

1X700 MW BELLARY 3 STPP

VOLUME: II B & III

**TECHNICAL SPECIFICATION
FOR
COOLING WATER OZONE GENERATION PLANT
REV 00**

SPECIFICATION NO.: PE-TS-367-174-14000-A001



BHARAT HEAVY ELECTRICALS LIMITED

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



TITLE:

**TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT.
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DATE: 29/05/2013

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VOLUME **II-B**

SECTION -A

REV. NO. 00

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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 to cover design, engineering, manufacturing, painting, inspection & testing at manufacturer's works, erection / installation, loading, unloading, storage and handling at site complete with all accessories including start up and commissioning spares, chemicals & consumables, packing, shipment and delivery to Power Station Site, in site transportation, statutory approval, site testing, commissioning, trial run, performance and guarantee tests and handing over to customer the **COOLING WATER OZONE GENERATION PLANT** for **1X700 MW BELLARY 3 STPP**. 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.
- 1.3 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.4 The omission of specific reference to any component/accessory necessary for the proper performance of Cooling Water 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. 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-award 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 and the correct requirement shall be obtained else BHEL interpretation shall prevail.
- 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 shall be furnished along with the technical bid.



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SECTION -B

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**SECTION B
PROJECT INFORMATION**



TITLE:
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- 1.0 Owner : Karnataka Power Corporation Ltd
Shakthi Bhavan
No.82, Race Course Road
Bangalore-560 001
Karnataka, India
- 2.0 Project Title : 1x700 MW Bellary Thermal Power Station Unit No3,
Stage-3
- 3.0 Location : **Kudatini Village
Bellary Dist
Karnataka state INDIA**
- 4.0 Latitude and Longitude : 15° 11' 58" N Latitude
76° 43' 23" E Longitude
- 5.0 Elevation above mean sea level : 478 meters
- 6.0 Climatic Conditions
- (a) Temperature
- i. Monthly basis
- Mean of daily maximum temperature : 42.5° C (in the month of April)
- Mean of daily minimum temperature : 19.5° C (in the month of Dec)
- ii. Monthly basis
- Mean of daily maximum : 37.5° C
- Mean of daily minimum : 19.5° C
- iii Highest temperature recorded : 42.5° C
- iv Lowest temperature recorded : 14.6° C
- (b) Relative Humidity : Varies between 11% and 70%
- (c) Rainfall
- Annual average rain : 492 to 846 mm most of which occurs during August to October
- (d) Wind Speed
- 1 Annual mean wind speed : 8.4 km / hr
- 2 Maximum mean wind speed : 19 km / hr in the month of July.
- 7.0 Wind Load
- (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
- 8.0 Wind Loading for Stack
- (a) For wind pressure as per clause 8.0 above
- (b) For RC stacks as per IS: 4998
- 9.0 Seismic data (as per IS:1893 latest issue)
- (a) Zone : Zone III
- (b) Importance factor (I) : 2.5 for electrical equipment 1.5 for others.



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- 10.0 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 175 kW : 11000V, 3 phase, 3 wire, 50Hz medium earthed AC
3300V, 3 phase, 3 wire, 50Hz medium earthed AC
 - (b) For motor control centre : 415V, 3 phase, 3 wire solidly earthed AC
 - (c) For motor rated 175 kW and below : 415, 3 phase, 3 wire solidly earthed AC
 - (d) DC. motor starters, DC solenoids, : 220 V DC, 2 wire, unearthed DC
DC alarm, control and protections
 - (e) 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.
 - (f) Uninterrupted power supply : 110 V, 1 phase, 50Hz, 2 wire AC supply from UPS system for I&C (including indicator recorders) and UCMS only
 - (g) AC solenoids, : 240V 1 phase, 2 wire, 50Hz AC system with effectively
indicators/recorders,space heaters earthed neutral. The power supply shall be derived by
(for motors rated 30KW and Contractor by providing 415V/ 240V transformer of
above) adequate rating with MCCB/MCB on
primary/secondary sides.
 - (h) Winding heating of motors below : 24 V 1 phase, 50Hz, AC with one point earthed. This
30kW 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.
 - (i) Solid state controls (including : 24 V DC, 2 wire, supply from Battery chargers for
solenoid valves) instrumentation system only.
 - (j) Lighting fixtures : 240 V, 1 phase, 2 wire, 50Hz system.
 - (k) Lighting fixtures and space : 240 V, 1 phase, 2 wire, 50Hz system.
heaters in panels
 - (l) Construction supply : 415 V, 3 phase, 4 wire, 50 Hz AC supply with neutral
lead solidly earthed. .
 - (m) 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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SPECIFIC TECHNICAL REQUIREMENTS-MECHANICAL



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1.0 GENERAL

The Cooling Water 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. Please refer Electrical and C&I sections also for respective scopes.

The Cooling water Ozone generation plant, as specified in Technical data sheets, P&ID, and shall consist of at least the followings:

- 2.1 Entire Cooling water Ozone generation plant of 18 Kg/Hr capacity as per P&ID (PE-DG-367-174-14000-A001), Data Sheet-A and technical specification requirements.
- 2.2 Oxygen generation plant consist of at least the following:
 - 2.2.1 Three (3) nos. (2 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 and other accessories.
 - 2.2.2 One (01) no. unit air receiver of 3 M³ capacity with all accessories.
 - 2.2.3 Two nos (2x100%) Air driers per stream (Total 4 numbers) with all accessories.
 - 2.2.4 Two nos (2x100%) Oxygen generators per stream (Total 4 numbers) with all accessories.
 - 2.2.5 Two nos (2x50%) Oxygen receiver of 2.5M³ Capacity (One number per stream) with all accessories.
- 2.3 Ozone generation plant with all accessories.
- 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 One number air cooled chillier with all accessories.
 - 2.4.3 One number portable water storage tanks of 5M³ capacity 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, flanges, pipe fittings etc.
- 2.6 All tanks complete with inlet and outlet connections, all fittings, flanges and appurtenances etc. as specified and as required.
- 2.7 PLC based control system.
- 2.8 Electrical scope shall be as per "Electrical scope between BHEL and Vendor" enclosed with the technical specification.
- 2.9 All necessary drains, vents, and sampling points, with valves, as specified and as required.
- 2.10 Hangers and supports as per the requirement.
- 2.11 All Instrumentation (minimum) as per the enclosed P&ID (PE-DG-367-174-14000-A001) including the electronic on line dew point transmitter, Ozone analyzer, Oxygen purity analyzer, Ozone leak detector, residual ozone analyser etc. with suitable sampling connection and isolation valve
- 2.12 Safety requirement as per Data Sheet-A.
- 2.13 Air conditioning and ventilation system.
- 2.14 Start-up and commissioning spares as required.
- 2.15 All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- 2.16 Oil & lubricants for consumption during the commissioning, trial operation
- 2.17 Finish paints for touch up painting of equipments after erection at site in sealed container.
- 2.18 Initial charge of all lubricants and grease.
- 2.19 Monitoring gadgets, instruments, and equipments required for maintenance (till PG test and plant handover).
- 2.20 All blank flanges/counter flanges, isolations valves, tees etc. to interconnect the pipes and all terminal points.
- 2.21 All handling facilities.
- 2.22 All necessary chemicals during commissioning and first fill.

