 NOISE & VIBRATION MEASURED AT SHOP FOR REFERENCE PURPOSE. HOWEVER VALUES SHALL BE DEMONSTRATED AT SITE, AS PER APPROVED TDS NOTE 6 DRIVE MOTOR INSPECTION AND TESTING AS PER SEPARATE APPROVED QP NOTE 7 CALIBRATION STATUS OF MEASURING INSTRUMENTS USED FOR PERFORMANCE TESTING SHALL BE VERIFIED DURING INSPECTION NOTE 8 The above mentioned quality inspection requirement are bare minimum. However any other test of any item as required by BHEL/Customer the same shall be provided by the bidder without and commercial and delivery implication to BHEL.														



TITLE:

**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOL- IIB

SECTION-C1

REV. NO. 01

DATE: 04/12/2014

**KEY PLAN OF OZONE GENERATION PLANT
ANNEXURE- X**

**TITLE:****TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT****2X800 MW YERMARUS THERMAL POWER STATION**

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOL- IIB

SECTION-C1

REV. NO. 01

DATE: 04/12/2014

ESSENTIAL SPARES LIST**ANNEXURE- XI**

1. 10% essential spares of di -electrode of the working ozone generators.



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B

SECTION –C2

REV. NO. 01

DATE: 04/12/2014

SECTION – C2

SPECIFIC TECHNICAL REQUIREMENTS-ELECTRICAL



TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT
(ELECTRICAL PORTION)

VOLUME II B
SECTION-C2
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

- 1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER
- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 3.1 to 3.8. In case of any discrepancy between Basic technical features for HT or LT motors and BHEL standard specification, Basic technical features for HT or LT motors shall prevail.
- 1.7 All the Motors shall be LT & Rating of all the Motors shall be below 174 KW.
- 2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID
- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for Ozonisation System' and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, 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.
- 3.0 LIST OF ENCLOSURES
- 3.1 Electrical scope between BHEL & vendor (Annexure-I).
- 3.2 Technical specification : Basic technical features for HT or LT motors
- 3.3 BHEL standard specification for LT motors
- 3.4 Datasheets – A and C for motors
- 3.5 Datasheet A for Cable trays & accessories
- 3.6 Datasheet A for Cable tray support system
- 3.7 Quality Plan for motors.
- 3.8 Cable erection philosophy
- 3.9 Load data format (Annexure-II).



TITLE:
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OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 01

DATE: 04/12/2014

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR



TITLE:
TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B

SECTION –C2

REV. NO. 01

DATE: 04/12/2014

ANNEXURE - I

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	415V MCC/PMCC	BHEL	BHEL	1. 415V MCC/PMCC shall be located inside/adjacent to the Ozone generation plant building. 2. 415 V, 4W AC/ 240 V AC supply shall be provided at switchgear terminals by BHEL based on load data provided by vendor at contract stage. 3. Interposing relays (RE 302 of Jyoti make or equivalent), if required for interface of MCC/PMCC with PLC and microprocessor based systems, shall be provided by BHEL in MCC/PMCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2.	415V Local PLC based Control Panel	Vendor	Vendor	
3.	Local Push Button Stations (for motors)	BHEL	BHEL	Located near the motor
4.	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor Vendor	1. Laying of cables from power house to MCC/PMCC is in BHEL scope. 2. Laying of all other cables by vendor 3. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL and the cables required shall be free issued to vendor for laying purpose. Vendor shall provide lugs & glands for equipment in vendor scope. 4. Termination at BHEL equipment by BHEL 5. Termination at vendor equipment by vendor
5.	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical cables	Vendor	Vendor	Fiber optic cable between Ozone generation plant PLC and plant DDCMIS shall be in BHEL scope
6.	Cable trays, accessories & cable trays supporting system	BHEL/Vendor	BHEL/Vendor	Cabling upto PMCC/MCC from power house is in BHEL scope. Cabling from PMCC/MCC to respective loads/panels shall be in vendor scope.
7.	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands heavy duty type. 2. Solder less crimping type heavy duty tinned copper rounded lugs for power cables 3. Solder less crimping type heavy duty copper rounded lugs for control cables.
8.	Conduit/trays and conduit/trays accessories for cabling between one end/ both end equipments supplied by vendor	Vendor	Vendor	1. Cabling shall be through conduits/trays. However vendor can use the trunk cable routes provided by BHEL (where available) for laying of cables as permitted by BHEL site engineers. 2. Conduits supplied by vendor shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. 3. Cable trays supplied by vendor shall be of hot rolled sheet and shall be hot dip galvanised. Trays shall meet all the requirements specified in Datasheet-A of cable trays (part of the electrical specification) 4. Makes of conduits/trays shall be subject to customer/ BHEL approval at contract stage. 5. Vendor shall provide plugs & sockets for wiring (if required).



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S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9.	Lighting	BHEL	BHEL	
10.	Equipment Grounding & Lightning Protection	BHEL	BHEL	
11.	Below grade grounding	BHEL	BHEL	
12.	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to approval at contract stage.
13.	Power supply arrangement (battery/ battery charger) for control system/ panel	Vendor	Vendor	Only 415 V AC/ 240 V AC supply to the power supply equipment for control system shall be provided by BHEL at outgoing switchgear terminals. All downstream equipment (eg. battery, battery charger, distribution board etc.) shall be in the package vendor's scope.
14.	Recommended O&M spares, E&C spares, erection & maintenance tools & tackle.	Vendor	-	
15.	Any other equipment/ material/ service required for completeness of system but not specified above (trouble free and efficient operation of the system).	Vendor	Vendor	
16.	a) Input cable schedules b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Routed cable listing (including soft copy) in BHEL Cable Schedule format (to be provided to vendor during contract stage) for the package shall be submitted by vendor during detailed engineering stage.
17.	Equipment layout drawings	Vendor	-	Vendor shall furnish ACAD drawing indicating location and identification of all equipments requiring cabling, and shall incorporate cable routing details marked on the drawing as per PEM (E) interface comments..
18.	Electrical equipment GA drawing	Vendor	-	

NOTES:

1. Make of all electrical equipments/ items supplied shall be of reputed make & shall be subject to approval of BHEL/ Customer after award of contract without any commercial implication.
2. All QPs shall be subject to approval of BHEL/ Customer after award of contract without any commercial implication.



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ELECTRICAL LOAD DATA FORMAT



TITLE:
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DATE: 04/12/2014

DATASHEET A FOR LT MOTORS

SL.NO.	PARAMETERS	UNIT	YERAMARUS
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, $\pm 10\%$
3	FREQUENCY WITH VARIATION	Hz	50 $\pm 5\%$
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	175 KW & below
6	SYSTEM FAULT LEVEL AND ITS DURATION	KA	50kA, 1sec
7	SUITABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		80%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		0.2 kW & Below
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	As per IS 12615 : 2011
12	ACCEPTABLE NOISE LEVEL	DB	Noise level for all motors shall be limited to 85dB(A) at 1 m
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP-55 & IP-54 for outdoor & indoor resp.
15	SPACE HEATER REQUIREMENT		30KW & ABOVE
16	PAINT SHADE		631 of IS-5
17	SPECIAL REQUIREMENT		TYPE TEST REPORTS MORE THAN 5 YEARS OLD ARE NOT ACCEPTABLE
18	ENERGY EFFICIENCY CLASS		IE2 AS PER IS:12615 2011



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DATASHEET A FOR GALVANISED CABLE TRAY SUPPORT SYSTEM (WELDED TYPE)