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- 2.23 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 Cooling water Ozone generation Plant.
- 2.24 Permanent ladder (not rungs) for approaching the top of tanks, valves for 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.
- 2.25 All auxiliary steel structures (U-clamps, nuts, bolts, channels etc.) for fixing the pipe on the pedestal or trestles.
- 2.26 Wrapping, coating and protection of all the buried pipe shall be as per IS 10221 or AWWA C 203.
- 2.27 Recommended spares for three years normal operation (optional item).

3.0 SCOPE OF SERVICE

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

- 1) Erection and commissioning, unloading, storage and handling at site.
- 2) In site transportation.
- 3) Arrangement of all instruments and lab facilities, chemicals, reagents to carry out trial run/commissioning and PG test.
- 4) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- 5) All personnel required during commissioning and PG Test.
- 6) Performance testing.
- 7) Painting as per enclosed painting schedule (Annexure-III). 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.
- 8) Final touch up paint at site.
- 9) Statutory approval.

4.0 CIVIL SCOPE

Nil. However the civil assignment drawing shall be submitted by the bidder.

5.0 TERMINAL POINT

- 5.1 Service water line: At 20 meters from Cooling water Ozone generation plant area. Further distribution of service water is in bidder's scope.
- 5.2 Portable water (RO water) line: At 20 meters from Cooling water Ozone generation plant area. Further distribution of portable water is in bidder's scope.
- 5.3 Instrument air line: At 20 meters from Cooling water Ozone generation plant area. Further distribution of instrument air is in bidder's scope.
- 5.4 The tap off of 250 NB in ACW system for cooling water line for Ozone generation plant shall be provided by BHEL. Further piping from the tap off upto the ozone generation plant is in bidder's scope. The piping distance between tap off to Ozone generation Plant building is approx. 300mts.
- 5.5 Ozone dosing line from each dosing pump in Cooling water Ozone generation plant upto the Condenser inlet and outlet dosing point is also in bidder's scope. The piping distance from Ozone generation building to dosing point in the Condenser inlet and outlet dosing point is approx. 400 mts.
- 5.6 All drains: Drains from all the systems shall be terminated at one point.

Note: Bidder to note that the pipe length as indicated in the specification may vary by +10 % for which no extra claim shall be applicable.

6.0 EXCLUSIONS

- 6.1 Drinking water and service water.
- 6.2 All Civil works at site.

7.0 QP AND SUB VENDOR APPROVAL

- 7.1 Minimum QP requirements part of section-C shall be as per the enclosed QP (Annexure – VII) 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.
- 7.2 Approved sub vendor list (Annexure – II) is enclosed elsewhere in this specification. However, any additional sub-vendor shall be subject to BHEL and CUSTOMER approval & the same shall be adhered by the bidder without any commercial and delivery implication to BHEL.



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8.0 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.

9.0 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, 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.

The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-IV. The submission of soft copy or hard copy of the document whichever is later will be considered as final date of submission of the document. The bidder has to submit the revised document along with the compliance sheet indicating enumerate reply to all BHEL comments. Without compliance sheet the submission of the documents will not be considered and the delay on this account will be solely on bidder's side only.

- a) Detailed piping and instrument or engineering flow diagram for process and utility, showing all equipments, machinery, piping and instruments. All pipes should be indicated with diameter, pipe class, pipe number, fluid flowing through it.
- b) Detailed configuration drawings, BOMs, Data Sheets, General arrangements and cross-sectional/assembly drags, along with the manufacturer's catalogue for all the items/equipment including control & instrumentation.
- c) Detailed installation drawings for all instruments and instrumentation schedule.
- d) Preparation and finalization of functional write-up and detailed logic diagram, for all control system, electrical wiring and schematic drgs for the development of logic diagrams, GA and layout drgs of control panels, junction boxes, bill of material for panel drgs and terminal, chart for all the panel drgs, inter connection diagram for cabling, cable schedule.
- e) Design calculation of process and mechanical design, equipments and systems. The bidder shall show, explain and prove the validity of the basis/procedures and methods used in these calculations.
- f) Details civil scope drawing for all civil works.
- g) Detailed piping layout drawings, pipe support drawings, complete bill of materials of the piping, valve schedule etc.
- h) Submission of detailed procedure for various performance tests and getting the Employer's approval for the same.
- i) Conducting PG test.
- j) Submission of O&M manual.
- k) Sub vendor list.

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

- Deviation schedule duly fill for deviation, if any.
- Equipment lay out.
- Un Price Schedule duly filled.
- List of Spares (start up and commissioning spares).

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.

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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: The Bidder shall arrange all the monitoring gadgets / instruments / equipment required for performing guarantee parameters (returnable after PG test). Site facility as available or as extended by Owner shall only be provided.

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

NOTE-6: Bidder to note that BHEL reserve the right for drg/doc submission 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.

- a. Internet explorer version – Minimum Internet Explorer 7
- b. Internet speed – 2 mbps (Minimum preferred)
- c. Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- d. Vendor's Internal proxy setting should not block DMS application's link
(<http://124.124.36.198/wrenchwebaccess/login.aspx>)

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DESIGN RAW WATER QUALITY**ANNEXURE -1**

Sl.No	Description	Unit	Water Quality Considered for design
	Physical Parameters		
1	pH		7.5-8.5
2	Temperature	Deg. C	30
3	Conductivity	mic.mhos/cm	1980
4	Total Suspended Solids	mg/l	100.0
5	Total Dissolved Solids	mg/l	1500 (max)
6	Turbidity	NTU	51.0
7	Oil & grease	mg/l	Nil
	Chemical Parameters		
8	Calcium as Ca	mg/l	50.0
9	Magnesium as Mg	mg/l	40.0
10	Sodium as Na	mg/l	347
11	Potassium	mg/l	5.1
12	Iron - Total (Fe)	mg/l	1.0
13	Alkalinity-m as CaCO ₃	mg/l	550.0
14	Alkalinity-p as CaCO ₃	mg/l	50.0
15	Bicarbonate as HCO ₃	mg/l	671
16	Carbonate as CO ₃	mg/l	10
17	Sulphate as SO ₄	mg/l	24.0
18	Chloride as Cl	mg/l	307
19	Silica reactive as SiO ₂	mg/l	32.0
20	C.O.D	mg/l	60.0
21	Colloidal silica	mg/l	3 to 18
22	Dissolved oxygen	mg/l	5.2
	Additional Parameters		
23	BOD	mg/l	8.2
24	TOC	mg/l	12.4
25	Nitrate	mg/l	19.0
26	Ammonia	mg/l	Nil
27	Total Silica	mg/l	22 to 46
28	Zinc	mg/l	0.37
29	Nickel	mg/l	< 0.005
30	Chromium Total	mg/l	0.009
31	Barium	mg/l	Nil
32	Bromide	mg/l	Nil
33	Fluoride	mg/l	0.9



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Sl.No	Description	Unit	Water Quality Considered for design
34	Hydrogen Sulphide	mg/l	Nil
35	Manganese	mg/l	0.16
36	Strontium	mg/l	Nil
37	Ammonical Nitrogen	mg/l	<0.1
38	Phosphate	mg/l	1 to 2
	Bacteriological Parameters		
39	Coliforms (e coli)	Cfu/ml	present
40	Faecal Coliforms	Cfu/100ml	86.0
41	Total Viable Count at 48 hrs	Cfu/100ml	67×10^{-2}

Clarified water analysis is as follows.

1. Turbidity <20 NTU
2. TSS <20 ppm
3. P^H 7.5 to 8.5
4. Residual chlorine <0.5 ppm

PORTABLE WATER ANALYSIS

- 1) RO Permeate TDS: less than 80 ppm at the end of membrane life.

NOTE:

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

B. DATA FOR COOLING TOWER:

- Total CW circuit water flow = 80000 Cum/hr.
- Storage/Holdup volume of cooling tower basin=8100 m³.
- Temperature difference across cooling tower is 9.8 Deg C.
- MOC of Condenser tube is Ti (ASTM A249 TP304).
- Cooling Water System metallurgy shall be as per P&ID CW/ACW System (enclosed in Technical Specification).
- Cooling Tower blow down= 354 M3/Hr.



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LIST OF APPROVED SUB VENDORS
ANNEXURE - II

SL NO.	ITEM	APPROVED 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.	LT XLPE POWER CABLES	HAVELLS INDIA LIMITED	
		CABLE CORPORATION OF INDIA LTD.	
		HINDUSTHAN VIDYUT PRODUCTS LTD.	
		TORRENT CABLES LTD.	
		UNIVERSAL CABLES LTD.	
		POLYCAB WIRES PVT.LTD	
		KEI INDUSTRIES LTD.	
		KRISHNA ELECTRICAL INDUSTRIES LIMITED,MORENA	
		CENTRAL CABLES PVT. LTD.	
		RADIANT CABLES PVT.LTD	
		PARAMOUNT COMMUNICATIONS LTD:	
GEMSCAB INDUSTRIES LTD.,NEW DELHI			
7.	LT PVC POWER CABLES	CORDS CABLE INDUSTRIES LTD	
		PARAMOUNT COMMUNICATIONS LTD.	
		CRYSTAL CABLE INDUSTRIES LTD.	
		FORT GLOSTER INDUSTRIES LTD.	
		GOYOLENE FIBRE (INDIA) PVT. LTD.	
		HINDUSTHAN VIDYUT PRODUCTS LTD.	
		KEI INDUSTRIES LTD.	
		KRISHNA ELECTRICAL INDUSTRIES LIMITED, MORENA	
		NICCO CORPORATION LTD.	
		POLYCAB WIRES PVT. LTD	
		RADIANT CABLES PVT. LTD	



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		RPG CABLES LTD.	
		TORRENT CABLES LTD.	
		UNIVERSAL CABLES LTD.	
		CABLE CORPORATION OF INDIA LTD.	
8.	ABOVE GROUND EARTHING MATERIALS	RUKMANI ELECTRICAL & COMPONENTS PRIVATE LTD	
		RABI ENGINEERING WORKS , KOLKATA	
		INDUSTRIAL PERFORATION (INDIA) PRIVATE LIMITED.	
		JAMNA METAL COMPANY	
		PREMIER POWER PRODUCTS (CALCUTTA) PVT. LTD.	
		PATNY SYSTEMS (P) L TD., SECUNDERABAD	
9.	LT PVC CONTROL CABLES	CABLE CORPORATION OF INDIA LTD.	
		CMI LTD.	
		CORDS CABLE INDUSTRIES LTD	
		ELKAY TELELINKS LTD.	
		CRYSTAL CABLE INDUSTRIES LTD.	
		DELTON CABLES LTD.	
		FORT GLOSTER INDUSTRIES LTD.	
		GOYOLENE FIBRE (INDIA) PVT. LTD.	
		KEI INDUSTRIES LTD.	
		PARAMOUNT COMMUNICATIONS LTD.	
		RPG CABLES LTD.	
		NICCO CORPORATION LTD.	
		POLYCAB WIRES PVT. LTD	
		RADIANT CABLES PVT. LTD	
		TORRENT CABLES LTD.	
		LT UNIVERSAL CABLES D.	
		HINDUSTHAN VIDYUT PRODUCTS LTD.	
		KRISHNA ELECTRICAL INDUSTRIES LIMITED,MORENA	
		GEMSCAB INDUSTRIES LTD.,NEW DELHI	
		THERMO CABLES LTD.,HYDERABAD	
10.	SCREENED CONTROL CABLES	CMI LTD.	
		DELTON CABLES LTD.	
		KEI INDUSTRIES LTD.	
		PARAMOUNT COMMUNICATIONS LTD.	
		NICCO CORPORATION LTD.	
		RADIANT CABLES PVT.LTD.	
		POLYCAB WIRES PVT.LTD	
		CORDS CABLE INDUSTRIES LTD	
		ELKAY TELELINKS LTD.	
		THERMO CABLES LTD.,HYDERABAD	
11.	BALL VALVES	AKAY INDUSTRIES PVT.LTD.	