1.0 APPLICABLE STANDARDS:

- a) IS: 2062 For Structural steel.
- b) IS: 2629 For hot dip galvanising of steel & surface pre treatment.
- c) IS: 2633 For testing of zinc coating.
- d) IS: 6745 For determining of mass of zinc coating.
- e) IS: 1852 For rolling & cutting tolerances of hot rolled steel products.
- f) IS: 4759 For hot-dip zinc coatings on structural steel & other allied products

2.0 GALVANISED CABLE TRAY SUPORT SYSTEM (WELDED):

- a) Material: Hot Rolled Mild Steel
- b) Length Standard length of 5.5m to 6.5m
- c) Sizes: ISA-50x50x6 (for horizontal bracket) & ISMC-100 (for vertical channel)
- d) Type: Hot-dip galvanised

3.0 SURFACE TREATMENT:

Galvanizing:

- a) Pre-treatment: As per IS 2629 prior to galvanisation
- b) Type Hot dip galvanization
- c) Applicable Standard: IS 2629
- d) Minimum thickness: 75 microns (minimum)
- e) Min. weight of:
Zinc deposit 610 gms. per square meter
- f) Tests for galvanizing:
 - i) Weight of zinc coating as per IS : 6745
 - ii) Thickness of zinc coating as per IS : 4759
 - iii) Uniformity of zinc coating as per IS : 2633
 - iv) Adhesion as per IS: 2629

Raw materials: - Steel shall be procured from SAIL/ TISCO/ RINL/ ISPAT IND/ JINDAL/ ESSAR/ BHUSHAN STEEL/ authorized re-rollers of SAIL



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DATASHEET-A FOR CABLE TRAYS & ACCESSORIES

1.0 APPLICABLE STANDARDS

- | | | |
|----|----------|--|
| a) | IS: 2062 | For Structural steel. |
| b) | IS: 1079 | For hot rolled carbon steel sheet and strip. |
| c) | IS: 1730 | For dimensions for steel sheet and strip. |
| d) | IS: 1363 | Hexagon head bolts, screws and nuts. |
| e) | IS: 2629 | For hot dip galvanising of steel & surface pre treatment. |
| f) | IS: 2633 | For testing of zinc coating. |
| g) | IS: 6745 | For determining of mass of zinc coating. |
| h) | IS: 1367 | Galvanised Coating on threaded Fasteners.
(Part-XIII) |
| i) | IS: 1852 | For Rolling and Cutting Tolerances of hot rolled steel products. |

2.0 CABLE TRAYS & ACCESSORIES

2.1 Material : Hot Rolled Mild Steel

2.2 Type : Ladder Type
 Perforated Type

2.3 Standard Length of
 Straight Length of
 Cable Trays : 2.5 meters

2.4 Standard Width (mm) : 600 450 300 150

2.5 Tolerance in length/width
 / height : + /- 2 mm

3.0 FITTINGS

End connections : Through Coupler plates
 (Side Coupler Plates shall be provided as part of cable tray &
 accessories supply with bolts, nuts, washers etc)

4.0 TRAY COVERS

- | | | |
|---|---|------------------------------------|
| a) Type | : | Non-Perforated type. |
| b) Material | : | Hot Rolled Mild Steel. |
| c) Width | : | Suitable for width of cable trays. |
| d) Tolerance in length/
width / height | : | Same as cable trays. |



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5.0 SHEET THICKNESS

- a) For cable trays & Accessories : 2.0 mm
- b) For cable tray cover : 1.6 mm
- c) For Coupler plate : 2.5 mm
- d) Tolerance in Thickness : (+/-0.2 mm)

6.0 SURFACE TREATMENT

- a) Pre-treatment : IS 2629 before galvanisation
- b) Type : Hot dip galvanisation
- c) Applicable Standard : IS 2629
- d) Minimum thickness : 75 microns (minimum)
- e) Min. weight of Zinc deposit : 610 grams per square meter
- f) Tests for galvanizing : Weight, thickness and uniformity of zinc coating as per IS: 6745 and IS: 2633.

7.0 NUMBER OF COUPLER PLATES, BOLTS, WASHERS & NUTS REQUIRED FOR EACH CABLE TRAY SECTION (2.5 MTRS)

Sl. No.	NAME OF ITEM	COUPLER PLATE (nos.)	NUTS (nos.)	WASHERS (nos.)	BOLTS (nos.)
1	Cable tray of standard length 2.5 meters	4	16	32	16

NOTE: - Based on above table, no. of coupler plates, bolts, washers & nuts shall be calculated for the offered lot. Over & above the calculated quantity, additional 10% coupler plates & 20% bolts, washers & nuts shall be supplied by the bidder.

Raw materials: - Steel shall be procured from SAIL/ TISCO/ RINL/ ISPAT IND/ JINDAL/ ESSAR/ BHUSHAN STEEL/ authorized re-rollers of SAIL



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QUALITY PLAN FOR MOTORS 55 KW AND ABOVE

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

		QUALITY PLAN			CUSTOMER			PROJECT			SPECIFICATION		
					BIDDER/ VENDOR			TITLE			NUMBER		
		SHEET 1 OF 9			SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III	
									P	W	V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL												
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-		
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-		
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

		QUALITY PLAN		CUSTOMER -			PROJECT TITLE			SPECIFICATION NUMBER -		
		SHEET 2 OF 9			BIDDER/VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE	
		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. / SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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		QUALITY PLAN				CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER		
		SHEET 3 OF 9				BIDDER/VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
						SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
1	2	3	4	5	6	7	8	9	P	W	V	10	11	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2			
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2			
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-			
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG.	MANUF'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT		
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2			
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.		
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2			
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE						BIDDER'S/VENDORS COMPANY SEAL					

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		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION NUMBER :			
SHEET 4 OF 9					BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III	
1	2	3	4	5	6	7	8	9	P	W	V	REMARKS	
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2		
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2		
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2		
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
		3.TEMP.WITH- STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2		
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2		
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-		
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-		
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

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		QUALITY PLAN		CUSTOMER		PROJECT TITLE			SPECIFICATION : NUMBER			
						QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
		SHEET 5 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY REMARKS			
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC/ ASTM-E165	MANUF'S SPEC/ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC/ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER/S/VENDORS COMPANY SEAL				

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(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
SHEET 6 OF 9		BIDDER/ VENDOR			SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			AGENCY			REMARKS		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE FOR MV MOTOR THREE DIPS TO BE GIVEN	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

			QUALITY PLAN			CUSTOMER			PROJECT			SPECIFICATION		
						BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			NUMBER		
SHEET 7 OF 9						SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III		
									AGENCY		REMARKS			
1	2	3	4	5	6	7	8	9	10	11				
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY		
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-			
		3.HV	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1			
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1			
		2.SOUNDNESS OF DIE CASTING	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1			
		1.ALIGNMENT	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1			
2.10	ASSEMBLY	2.WORKMANSHIP	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-			
		3.AXIAL PLAY	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-			
		4.DIMENSIONS	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1			
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-			
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	1			

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

**THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)**

		QUALITY PLAN SHEET 9 OF 9		CUSTOMER			PROJECT			SPECIFICATION		
				BIDDER/ VENDOR SYSTEM			TITLE QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03 ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			NUMBER : SPECIFICATION TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III	REMARKS	
1	2	3	4	5	6	7	8	9	10	11		
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 01