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		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.	
12.	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	
		MIL. CONTROLS LTD.	
13.	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	



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		VALTECH INDUSTRIES ,MUMBAI	
		SURYA VALVES AND INSTRUMENTS	
		MANUFACTURING COMPANY, CHENNAI	
		FEDERAL HARDWARE ENGINEERING CO PTE	
		LTD.,SINGAPORE	
		CRESCENT VALVES MFG. CO. PVT. LTD.	
14.	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	
15.	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	
16.	A/C SYSTEM	ABB,LTD.	
		BLUE STAR LTD.	
		VOLTAS LTD.	
17.	VENTILATION SYSTEM	ASEA BROWN BOVERI LTD.	
		ALSTOM LTD.	
		BLUE STAR LTD.	
		HYDERABAD POLLUTION CONTROLS LTD.	
		VOLTAS LTD.	
		C. DOCTOR & CO. PVT. LTD.	



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18.	SINGLE GIRDER HOT/EOT MISC .CRANES	REVA INDUSTRIES LTD.	
		CONSOLIDATED HOIST PVT LTD	
		TUOBRO FURGUSON(INDIA)PVT.LTD	
		ARMSEL MHE PVT. LTD.,BANGALORE	
19.	FLOW ELEMENT	ENGINEERING SPECIALTIES PRIVATE LTD	
		INSTRUMENTATION LTD.	
		MICRO PRECISION PRODUCTS	
		STAR-MECH CONTROLS (I) PVT.LTD	
20.	DOUBLE GIRDER EOT CRANE ABOVE 50T TO 150T (TG/GT HALL & OTHER AREAS)	HEAVY ENGG. CORPORATION LTD.	
		MUKAND LIMITED,	
		THE TATA IRON &STEEL CO.LTD	
		WMI CRANES LTD.	
		FURNACE & FOUNDRY EQUIPMENT CO.	
21.	LT SWITCHGEAR	ANUPAM INDUSTRIES LTD.	
		ABB LTD.	
		ALSTOM LTD.	
		C & S ELECTRIC LTD.,DELID	
		GE INDIA INDUSTRIAL PVT LTD	
		LARSEN & TOUBRO LTD.	
		SIEMENS LTD	
		SCHNEIDER ELECTRIC INDIA PVT. LTD.	
22.	PUMPS (HORIZONTAL)	CONTROLS & SCHEMATICS LIMITED ,HYD	
		BEST & CROMPTON ENGG. LTD.	
		FLOWMORE LTD.	
		JYOTI LTD.	
		KIRLOSKAR BROS. LTD.	
		MATHER & PLAN PUMPS LTD.	
		KSB PUMPS LTD.	
		SULZER PUMPS INDIA LTD.	
		WPIL LIMITED	
23.	PROGRAMMABLE LOGIC CONTROLS	SAM TURBO INDUSTRY LTD.	
		SIEMENS LTD	
		ABB LIMITED	
24.	LOCAL CONTROL PANELS	SCHNEIDER ELECTRIC INDIA PVT. LTD., NEW DELHI	
		C & S ELECTRIC LTD.	
		PYROTECH ELECTRONICS PVT.LTD	
		PROCON INSTRUMENTATION PVT LTD.	
25.	ROTAMETER	INDUSTRIAL CONTROLS & APPLIANCES P.LTD	
		CHEMTROLS SAMIL (INDIA) PVT. LTD., MUMBAI	



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26.	DIAPHRAGM VALVE	BKD VALVES –HUBLI	
		CRANE FLOW PROCESS-SATARA	
27.	CHECK VALVES (FLAT TYPE SIZE UPTO 50 NB)	B BKD VALVES –HUBLI	
		H SARKAR-HOWRAH	
		LEADER-JALANDHAR	
		MAJESTIC WORKS, MUMBAI	
28.	DUAL PLATE NON RETURN VALVES (SS & CI UPTO 100 NB CLASS 150)	ADVANCE VALVES-NOIDA	
		R&D MULTIPLES-VALSAD	
		B BKD VALVES –HUBLI	
29.	SOLENOID VALVES	ROTEX AUTOMATION-BARODA	
		ASCO - CHENNAI	
30.	Y-TYPE STRAINER	OTOKLIN-MUMBAI	
		GRAND PRIX-NEW DELHI	
		JAYPEE-NEW DELHI	
		GREAVES COTTON-MUMBAI	
		MULTITEX- NEW DELHI	
31.	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	
32.	MS PLATES	SAIL	
33.	LEVEL GAUGES	SIGMA INSTRUMENTS	MUMBAI
		LEVCON	KOLKATA
		SBEM	PUNE
		V. AUTOMAT	NEW DELHI
34.	LEVEL TRANSMITTER (FOR ULTRA SONIC TYPE)	EMERSON PROCESS MANAGEMENT (I) LTD	
		SIEMENS	
35.	ANALYSERS	POLYTRON	FRANCE
		HACH ULTRA	FRANCE
		ABB	UK
		ORION	USA
		SWAN	USA
		EMERSON PROCESS MANAGEMENT	CHENNAI
36.	PRESSURE / DP TRANSMITTER	EMERSON PROCESS MANAGEMENT	USA/DAMAN
		FUJI ELECTRIC	JAPAN



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		HONEYWELL	USA
		YOKOGAWA	JAPAN
		ABB	ITALY/FARIDABAD/BANGALORE
37.	PRESSURE AND DIFFERENTIAL PRESSURE GAUGE	A.N.INST	KOLKATTA
		WAREE	MUMBAI
		SWITZER INSTRUMENTS	CHENNAI
		GENERAL INSTRUMENTS CONSORTIUM	GOA / MUMBAI
		H.GURU (SI) P LTD	BANGALORE
		MANOMETER	MUMBAI
		WIKA	PUNE
38.	TEMPERATURE GUAGE	A.N.INST	KOLKATTA
		H.GURU (SI) P LTD	BANGALORE
		GIC	GOA/MUMBAI
		PYRO ELECTRIC INSTRUMENTS P LTD	GOA
39.	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM	NEW DELHI
		PYRO ELECTRIC	GOA
		TOSHINWAL BROS	NEW DELHI
40.	TEMPERATURE TRANSMITTER	SOR INC	USA
		DELTA CONTROLS LIMITED	USA
		ABB	CHENNAI
41.	PNEUMATIC ACTUATORS (POWER CYLINDER)	INSTRUMENTATION LTD	
		KELTRON CONTROLS	
		ROTEX MANUFACTURERS & ENGINEERS PVT LTD	
42.	LT MOTORS	BBL	MUMBAI
		CGL	MUMBAI/AHEMDABAD
		ALSTOM	KOLKATTA
		KEC	BANGALORE/HUBLI
		SEIMENS	MUMBAI
		ABB	FARIDABAD
43.	UPS	HITACHI	GANDHI NAGAR
		EMERSON PROCESS MANAGEMENT	CHENNAI
44.	AGITATOR/STIRRER	FIBRE & FIBRE	MUMBAI
45.	FITTINGS	BHARAT FORGE	PUNE
		RELIANCE FORGE	PUNE
46.	FLANGES	BHARAT FORGE	PUNE
		RELIANCE FORGE	PUNE
47.	220V DC BATIERY CHARGER	CHHABI ELECTRICALS PVT. LTD.	
		CALDYNE AUTOMATICS LTD.	
		HBL POWER SYSTEMS LTD	
		AFCO INDUSTRIAL AND CHEMICALS LTD.	
		STATCON POWER CONTROLS L.TD.	
		AMARA RAJA POWER SYSTEMS PVT. LTD	

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48.	220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE)	EXIDE INDUSTRIES LTD	
		HBL NIFE POWER SYSTEMS LTD.	