DATE: 04/12/2014

QUALITY PLAN FOR MOTORS BELOW 55 KW

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

		QUALITY PLAN SHEET 1 OF 2		CUSTOMER :			PROJECT			SPECIFICATION :			
				BIDDER/ VENDOR SYSTEM			TITLE QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01 ITEM AC ELECT. MOTORS BELOW 55KW (LV)			NUMBER :			
										SPECIFICATION TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-		
			MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-		
			MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-		
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-		
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1			NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-		NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
				VENDOR			QUALITY PLAN			SPECIFICATION :		
SYSTEM			NUMBER PED-506-00-Q-006, REV-01			TITLE :			SECTION			
ITEM AC ELECT. MOTORS BELOW 55KW (LV)			VOLUME III									
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

SECTION C3: SPECIFIC TECHNICAL REQUIREMENTS FOR C&I



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

SCOPE OF SUPPLY FOR C&I ITEMS

- 1) Bidder to include Field instrumentation and Field Junction Box (JB's) in his scope of supply. Field instrument specification and Data Sheet are given elsewhere in this specification.
- 2) In case of any discrepancy in the requirement noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of prebid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of BHEL/customer shall prevail without any delivery/commercial implication.
- 3) Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.
- 4) The controls for Ozone generation Plant/ Electrical breaker control shall be realized in PLC based system. PLC control system as defined in the enclosed specification and DATA Sheets shall be in bidder scope. The PLC system shall comprise of
 - (i) PLC based local panel
 - (ii) UPS Power supply
 - (iii) Operator interface in the form of CRT, keyboard and OWS along with required furniture.
- 5) The redundant I/O's shall be provided for all Controls.
- 6) PLC shall have the facility to synchronize its time with BHEL supplied GPS. Necessary Hardware (IRIG-B port) for the same at PLC end to be provided by bidder.
- 7) Plant schematic for monitoring & operation shall be available on OWS, bidder to further submit list of important signal along with applicable schematic for monitoring in DCS.
- 8) All furniture (tables, chairs etc.) required for PLC operator HMI/ printer shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests. One table and chair shall be provided for each operator station and separate table for each printer. Vendor shall submit the furniture details to customer/owner for approval during detail engineering.
- 9) Specification for Instruments used in P&ID other than specified in this specification (i.e. O3 analyser, O2 purity analyser, dew point transmitter etc.) shall be evaluated during detail engineering. All Data sheets submitted by bidder are subject to customer approval.
- 10) Soft-link communication between PLC and DDCMIS shall be redundant Bidirectional OPC link. Bidder shall supply required hardware and software. Communication protocol between PLC end & DDCMIS shall be TCP/IP (Ethernet) and the maximum communication time for receipt of signal at DDCMIS end should not exceed 2 second. Necessary Patch Chord/ Converters, LIU at PLC end, shall be in bidder scope.
- 11) Bidder shall provide redundant UPS with 60 minutes Lead Acid battery backup & necessary redundant power packs for PLC panel and PC, OWS, printer etc.
- 12) VMS to be included in bidder's scope for HT drives, if applicable.
- 13) Connected data cable for PLC to remote I/O panels shall be through redundant cable/optic fibre with redundant I/O, if applicable.
- 14) Bidder shall include measurement and control instruments of transmitters only. No switches shall be considered. All the control measurement and analysers and interlocks shall have redundant sensors.
- 15) Offered Ozone PLC shall have the provision to accept metering signals (Current, Voltage, Power for all phases)/ Protection signals (Overcurrent, Earth fault, under-voltage and no voltage) from numerical relay (BHEL supply) using IEC 61850. Required hardware/software shall be in bidder's scope.



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

SPECIFIC TECHNICAL REQUIREMENT FOR PLC

RPCL/YTPS



RAICHUR POWER CORPORATION LIMITED
YERMARUS STPS – 2 X 800 MW

TITLE **SPECIFICATIONS FOR INSTRUMENTS / LOCAL PANELS /
JUNCTION BOXES / PLC**

SHEET 00 OF 10

Programmable Logic Controllers (PLC):

The microprocessor shall be based on 32 bit processing. The programme memory shall be non-volatile memory. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, maths functions, boolean functions & timer functions. PLC shall complete with processor, I/O cards, memory modules, racks, mounting accessories. The scan time for digital inputs shall not be more than 60msec and execution 120msec. The system shall be loaded to maximum 60% under worst loading conditions.

The redundant processors, redundant communication cards, redundant bus, redundant Power Supply cards for PLC system shall be considered. Further, I/O cards shall be redundant for critical inputs and outputs used for protection, interlock & commands for critical services.

The system shall have self diagnosis features. The operation, monitoring and programming shall be performed from the MMI Monitor station. The system shall be connected to DCS using hot redundant bi-directional OPC communication link and shall have time synchronisation with master clock system. The required hardware for this connectivity shall be included.

Independent redundant UPS with 1 hour Battery backup shall be provided for each of local PLC systems. PLC system with MMI, laser printer shall be included. For PLC system without MMI OWS, a hand held programmer shall be provided.

RPCL/YTPS



RAICHUR POWER CORPORATION LIMITED
YERMARUS STPS – 2 X 800 MW

TITLE **SPECIFICATIONS FOR INSTRUMENTS / LOCAL PANELS /
JUNCTION BOXES / PLC**

SHEET 01 OF 10

Input/Output Modules as required in the control system for all type of field input (4-20 mA, RTD, T/C, Digital contacts etc.) and output from the control system are to be provided as per requirement. Electrical isolation for 1.5 KV with optical coupler between the plant put/output and surge protection as per IEEE 472. The hardware design shall be such that it is able to withstand power line disturbance. The system shall conform to ANSI/IEEE C 62.4 (Immunity to power supply line disturbance).

Contractor shall provide at least 20% wired spare capacity of input/output modules over and above the system requirement. Contractor shall provide built in diagnostic for easy fault detection.

System shall be able to operate in non air conditioned area. However where PLC panels/ I-O racks are located at local areas in dusty and hot zone, PLC panels/I-O racks shall be provided with air condition with suitable protection class. Contractor may provide Annunciation System as integral part of PLC. Field contacts shall be acquired through PLC only. The Annunciation sequence logic shall be implemented as a part of PLC controllers. The No. of Annunciation facia windows and provision of original input will be on as required basis.

Contractor shall provide electronic grounding for PLC which shall be separate from Electrical grounding as per IS or IEEE Standard.

The Factory Acceptance Test for PLC system shall consist of a) Hardware & Software as per BOM b) Spare capacity in cabinet for new module c) Current & Power Consumption d) Power Failure Test e) Healthiness of Hardware/all module f) On line removal of I/O card g) Accuracy Test h) Diagnostic Test i) Functional Test j) Verification of Software k) Redundancy Test of Controller l) Redundancy Test of power supply m) CPU loading duty cycle n) Power failure auto restart. Any other Test as per QAP. The Type test reports also shall be submitted for review.



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

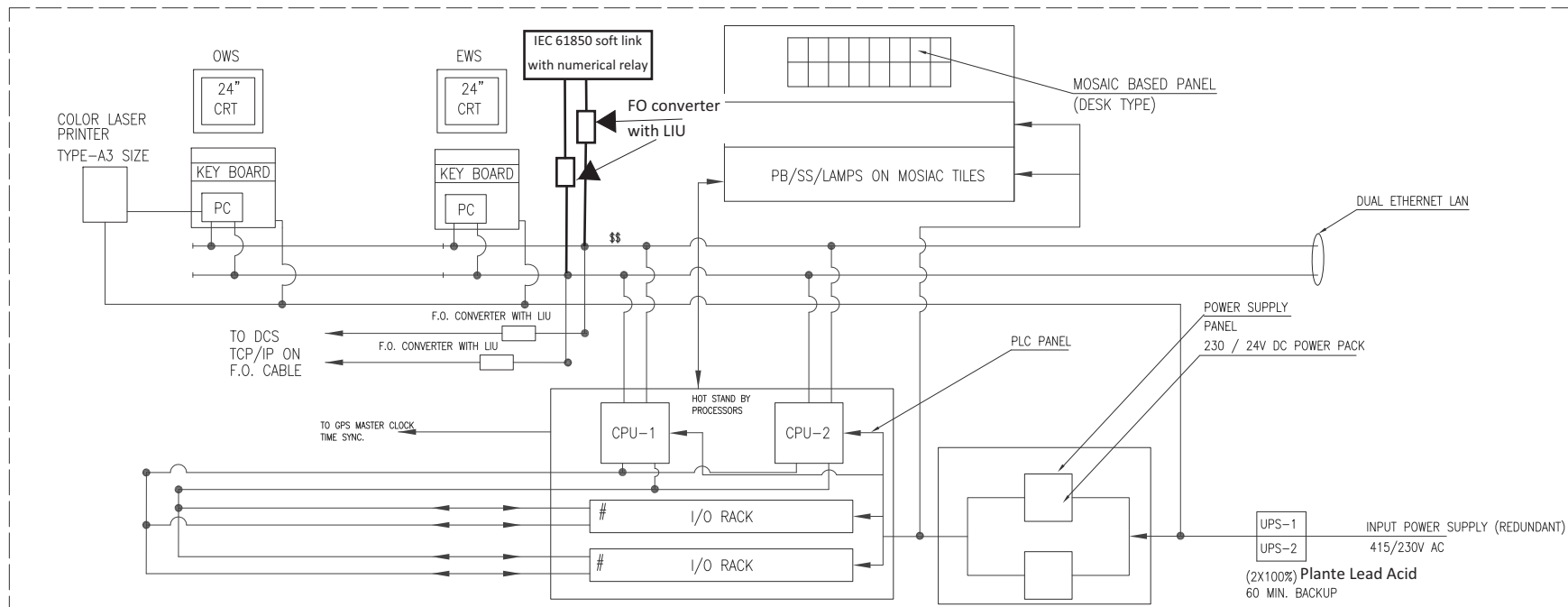
VOLUME **II-B**

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

PLC SYSTEM CONFIGURATION DIAGRAM



Notes:

: Redundancy to be provided for all the I/O's.

\$\$ Redundant Ethernet Switches to be provided to maintain overall Network redundancy at all levels.

All the items shown here are in bidder's scope.

JOB No. : 362		RAICHUR POWER CORPORATION LIMITED (A JVC OF KPCL & BHEL)	
STATUS: CONTRACT		2X800 MW YERMARUS STPP	
DISTRIBUTION		BHARAT HEAVY ELECTRICALS LTD	
TO		POWER SECTOR	
No. OFF		PROJECT ENGINEERING MANAGEMENT	
REV		NOIDA	
DATE 10.09.2013		TITLE	
00		SYSTEM CONFIGURATION DIAGRAM FOR	
		OZONE GENERATION PLANT	
		DEPT. SCALE	
		SIGN	
		DATE	
		DRAWING No.	
		PE-DG-362-174-14000A-A002	
		SHEET 1 OF 1	
		REV 01	



TITLE:
**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**
2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

QUALITY PLAN FOR PLC SYSTEM

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

 PEM :: C&I		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN: PE-TS-362-174-14000A-A001				
								VOLUME	IIB			
								SECTION	C3			
								REV. NO.	01			
								SHEET	1	OF	8	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection - Identification Labels - Physical Damages - Quantity - Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)



STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER		REVISION PLAN NO. PE-01-000-110-1000										
		VOLUME	IIB									
		SECTION	C3									
		REV. NO.	01	DATE	04.08.2007							
PEM :: C&I		SHEET	2	OF	8							
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND:	* CR - Critical characteristics	\$ P - Agency Performing the Test.	1 - BHEL
	MA - Major characteristics	W - Agency Witnessing the Test.	2 - Vendor
	MI - Minor characteristics	V - Agency Verifying the Test.	3 - Sub-vendor

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

- 1 - BHEL
- 2 - Vendor
- 3 - Sub-vendor

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

 PEM :: C&I		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER							QUALITY PLAN NO.: PE-QP-355-143-1030			
									VOLUME IIB			
									SECTION C3			
									REV. NO.: 01 SHEET 3 OF 8			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
2.0	Assembly											
2.1	Functional Test for HMI/OVS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

(बीएसईएल)  PEM :: C&I		STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN - PE-Q-003-140-1000							
								VOLUME		IIB					
								SECTION		C3					
								REV. NO.		01		DATE: 21.03.2007			
		SHEET		4		OF		8							
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks			
									P	W	V				

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^{\$} P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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FOR
PROGRAMMABLE LOGIC CONTROLLER**

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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

**STANDARD QUALITY PLAN
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[REDACTED]			
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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

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[REDACTED]			
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ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.



TITLE:
**TECHNICAL SPECIFICATION FOR
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2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 01

DATE: 04/12/2014

QUALITY PLANS CHECKLIST FOR INSTRUMENTS

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

FORM NO. PEM-5666-0

	QUALITY CHECK LIST FOR TEMPERATURE ELEMENTS (Mechanical Auxiliary Packages)	SPECIFICATION NO.: VOLUME: SECTION: REV. NO. _____ DATE: _____ SHEET 1 OF 1 Data Sheet No.: PE-CL-999-145-1003-0
---	--	---

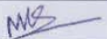
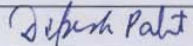
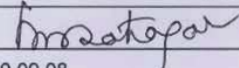
SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT / DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%.
	1.1 MODEL NO/TAG NO	100%		M	C	C	
	1.2 CONTINUITY & POLARITY OF ELEMENT	100%		M	C	C	
	1.3 IR BETWEEN SHEATH & ELEMENT	100%		M	C	C	
	1.4 THERMAL RESPONSE TIME			M	C	C	
	1.5 END CONNECTION	100%		M	C	C	
	1.6 DIMENSIONAL CHECK OF THERMOWELL	100%		M	C	C	
2.0	CALIBRATION						WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED.
	2.1 ACCURACY	100%		M	C	B	
3.0	REVIEW OF T.C. FOR MATERIAL OF--						* IBR CERTIFIATE TO BE PROVIDED IF APPLICABLE
	3.1 SENSOR WIRE	FOR LOT		-	-	C,B	
	3.2 PROTECTIVE SHEATH			-	-	C,B	
	3.3 TERMINAL HEAD			-	-	C,B	
	3.4 THERMOWELL			-	-	C,B	
4.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	C,B		
5.0	REVIEW OF IBR CERTIFICATE FOR THERMOWELL *	100%	-	-	C,B		
6.0	HYDRO TEST ON THERMOWELL	100%	M	C	C		

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR. C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	MAYANK KESHARWANI	DIPESH PALIT	SHAIENDRA BHATNAGAR
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

FORM NO. PEM-6656-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)	SPECIFICATION NO.: VOLUME: SECTION: REV. NO.: DATE: SHEET I OF I
	Data Sheet No.: PE-CL-999-145-1026-0	