NOTE: - Any other sub-vendor not specified in above sub-vendor list shall be subject to approval of BHEL/CUSTOMER during detailed engineering without any price and delivery implication to BHEL.



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PAINTING SCHEME DETAILS
ANNEXURE – III

1.0 SCOPE

- 1.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

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 the Contractor 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 Ann-A enclosed. Insulated surfaces will have only primer coating and no finish painting.



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5.0 FINISH PAINT

Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by the OWNER. 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 PURCHASER/OWNER. 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 Ann-B 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 shall be furnished by the successful bidder after award of contract. 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.

9.0 Approved Paint Makes

- i) Asian Paints (I) Ltd.
- ii) Berger Paints India Ltd
- iii) Goodlass Nerolac
- iv) Jenson & Nicholson (I) Ltd
- v) CDC carboline (I) Ltd.

- vi) Shalimar Paints Ltd.
- vii) Addison Paints Ltd.
- viii) Grand Polycoat
- ix) Bombay Paints

10 PAINTING SCHEDULES

10.1 Painting schedules for various systems/ items are furnished as per enclosed Annexures-A . Vendors of different packages/ items will furnish detailed painting schedule for customer approval during detail engineering as per this guide 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/structural 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 like CPU etc.	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. However these items carrying under Fire Fighting System shall be painted Fire Red as per TAC guidelines. 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 Cooling water 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	Boiler casing, ESP and ducting	Nut Brown	413	-	-
3.0	Crane				
3.1	Crane structure	Golden Yellow	356	-	-
3.2	Trolley and hook	Crimson	540	-	-
4.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.0	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.0	Switchgear	Light grey	631	-	-
8.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
9.0	Turbine	Golden Yellow	356	-	-

SL.NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
10.0	Generator & exciter	Light grey	631	--	-
11.0	Transformers	Aluminium	-	-	-
12.0	Machinery guards	Signal red	537	-	-
13.0	Piping (without insulation and cladding_)				
13.1	Water System				
	Boiler feed	Sea green	217	-	-
	Condensate	Sea green	217	Light brown	410
	D M Water	Sea green	217	Light orange	557
	Soft water	Sea green	217	French blue	166
	Bearing cooling water	Sea green	217	French blue	166
	Potable & filtered water	Sea green	217	French blue	166
	Service & clarified water	Sea green	217	French blue	166
	Raw water	Sea green	217	White	-
	Cooling water	Sea green	217	French blue	166
13.2	Air System				
	Station air	Sky blue	101	-	-
	Control air	Sky blue	101	White	-
13.3	Oil system				
	Fuel oil	Light brown	410	French	166
	Light oil	Light Brown	410	Brilliant green	221
	Lubricating oil	Light brown	410	Light grey	631

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	Transformer oil	Light brown	410	Light orange	557
13.4	Gas system				
	Carbon dioxide	Canary yellow	309	Light grey	631
	Hydrogen	Canary yellow	309	Signal red	537
13.5	Fire services	Fire red	536	-	-
13.6	Ash slurry pipes	Black	-	-	-
13.7	Vacuum pipes	Sky blue	101	Black	-
13.8	Fuel pipes (pulverised coal)	Light brown	410	-	-
13.9	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 - IV

S. NO.	DESCRIPTION	CONSULTANT	KPCL HEAD OFFICE	KPCL 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 KPCL	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

KPCL- KARNATAKA POWER CORPORATION LIMITED
CONSULTANT – TRACTEBEL ENGINEERING PVT. LTD.
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 Eleven (11) 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.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- 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 (KPCL) 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.

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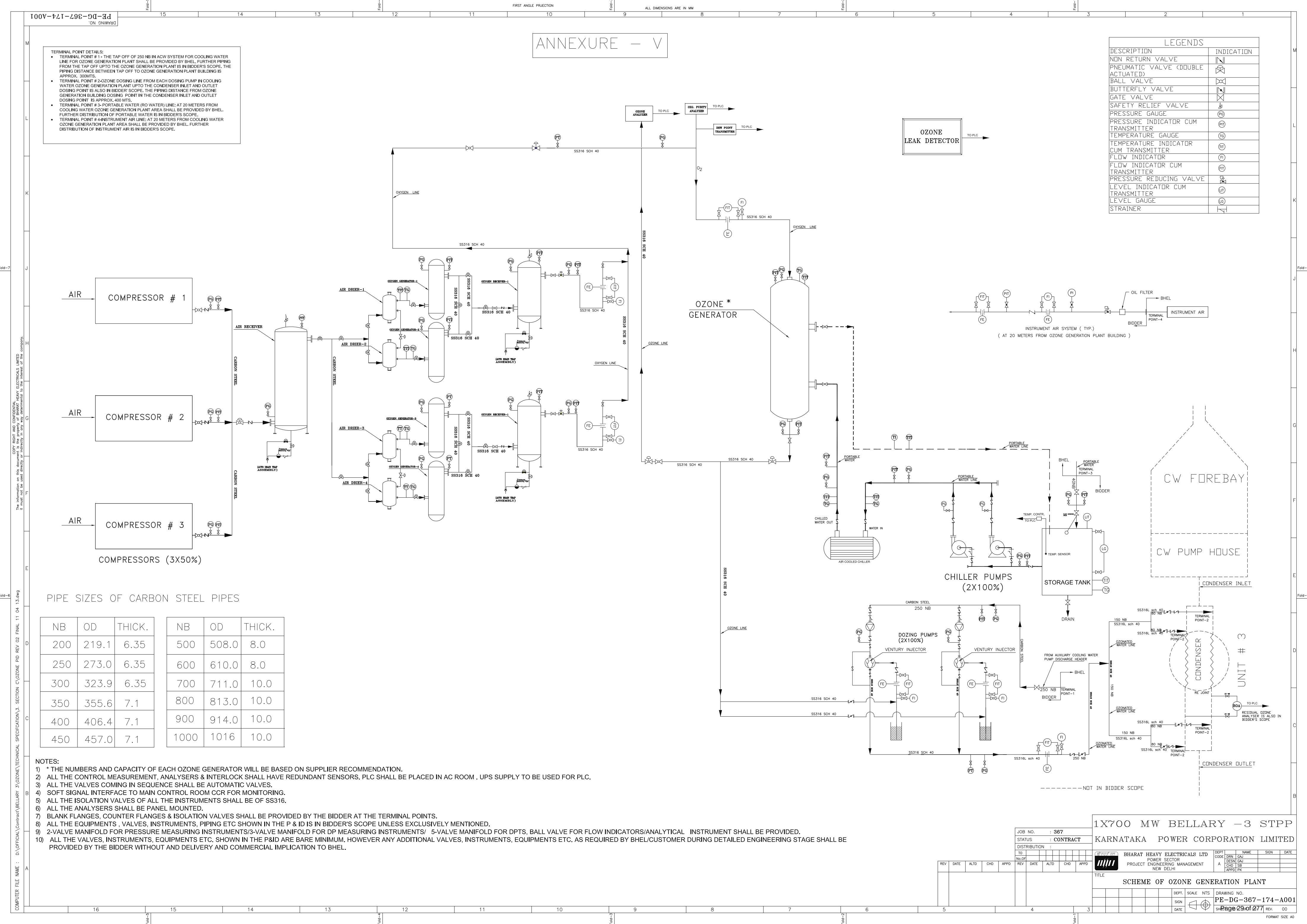
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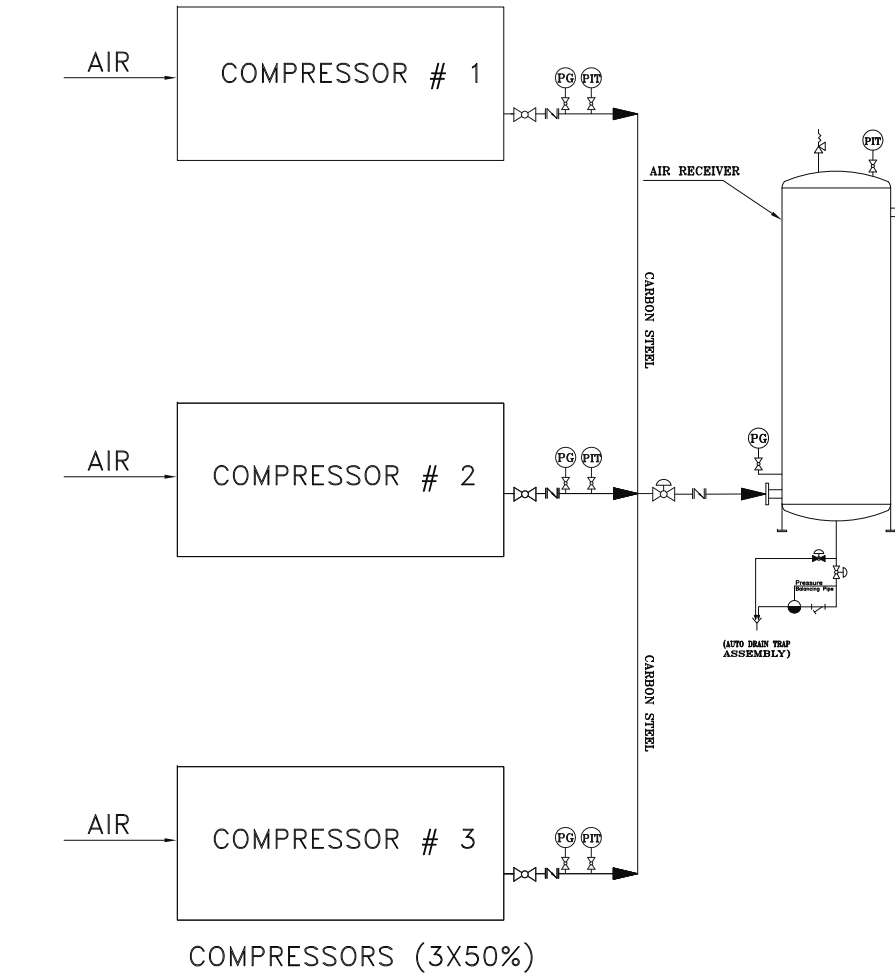
**P & ID
ANNEXURE - V**



TERMINAL POINT DETAILS:

- TERMINAL POINT # 1 - THE TAP OFF OF 250 NB IN ACW SYSTEM FOR COOLING WATER LINE FOR OZONE GENERATION PLANT SHALL BE PROVIDED BY BHEL. FURTHER PIPING FROM THE TAP OFF UPTO THE OZONE GENERATION PLANT IS IN BIDDER'S SCOPE. THE PIPING DISTANCE BETWEEN TAP OFF TO OZONE GENERATION PLANT BUILDING IS APPROX. 300MTRS.
- TERMINAL POINT # 2-OZONE DOSING LINE FROM EACH DOSING PUMP IN COOLING WATER OZONE GENERATION PLANT UPTO THE CONDENSER INLET AND OUTLET DOSING POINT IS ALSO IN BIDDER'S SCOPE. THE PIPING DISTANCE FROM OZONE GENERATION BUILDING DOSING POINT IN THE CONDENSER INLET AND OUTLET DOSING POINT IS APPROX. 400 MTS.
- TERMINAL POINT # 3- PORTABLE WATER (RO WATER) LINE; AT 20 METERS FROM COOLING WATER OZONE GENERATION PLANT AREA SHALL BE PROVIDED BY BHEL. FURTHER DISTRIBUTION OF PORTABLE WATER IS IN BIDDER'S SCOPE.
- TERMINAL POINT # 4-INSTRUMENT AIR LINE; AT 20 METERS FROM COOLING WATER OZONE GENERATION PLANT AREA SHALL BE PROVIDED BY BHEL. FURTHER DISTRIBUTION OF INSTRUMENT AIR IS IN BIDDER'S SCOPE.