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS	
				P	W	V		
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED	
	1.1 DIAL SIZE	100%		M	C	C		
	1.2 MODEL NO/TAG NO	100%		M	C	C		
	1.3 RANGE/SCALE	100%		M	C	C		
	1.4 END CONNECTION	100%		M	C	C		
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C		
2.0	CALIBRATION							
	2.1 ACCURACY	100%		M	C	B		
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B		
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C		
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C		
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C		
5.0	REVIEW OF T.C. FOR MATERIAL OF--							
	5.1 SENSOR	FOR LOT		-	-	B		
	5.2 MOVEMENT			-	-	B		
	5.3 PROCESS CONNECTION		-	-	B			
	5.4 HOUSING		-	-	B			
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	B			
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE	-	-	B			
8.0	ACCESSORIES AS APPLICABLE	100%	M	C	C			

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	S C NARANG/ MAYANK KESHARWANI	DIPESH PALIT	SHAILENDRA BHATNAGAR
SIGNATURE			
DATE	21.08.08	21.08.08	21.08.08

THIS IS A PART OF TECHNICAL SPECIFICATION FOR OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-362-174-14000A-A001 REV 01)

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 1	
Data Sheet No.: PE-CL-999-145-1026-0			

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

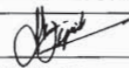
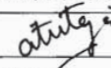
LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE - BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	SACHIN SRIVASTAVA	DILIP JEJURIKAR	ALKA TUTEJA
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08



TITLE:

TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME **II-B**

SECTION -D

REV. NO. 01

DATE: 04/12/2014

GENERAL TECHNICAL REQUIREMENT

D1: GENERAL TECHNICAL REQUIREMENTS FOR MECHANICAL

D2: GENERAL TECHNICAL REQUIREMENTS FOR ELECTRICAL

D3: GENERAL TECHNICAL REQUIREMENTS FOR C&I



TITLE:

**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B

SECTION –D1

REV. NO. 01

DATE: 04/12/2014

SECTION-D1

GENERAL TECHNICAL REQUIREMENT-MECHANICAL



TITLE:

TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B

SECTION -D1

REV. NO. 01

DATE: 04/12/2014

1. DESIGN CRITERIA:

Ozone treatment is to be done for Cooling Water to prevent growth of biological substances. Ozone generation plant shall comprise of the Ozone generating system including mixing device, ozone generators, its feed gas preparations device & its controls. Ozone shall be generated using a dry filtered gas containing oxygen, which is fed through an electrical discharge created between the two electrodes. The discharge, known as "silent corona discharge" causes the dissociation of some of the oxygen molecules resulting into the formation of ozone. The produced ozone gas is mixed with water and resulted ozonized water is dosed into the Condenser inlet and outlet. The ozone concentration shall be of 8-10% (W/W). The design pressure of all the pressure vessels shall be 8kg/cm² (g) minimum.

The ozone generation plant shall consist of at least the following sub systems:

- OXYGEN GENERATION PLANT
- OZONE GENERATOR
- OZONE DOSING SYSTEM
- COOLING WATER PLANT
- MEASURING & MONITORING DEVICES
- PLC BASED CONTROL SYSTEM

The brief description of above mentioned sub systems are as follows:

- **OXYGEN GENERATION PLANT**- Oxygen generation plant is used to feed desired quantity & quality of feed gas to Ozonator. It shall consist of following equipments:
 - **Compressor**: Five numbers (4 Working +1 Standby) screw type air cooled compressors of suitable capacity along with electrical motor, instruments, ducting arrangement, valves, piping shall be provided by the bidder.
 - **Air Receiver**: One number air receiver shall be provided by the bidder along with all the accessories. The capacity of air receiver shall be 8.0 M³ (minimum).
 - **Dryer Unit**: Two numbers (2X100%) Dryer unit per stream (total 4 numbers for both the streams) along with all the accessories shall be provided by the bidder to remove the moisture from the air. The dryer shall be based on adsorption phenomenon using activated alumina or equivalent material based on supplier recommendations.
 - **Oxygen generator**: Two numbers (2X100%) oxygen generator / concentrator per stream (total 4 numbers for both the streams) along with all the accessories to achieve the pure oxygen shall be provided by the bidder. Online measurement & monitoring facilities of oxygen purity & dew point shall also be provided by the bidder.
 - **Oxygen receiver**: Two nos (2x50%) oxygen receiver shall be provided by the bidder along with all the accessories. The capacity of each oxygen receiver shall be 6 M³ (minimum).
- **OZONE GENERATION PLANT**- Ozone generator shall be vertical/horizontal shell and tube, corona discharge, water cooled, fixed voltage and variable frequency type. Ozone shall be generated by passing oxygen through a gap formed between power connection and SS tube. Ozone production shall be controlled by varying the applied frequency. However the design and configuration of ozone generator shall be purely supplier specific.
- **OZONE DOSING SYSTEM**: Ozone produced from ozone producing cells is mixed with water. This system consists of venture injection to contact the ozone with the cooling water. The water flow through the injector produces a partial vacuum which is utilised to draw ozone into the water stream and mix the two phases vigorously. The water jet exiting the injector with great turbulence from the motive nozzle disperses the gas into a stream of finest bubbles. This action increases the contact surface between gas and water phases tremendously which is essential for optimized mass transfer. The ozonated water will be introduced into the inlet & outlet to condenser. Static mixtures shall also be provided for the ozone dosing line at the interval of 20 meters. However minimum number of Static mixtures shall be 30 numbers.
- **COOLING WATER PLANT**: Cooling water plant is provided for removal of excess heat generated during ozone generation from ozone producing cells. Suitable capacity two numbers (2X100%) air cooled Chillers for removal of excess heat generated during ozone generation from ozone producing cells shall be provided by the bidder. Ozone system shall be water cooled. Potable water is used for removal of excess heat from the ozone producing cells. The water analysis of potable water has been attached as Annexure – III elsewhere in the specification.

**TITLE:****TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT****2X800 MW YERMARUS THERMAL POWER STATION**

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

VOLUME II-B**SECTION –D1**

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DATE: 04/12/2014

• MEASURING & MONITORING DEVICES:

Following minimum number of measuring and monitoring devices shall be provided by the bidder

- a. Outlet ozone gas of each ozone-generating module shall be measured by one number (minimum) common ozone analyser.
- b. One number (minimum) ambient ozone leak detector shall be placed in the ozone generator room to detect ozone leakage with alarm and cut-off signal on set value.
- c. Two numbers (minimum) Residual Ozone analyser at the condenser outlet of each unit.
- d. O₃ Concentration indicator at the outlet of each Ozone generator.
- e. One number (minimum) ozone gas destructor (if applicable).

2. CAPACITY SELECTION:

Total CW Flow	=	1,88,116 m3/hr (approx.)
Ozone dosing rate	=	0.2 ppm
Ozone requirement	=	37.63 Kg/hr.
Ozone Dosage rate selected	=	38 Kg/hr.
Nos of ozone generator	=	N (Working)+1(Stand by) *
Capacity of each ozone generator	=	Supplier Specific *

*The numbers of ozone generator and capacity of ozone generator including stand by shall be supplier specific.

3. PLANT OPERATION AND CONTROL

The operation of the Ozone generation Plant shall be from PLC based complete automatic control system. PLC shall have one OWS+ one OWS with Engineer's station with associated auxiliaries and shall be kept in AC room. The critical parameters shall be sent to plant DDCMIS for monitoring purpose only. It shall be possible to operate the plant in Auto / Semi auto / Manual mode. In 'Auto mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi auto' mode each step shall be performed only after initiation by the operator. In 'manual' mode complete operation shall be by the operator. However the detailed control shall be furnished by the bidder during detailed engineering stage.