LEGENDS	
DESCRIPTION	INDICATION
NON RETURN VALVE	
PNEUMATIC VALVE (DOUBLE ACTUATED)	
BALL VALVE	
BUTTERFLY VALVE	
GATE VALVE	
SAFETY RELIEF VALVE	
PRESSURE GAUGE	
PRESSURE INDICATOR CUM TRANSMITTER	
TEMPERATURE GAUGE	
TEMPERATURE INDICATOR CUM TRANSMITTER	
FLOW INDICATOR	
FLOW INDICATOR CUM TRANSMITTER	
PRESSURE REDUCING VALVE	
LEVEL INDICATOR CUM TRANSMITTER	
LEVEL GAUGE	
STRAINER	



PIPE SIZES OF CARBON STEEL PIPES

NB	OD	THICK.	NB	OD	THICK.
200	219.1	6.35	500	508.0	8.0
250	273.0	6.35	600	610.0	8.0
300	323.9	6.35	700	711.0	10.0
350	355.6	7.1	800	813.0	10.0
400	406.4	7.1	900	914.0	10.0
450	457.0	7.1	1000	1016	10.0

- NOTES:
- * THE NUMBERS AND CAPACITY OF EACH OZONE GENERATOR WILL BE BASED ON SUPPLIER RECOMMENDATION.
 - ALL THE CONTROL MEASUREMENT, ANALYSERS & INTERLOCK SHALL HAVE REDUNDANT SENSORS. PLC SHALL BE PLACED IN AC ROOM . UPS SUPPLY TO BE USED FOR PLC.
 - ALL THE VALVES COMING IN SEQUENCE SHALL BE AUTOMATIC VALVES.
 - SOFT SIGNAL INTERFACE TO MAIN CONTROL ROOM CCR FOR MONITORING.
 - ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316.
 - ALL THE ANALYSERS SHALL BE PANEL MOUNTED.
 - BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS.
 - ALL THE EQUIPMENTS , VALVES, INSTRUMENTS, PIPING ETC SHOWN IN THE P & ID IS IN BIDDER'S SCOPE UNLESS EXCLUSIVELY MENTIONED.
 - 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/ 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
 - ALL THE VALVES, INSTRUMENTS, EQUIPMENTS ETC. SHOWN IN THE P&ID ARE BARE MINIMUM, HOWEVER ANY ADDITIONAL VALVES, INSTRUMENTS, EQUIPMENTS ETC. AS REQUIRED BY BHEL/CUSTOMER DURING DETAILED ENGINEERING STAGE SHALL BE PROVIDED BY THE BIDDER WITHOUT AND DELIVERY AND COMMERCIAL IMPLICATION TO BHEL.

JOB NO. : 367		STATUS : CONTRACT	
DISTRIBUTION :			
TO	No. OF	REV	DATE
DRN	GAJ		
CHK	GAJ		
APPD	PK		
TITLE			
SCHEME OF OZONE GENERATION PLANT			
DEPT.	SCALE	NTS	DRAWING NO.
SIGN			PE-DG-367-174-A001
DATE			Page 29 of 277

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**DATASHEET -A
ANNEXURE - VI**



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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	3 Nos (3 x 50%)
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 etc.
1.2	AIR RECEIVER	
1.2.1	Numbers	1 No.
1.2.2	Capacity	3.0 M ³ (minimum) or as per system requirement whichever is higher
1.2.3	Material of construction	Carbon Steel to SA 516 Gr. 70 or 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	Out door
1.2.7	PROTECTION	
1.2.6.1	Internal	Two coats each of epoxy zinc Phosphate primer & Epoxy Paint
1.2.6.2	External	As per attached painting schedule
1.3	AIR DRYERS	
1.3.1	Numbers	2 Nos (2 x 100%) per stream. Total 4 nos.
1.3.2	Capacity	As per system requirements
1.3.3	Material of construction	Carbon Steel to SA 516 Gr. 70 or 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
1.4	OXYGEN GENERATORS	
1.4.1	Numbers	2 Nos (2 x 100%) per stream. Total 4 nos.
1.4.2	Capacity	As per system requirements
1.4.3	Material of construction	Carbon Steel to SA 516 Gr. 70 or IS 2062/IS 2002 with 4.5 mm thick rubber lining
1.4.4	Design Code for vessel	IS 2825/ASME Sec VIII Div. 1 or equivalent
1.5	OXYGEN RECEIVER	
1.5.1	Numbers	2 Nos (2 x 50%)
1.5.2	Capacity	2.5 M3 each (minimum) or as per system requirement whichever is higher
1.5.3	Material of construction	Carbon Steel to SA 516 Gr. 70 or IS 2062/IS 2002 with 4.5 mm thick rubber lining
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	PROTECTION	
1.5.6.1	Internal	Two coats each of epoxy zinc Phosphate primer & Epoxy Paint
1.5.6.2	External	As per attached painting schedule
2.0	OZONE GENERATION PLANT	Total Capacity 18 Kg/hr
2.1	OZONE GENERATORS	
2.1.1	Numbers	N (Working)+0(Stand by)
2.1.2	Capacity	Supplier Specific
2.1.3	Type	Vertical/Horizontal tubular
2.1.4	Material of construction	SS316 Ti/equivalent
2.1.4.1	Material of Tube	SS 316Ti
2.1.4.2	Material of construction of Electrode	SS 316Ti
2.2	DI ELECTRIC GLASS TUBE	
2.2.1	Type	Cylindrical
2.2.2	Material of construction	Borosilicate glass tube/ equivalent based on supplier



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		recommendations
2.2.3	Construction	Close at one end 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 condenser.
3.5	Type of Pump	Horizontal Centrifugal
3.6	Rated Capacity	As per supplier recommendations
3.7	Head to be developed at rated capacity	As per system requirements with 20% margin
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, pressure gauges, pulsation dampener.
3.12	Pressure dampener	One number per pump
3.13	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	Portable water
4.1.4	Type of Pump	Horizontal Centrifugal
4.1.5	Rated Capacity	As per supplier recommendations
4.1.6	Head to be developed at rated capacity	As per system requirements with 20% margin
4.1.7	Operation	Continuous
4.1.8	Material of construction	
	• Casing	CI to IS 210 Gr. FG 260
	• 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, pressure gauges, pulsation dampener.
4.1.11	Pressure dampener	One number per pump
4.1.12	Dive motor	Electric drive motor
4.2	CHILLER	
4.2.1	Numbers	One number
4.2.2	Type	Air cooled