Alarm windows and No. of alarm shall be finalised during detail engineering.

UPS: PLC shall be powered from 2x100% parallel redundant UPS Power supply with 60 minutes battery back-up.

Dual redundant measurements shall be envisaged for CLCS / OLCS functions and Single measurements are envisaged for monitoring.

Soft signal exchange between Ozone PLC and main plant DCS is only envisaged & for monitoring of critical parameters

All the pumps/compressors /heat exchanges shall have inlet and outlet process measurement at locals as well as in remote (PLC-OWS).

All the valves coming in sequence shall be automatic valves.

Following minimum alarms shall be provided:

- High gas exit temperature
- High or low gas pressure
- Low chilled water flow
- High chilled water exit temperature
- Frequency drive failure
- Loss of phase detect
- High inverter current trip
- Low feed gas flow
- Door interlock trip
- Ozone concentration (intermittent)
- ORP/ residual ozone



TITLE:

TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT

2X800 MW YERMARUS THERMAL POWER STATION

BHEL DOCUMENTS NO.: PE-TS-362-174-14000A-A001

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SECTION –D1

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DATE: 04/12/2014

4. LAYOUT CONSIDERATIONS

- Ozone generation plant will be located indoor in a separate building. However the equipments like air compressors, air and oxygen receivers, chillers shall be housed under industrial shed. All the outdoor panels shall be housed as per IP 55. The maximum space available for complete ozone generation plant is 40 meters X 26 meters. The Coordinate of the Ozone generation plant building has been indicated in the Key plan of Ozone Generation Plant (Dwg. No. PE-DG-362-174-14000A-A003 REV 00). Bidder to accommodate entire ozone generation plant within the space. All the arrangements for the same is in bidder's scope.
- Complete Air Drying Plant and Oxygen generation plant equipment shall be mounted on a skid and located indoor.

5. VENTILATION CONSIDERATION:

- Rooms where ozone might be emitted in case of failure shall be effectively monitored by gas detectors with alarms that stop the generation of ozone when activated. Effective monitoring means are the gas detector sensors. Rooms with ozone generators shall be equipped with ventilation actuated automatically by the gas detectors. The number of air changes per hour shall be as follows:

S.No.	Area	Inside Condition	Type of Ventilation	AIR CHANGE PER HOUR (ACPH)
1.	MCC Room	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Supply air through axial fan filter unit and exhaust through gravity damper.	20
2.	All toilets, pantries.	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Mechanical ventilation with propeller type exhaust fan.	20
3.	Battery and battery charger room	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Negative pressurization of 5 mm by means of axial flow exhaust fans with flameproof motors.	30
4.	Compressor House	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Supply air through axial fan filter unit and exhaust through axial exhaust fan.	15
5.	Ozone building	Inside temperature not exceeding 3°C above outside dry bulb temperature.	Mechanical exhaust by means of axial flow exhaust fans / RE units	15

➤ DESIGN CRITERIA

The outside design conditions considered are as follows:

	Summer	Monsoon	Winter
DBT (°C)	45	34.4	15.6
WBT (°C)	26.1	27.8	12.2

- All Ventilation equipment's shall be designed for continuous duty & shall operate on 100% fresh air basis.
- The ducting shall be sized to have constant friction drop along its length with air velocity in the ducts normally not exceeding 12 m/sec for ventilation system.
- All air conditioning and ventilation systems etc. are in bidder's scope.

6. AIR-CONDITIONING CONSIDERATION:

Split type air conditioners (air cooled) with necessary MCBs, shall be provided to cater to the air conditioning requirements of PLC area. These air-conditions shall be operated with Push Button Station / Remote type. The configuration of the air conditioners shall be N(Working) +1 (standby). Minimum capacity and rating of each air conditioner shall be 1.5 TR & 4 star respectively. Heat load calculation for the air conditioning area shall be as per ISHRAE guideline.



TITLE:

**TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT**

2X800 MW YERMARUS THERMAL POWER STATION

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7. DESIGN REQUIREMENT FOR PIPING:

- ❖ Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:

Water	
Pump suction	1.5 m/s
Pump delivery	3.0 m/s
Service/Potable water	1.5 m/s
Gas	
Compressed air	15 m/s

- ❖ Drain and vent connections on pipelines shall be atleast of NPS 25 mm size.

❖ UNDERGROUND PROTECTION

- Where pipelines are buried, underground protection shall be provided by the bidder for the piping system as indicated any one of the methods given below:
- Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre glass. Total thickness of coating shall not be less than 4.0 mm.
 - With anti-corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93.
 - Pipe surfaces shall be cleaned by shot or sand blasting before application.
 - Tests to be carried out after application
 - Bond/Adhesion test
 - Holiday test

8. DESIGN REQUIREMENT FOR VALVES:

- ❖ All gate and globe valves shall be of rising stem, outside screw and yoke type.
- ❖ Check valves of sizes 400 mm NB and larger shall have dash pot arrangement.
- ❖ All gate and globe valves shall have back-seating arrangement to facilitate easy replacement of packing with the valve in service.
- ❖ All valves shall be so designed that the hand-wheel moves in a clockwise direction to close the valve. The face of the hand-wheel shall be clearly marked with the words 'OPEN' and 'CLOSE' and an arrow to indicate the direction for opening. All hand-wheels shall be fitted with name plate.
- ❖ All gate, globe, Y-type and angle valves intended for manual operation and falling under the following categories shall be equipped with a gear operator for ease of operation and to ensure fast and tight closure:

ANSI PRESSURE RATING	VALVE SIZES FOR WHICH GEAR OPERATOR IS REQUIRED
Class 300 and below	350 mm and larger
Class 600 and above	200 mm and larger

- ❖ All gate valves falling in the following categories shall be provided with integral bypass valve. Bypass size shall conform to MSS-SP-45 as a minimum standard unless otherwise specified. The bypass valve shall be hand operated unless otherwise specified. Pipe for bypass shall be at least Schedule 80 seamless and of a material of the same nominal chemical composition and physical properties as that used for the main line. Orientation of bypass arrangement shall be subject to the approval of BHEL/Customer.

ANSI PRESSURE RATING	VALVE SIZES FOR WHICH BYPASS IS REQUIRED
Class 600 and over	200 mm and larger
Class 300 & 150	350 mm and larger

- ❖ All gate valves of ANSI pressure rating class 150 and 300 shall have solid or flexible wedge and ANSI pressure rating class 600 and above shall have flexible or parallel slide type of wedge.
- ❖ Valves that are to be kept in full 'OPEN'/'CLOSE' position shall be provided with a non-detachable locking arrangement.



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- ❖ Valves operating under vacuum conditions shall have glands with water sealing. The inlet and outlet connections shall be NB 15mm. The bidder shall indicate the maximum and minimum sealing water pressure and the required flow rate.

9. DESIGN REQUIREMENT FOR HORIZONTAL CENTRIFUGAL PUMPS

- ❖ Flow rate versus head curve shall have a stable and continuously rising characteristics towards the shut-off head. In case of unstable (drooping) characteristics the duty point shall be well away from the unstable region. Besides the actual flow rate versus head curve, curves for minimum and maximum impeller diameters shall also be shown.
- ❖ The shut-off head shall be at least 110% of the differential head.
- ❖ The required NPSH at duty point shall be at least one (1) metre less than the available NPSH.
- ❖ The rating of the pump driver shall be the larger of the following:
 - (a) The maximum power required by the pump from zero discharge to run-out discharge at site climatic conditions.
 - (b) 110% of the power required at the duty point at site climatic conditions.
- ❖ The corrosion allowance for pressure parts shall be 3 mm.
- ❖ Pumps shall run smooth without undue noise and vibration. Noise level produced individually or collectively shall not exceed 85 dB(A) measured at a distance of 1.0 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1.
- ❖ Bearing shall be oil-lubricated or grease-lubricated and shall have a life of 40,000 hours of working. In case of oil-lubricated bearing, constant oil leveller with magnetic drain plug shall be provided.
- ❖ For all pumps while calculating the pump head, 20% margin (minimum) shall be considered on the value of friction losses. The static head shall be considered based on the pipe routing, however it shall be minimum 15 m.

10. DESIGN CONSTRUCTION OF AIR COOLED SCREW COMPRESSORS

- ❖ Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
- ❖ Air compressors will be multi stage oil free, screw type, air cooled.
- ❖ Testing of compressor will be as per ISO: 1217.
- ❖ Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.
- ❖ The continuous motor rating will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.
- ❖ Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.
- ❖ Noise level shall not exceed 85 dBA plus tolerances as per IS standard to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures have to be provided to meet the above condition. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level.
- ❖ Compressed air velocity shall be 10 m/sec.
- ❖ Air ducting arrangement for each compressor shall also be provided by the bidder.
- ❖ **ROTORS**
 - o Rotors will be one-piece construction with a suitable forged carbon steel or stainless steel coated with corrosion resistant material to minimize leakage and wear.
 - o The rotors will have an asymmetric profile, so as to keep leakage losses to a minimum and ensure high efficiency.
 - o Highly precise timing gears will be mounted on the rotor shafts to maintain the rotors in correct relative position.
 - o These gears will be designed to counteract the axial forces incurred in compression.
 - o Rotors shall be dynamically balanced.
- ❖ **INTAKE FILTER**
 - o Dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the cylinders. The filtering efficiency shall be 99.9 %, down to 03 microns. Sound suppressing characteristics will be considered in the filter design.

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11. DEMONSTRATION TEST PROCEDURE

The demonstration Test Procedure shall cover the test to be conducted at site for the entire system / sub-systems and individual equipment covered in Ozone Generation Plant and shall include at least Ozone Generators, Compressors, Air receiver, Oxygen generators, Air driers, oxygen receivers, chillers, all pumps, atmospheric tanks, analyzers, air conditioning and ventilation system, electric hoist all piping and valves, Electrical and Electronic controls including PLC etc.

11.1 Objective of the Test: The following minimum objectives will be checked:

- To check healthy working of all the equipment forming the total Ozone Generation Plant.
- To check the total power consumption of the Ozone Generators, Compressors, Driers, Oxygen generators, pumps etc at rated capacity of the respective equipment.
- To check the capacity of the Ozone generators, Oxygen generators, capacity and head Compressors, pumps etc.
- To log the operating parameters of the Ozone Generators and Compressors with online calibrated instruments at the time of capacity test. Separate calibrated instruments can also be used to measure the parameters other than online instruments
- To check satisfactory operation of all interlock protection devices, trace Ozone analyzers, Oxygen purity analyzer, dew point transmitter, residual ozone analyser etc.
- To measure the purity of the Oxygen and ozone gas.

11.2 Condition of conductance of Test:

- Demonstration Test at site shall be conducted by bidder and witnessed by BHEL and/or customer. The Bidder shall inspect the entire system in advance and make it ready for the test. The Bidder's representative shall conduct and/or witness and associate with all the phases of the test.
- The entire responsibility for conducting the test rests with the bidder.

11.3 Test Instruments:

- All instruments required for Demonstration Test as per objective of the test is in bidder's scope. Online instruments installed in the system shall be used for majority of readings. In case any offline instruments are required, the same shall be provided by the bidder free of cost on returnable basis.
- Calibration of all the test instruments (installed online instruments and offline instruments) shall be the responsibility of the bidder.
- Calibration of all the instruments shall be carried out within a period of six months preceding the commencement of test.
- Calibration certificates of all the instruments shall be submitted by bidder to BHEL.
- The instruments to be arranged by the bidder shall however not be limited to those listed above and any other instrument / apparatus required for successful conduction of Demonstration Test as per the objectives of the test shall also be arranged by the bidder free of cost.

12. Demonstration test procedure:

The Demonstration Test of all Ozone Generators and Compressors and their associated equipments shall cover mainly following tests:

- Capacity test (NM3/Hr) of electrolyzers, compressors, Oxygen generators, air driers, pumps, chiller etc.
- Checking the ability of electrolyzers, compressors, Oxygen generators, air driers, pumps, chiller etc. to operate continuously at rated capacity and rated discharge pressure.
- Measurement of Oxygen purity at oxygen generator outlet.
- Measurement of Ozone purity at Ozone generator outlet.
- All interlocks & logics functioning as per approved interlock logic diagram.
- Parallel operations of streams.
- Noise level and vibration of compressors.
- Power consumption.
- Ozone dosing and its effectiveness in the Cooling water.



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Note: The above mentioned Demonstration test requirements are bare minimum. However any comments/requirement as required by BHEL/Customer during detailed engineering stage shall be provided by successful bidder without and price and delivery implication to BHEL.

13. SPARES:

13.1 The Bidder shall include in his scope:

(a) Start-up / commissioning spares as necessary and (b) Essential spares, as specified in Annexure- XI to Section C1.

A detailed list of recommended spares shall also be furnished by the Bidder.

13.2 The spares (both start up and essential spares) shall be delivered at the site well in time before the start up and commissioning of the plant.

13.3 Start Up Spares

Start up spares (also termed as 'commissioning spares') are those spares which will be required during the start-up and commissioning of the equipment / systems and until performance testing. It is the responsibility of the Bidder to supply all necessary spares as required until the equipment / systems are handed over to the Customer. The prices of the start up spares should be included in the price of the package. An adequate stock of start-up spares shall be made available at the site such that the start-up and commissioning of the equipment / systems, performance testing and handing over the equipment / systems to the Customer can be carried out without hindrance and delay.

13.4 Essential Spares

Essential spares are those spares considered necessary by the Customer for the first three (3) years of normal plant operation. When a particular item of spares is indicated as 'percentage', it shall be considered as percentage of total number of that item for scope of work. The fraction shall be rounded off to the next higher whole number.



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GENERAL TECHNICAL REQUIREMENTS FOR ELECTRIC HOIST



TITLE:

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1.0 GENERAL

Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of Electric hoist.

2.0 GENERAL DESIGN FEATURES

- Bidder shall provide Electric hoists to facilitate the lifting and transporting of various pieces of equipment during construction, maintenance, or replacement of the Ozone generation plant components.
- The electric hoist shall be complete with its accessories, supporting structure, power supply, safety devices, and controls and shall conform to local statutory rules and regulation.
- Equipment offered shall be conforming to specification requirements as per IS: 3938 class II duty.
- Parts requiring replacement or lubrication shall be easily accessible & without dismounting type.
- Equipment shall include the devices as required and comply with applicable standards/specification requirements.
- Defects in material not acceptable/allowed. Rectification of any flaw is permissible only with the approval of Purchaser.
- Design shall provide for easy maintenance of all parts, particularly the wheel bearings.
- Both hoists and trolleys are driven electrically as specified
- Wheels shall be single flanged type and to suit different monorail beam sizes
- Hook shall be swiveling type and fitted with a safety latch.
- Hoists shall be designed for minimum headroom above the highest position of hook and for closest hook approaches.
- All material, castings and forgings will be of tested quality & certificates shall be made available for approval as per approved QAP.

Electric Hoist

S.No.	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Overload test	125% of SWL
3.0	Design Ambient temperature	50 ° C
4.0	General Design	As per IS: 3938 / 1983, class-II
5.0	Operating speed	Full speed (m/min)
5.1	Hoisting speed	2.5 – 3.0 M / min.
5.2	Trolley speed	7.0- 10.0 M / min.
6.0	Type of transmission	Through Electric motor and gearbox
7.0	Wire Rope	Min ultimate tensile strength = 180 kg/mm ²
7.1	Construction / core	6 x36 Steel core
7.2	Code	IS:2266
7.3	Factor of safety	Not less than 5



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7.4	No. of full laps on the drum at extreme low position of hook	Rope shall be of sufficient length so that 3 (three) full laps remain on the drum at extreme low position of the hook not taking into consideration the turns covered by the wore rope anchorage and one spare groove for each lead of the wire rope on the drum when hook is at its highest position.
8.0	Load Hook and block	
8.1	Type of load hook	Plain shank type swiveling with safety latch (section: circular/ trapezoidal/'c' type)
8.2	Load hook Code	IS:15560
8.3	Load hook Material	As per IS: 1875, min. C 20 forged
8.4	Hook suspension	Thrust bearing
9.0	Gear (Hoisting)	
9.1	Type	Spur / Helical
9.2	Material	Gear: 16 Mn Cr 5 / 20 Mn Cr 5 / C40 / C50 / EN19 / EN24 / SAE 8620 / 16 Cr Ni 4 / 18 Ni Cr Mo5 / 39 Ni Cr. MO3 / 42 Cr MO4
9.3	Bearing type	Antifriction Ball
10.0	Trolley drive	
10.1	Wheel	Single flange taper thread
10.2	Wheel conform to (Std. / code)	IS: 3938
10.3	Wheel material	As per IS 3938
10.4	Bearing type	Antifriction Ball
11.0	SHEAVE	
11.1	Material	Cast / forged steel . IS: 2062 Gr. B / as per IS: 3938
11.2	Bearing type	Antifriction Ball
12.0	BRAKE (Hoist)	
12.1	Type	ACEM / DC EM brakes
12.2	Capacity	150 % of FLT
12.3	Number	One number for each motor
13.0	BRAKE (Trolley)	
13.1	Type	ACEM / DC EM brakes
13.2	Capacity	125 % of FLT or 100% of motor torque (Which ever is higher)
13.3	Number	One number for each motor



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14.0	ROPE DRUM	As per IS:3938
14.1	Material	Seamless steel pipe. ASTM A106 / A53 grade B
14.2	Type of groove	<u>Right hand groove or Right hand and left hand groove</u>
14.3	Spare groove on drum	One (1) spare groove when the hook is at its highest position
15.0	TYPE OF DSL	
15.1	Travel	PVC shrouded bus bar conductor type
16.0	MOTORS (for hoisting and trolley)	(As per IS: 325 & IS : 3938)
16.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF
16.2	Number of start	150 starts / hr
16.3	Voltage, Phase and Frequency	415V $\pm$ 10%, 3 phase, 4 wire, 50 Hz, $\pm$ 5 %
16.4	Class of insulation	Class "F" and temperature rise limited to class "B".
16.5	Type of enclosure	TEFC
16.6	Degree of protection provided for enclosure	IP-54/IP-55 depending upon Indoor / Outdoor application
16.7	Margin	Kindly note that margin for motor rating shall be 15% over maximum power requirement at the rated speed.
16.8	RPM	Shall not exceed 1500RPM
16.9	Starting torque	The starting torque of the main motor shall be minimum 225% of FLT
16.10	Pull out torque	275% of FLT
17.0	LIMIT SWITCHES	Hoisting / lowering Trolley
17.1	Type	Snap action, self actuating type / two way lever
18.0	Operation from	Pendant push button for all motions of hoist
19.0	Power cable	FRLS / EPR flexible Cu cable / Aluminum cable
20.0	Control cable	FRLS / EPR flexible Cu cable / Aluminum cable
21.0	Control Voltage	110 V
22.0	Buffer stop/wheel stop	Buffer shall be provide at the end of monorail beam



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D2: GENERAL TECHNICAL REQUIREMENTS FOR ELECTRICAL



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GENERAL TECHNICAL REQUIREMENTS FOR MOTORS



2X800 MW YERMARUS THERMAL POWER STATION

BASIC TECHNICAL FEATURES FOR HT / LT MOTORS

- 1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries in 2x800 MW Yeramarus supercritical thermal power station Unit# 1, 2.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors shall confirm to IS-12615, EFF1 for efficiency.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
175 kW & Above upto 1500 kW	3.3 KV	3.3 KV
Below 175 kW	415 V	415 V

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (+/-) 10%
Frequency variation (+/-) 5%
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 deg C. Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment at duty point or 10% margin over the continuous maximum demand of the driven equipment under entire operating range, whichever is higher.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value of 80 (eighty) percent rated voltage.



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BASIC TECHNICAL FEATURES FOR HT / LT MOTORS

3.4.3 The locked rotor current of the HT motors shall not exceed six times full load current inclusive of tolerance as per IS:325 and for LT motors (except energy efficient motors) six times full load current subject to tolerance as per IS:325.

3.4.4 The following frequency of starts shall apply

- i) Three cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.
- ii) Two hot starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- iii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature.(not to be repeated in the second successive hour)

3.4.5 Locked motor withstand time of hot motors at 110% rated voltage shall be as follows:

- a) For motors with starting time upto 20 sec.
- at least 3 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
- at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
- at least 10%. more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For HT motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.5.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 1 secs. The pull-out torque of the motor shall be at least 205% of full load torque to meet this requirement.

3.6 Stress During bus Transfer

3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.



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- 3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.
- 3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.
- 3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.
- 3.7 Noise level
- Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed 85 db(A) in line with IS 12065.
- 3.8 Vibration
- The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS:12075.
- 4.0 CONSTRUCTIONAL FEATURES
- 4.1 Degree of Protection
- 4.1.1 Indoor motors shall conform to degree of protection IP:54 as per IS:4691. Outdoor or semi-indoor motors shall conform to degree of protection IP:55 as per IS:4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.1.2 The stator laminations shall be made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.
- 4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.
- 4.2 Enclosure and Cooling
- 4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. Alternatively, motors may have Closed Air circuit Air (CACA) method of cooling conforming to IC-0161 of IS: 6362.
- 4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.3 Class of Insulation
- Tropicalised insulation material of Class 'F' shall be used. The temperature rise shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS:325 shall be permissible.



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THERMAL POWER STATION**

**BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS**

4.4 Bearings

- 4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.
- 4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.
- 4.4.3 After taking all motor driven eqpt. loads and thrust(if any) into account , the bearings shall be suitable for min. 20,000 working hours . Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.
- 4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.
- 4.4.5 For motors upto 2 kW, double sealed type bearings shall be provided.

4.5 Terminals and Terminal Boxes

- 4.5.1 Motors of rating 125 kW and above will be controlled by circuit breaker and below 125 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current of 44 kA, 0.25 secs and 50 kA, 0.2 secs for HT & LT motors respectively.
- 4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.5.3 For MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.
- 4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.
- 4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.
- 4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression tinned brass glands shall be provided in terminal boxes.
- 4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 180 and 90 degree for HT and LT motors respectively.