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4.2.3	Capacity	As per system requirements based un supplier recommendations
4.2.4	Material of construction	Carbon steel with 4.5mm thick rubber lining
4.3	PORTABLE WATER STORAGE TANK	
4.3.1	Numbers	One number
4.3.2	Capacity	5 M3 (minimum).
4.3.3	Material of construction	HDPE/equivalent
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	Piping shall conform to Carbon steel to IS 1239 heavy grade /IS 3589 grade 410 galvanized to IS-4736. 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 Stain less steel to ASTM A 312 TP 316 sch. 40 (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 Stain less steel to ASTM A 312 TP 316 sch. 40 (minimum) seamless. The material of fittings and flanges shall be of SS316 class 150 (minimum).
5.4	Material of construction of piping, fittings and flanges handling Auxiliary Cooling water. Design pressure of auxiliary cooling water line shall be 5 kg/cm2 (g) and design mechanical temperature shall be 50°C.	• Piping upto and including 50 NB shall be of SS conforming to ASTM-A-312 Gr. 316 SCH 40S. The material of fittings and flanges shall be of SS316 class 150 (minimum). • Piping from 65 NB to 150 NB (including) shall be of SS conforming to ASTM-A-312 Gr. 316 SCH 10S. The material of fittings and flanges shall be of SS316 class 150 (minimum). • Piping 200 NB and above shall be of Carbon steel rolled and welded as per IS:3589 from CS plates as per IS:2062 with PU (Polyurethane) coating internally with minimum 2mm DFT as per AWWA-C-222. The material of fittings and flanges shall be of Carbon steel class 150 (minimum). The thickness of the piping shall be as indicated in P&ID.
5.5	Material of construction of piping, fittings and flanges handling Portable 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).
5.6	Material of construction of piping, fittings and flanges handling instrument air	Piping shall conform to Carbon steel to IS 1239 heavy grade /IS 3589 grade 410 galvanized to IS-4736. The material of fittings and flanges shall be either be same as the parent material or malleable iron to IS-1879 (galvanised).



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6.0	VALVES						
6.1	Valves handling Compressed Air Services: All the ball valves used shall be full bore type. The material of all the safety relief valves shall be SS316.	All compressed air application valves shall be ball valve type. For compressed air application, valve material shall be galvanized cast carbon steel as mentioned below:					
		SIZE	BODY BONNET	DISC	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
		≤50 NB	ASTM A 105	13% Cr Steel (Ball)	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	SCREWED TYPE
6.2	Valves handling handling Oxygen, Ozone, Ozonated water, Auxiliary cooling water and portable water. The material of all the safety relief valves shall be SS316.	GATE AND CHECK VALVES					
		Body & Bonnet		ASTM A 743 Gr. CF8M			
		Seating surface		SS 316L			
		Stem & Disc		SS 316L			
		Hinge pin		AISI – 316			
		BUTTERFLY VALVES					
		Body & Disc/flange		ASTM A 743 Gr. CF8M			
		Shaft		SS 316L			
		BALL VALVES (Full bore type)					
		Body & Bonnet		ASTM A 743 Gr. CF8M			
		Seating surface		SS 316L			
		Stem & ball		SS 316L			
		Hinge pin		AISI – 316			

Note: 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.

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**QUALITY ASSURANCE PLAN
ANNEXURE- VII**



3.1

INTRODUCTION

The minimum Quality Assurance / Quality Control (QA/QC) requirements and the services the Contractor is expected to provide to assure 'Quality Assurance' are described in this section. 'Quality Assurance' is defined as the entire programme adopted by the Contractor during engineering, procurement and construction to assure conformity with the contract specifications. Quality Assurance/Quality Control procedures proposed by the BIDDER should address the QA/QC requirements under the following phases of the project:

- (a) Engineering
- (b) Procurement
- (c) Construction including commissioning testing

Bidder shall submit documents to demonstrate that the Bidder and his sub-vendors possess, QA/QC programs meeting the requirements set forth in this section. Typical inspection requirements for some of the critical equipments like steam turbine, boiler drum, pressure parts, boiler feed pumps, piping and valves have been enclosed for Bidder's guidance. Bidder shall prepare the quality assurance plans for all the other equipments in line with the above requirements to cover the overall quality assurance requirements. Bidder shall submit a quality assurance plan along with the bid as per the format enclosed in Section F10 Schedule of Quality Plan for all applicable equipment & systems.

The BIDDER must submit an organisation chart defining the permanent positions responsible for QA/QC accompanied by a brief description of each position's function and responsibility. A second organisation chart along with a descriptive write up should also be provided outlining the proposed QA/QC program for this particular project. This chart and write up should identify the personnel responsible for the Engineering Quality Assurance Plan for the complete duration of the project.

3.2

Engineering

3.2.1

Prior to finalisation of contract

Prior to finalisation of the Contract, the Contractor shall prepare and submit a project Quality Assurance Plan that covers the engineering phase of the Works. The plan will be designed for this project and will address the specifics of how the CONTRACTOR will control, monitor and verify the requirements contained in this section. The Contractor will utilise all of his QA/QC resources, manuals and procedures when preparing the plan. Owner will review the plan prior to utilisation and upon issue the plan will become the basis by which Owner will evaluate the Contractor's engineering QA/QC activities as they relate to this project.

3.2.2

Owner's Participation

The Owner reserves the right to audit and verify procedures set forth in the Engineering Quality Assurance Plan. This audit right in no way relieves the Contractor from performing the control verification procedures outlined in the plan.



3.3 **Engineering Quality Assurance and Quality Control Requirements**

Following are the minimum Quality Assurance and Quality Control requirements for the project. The Contractor's Engineering Quality Assurance Plan shall set forth in detail the procedures to satisfy these QA/QC requirements:

3.3.1 **Design control**

The Contractor will define, document and advise the appropriate handling of the following design controls:

- (a) Establish internal as well as external discipline relationships
- (b) Qualifications of personnel assigned for each task
- (c) Establish audit procedures to ensure that the design conforms to the requirements
- (d) Define and outline the number of multi-discipline design reviews
- (e) Establish procedures for handling design changes
- (f) Establish guidelines to handle all issues in pre-award, award and pre-fabrication with Manufacturer's and Sub-contractors.

3.3.2 **Document control**

The Contractor must include in its QA/QC Plan the document control procedures defining :

- (a) Authorised use of documents
- (b) Receipt, logging and distribution of documents
- (c) Procedure for updating and implementation of additions and revisions
- (d) Procedure for document transmittal to Owner / Engineer. Some of the requirements for document transmittal maybe covered in other parts of this specification.

3.3.3 **Audits**

All documents shall be audited by the Contractor for conformance with the QA/QC procedures.

The Owner reserves the right to review design details, either directly or through their Consultants. The Owner may audit detailed design including steam turbine generator (STG), steam generator (SG) and auxiliaries related design, structural / foundation designs/piping design and other areas.



3.3.4 Engineering Sub-contractor

The subcontracting of detailed engineering to third parties does not relieve the Contractor the responsibility for Engineering Quality Assurance.

3.4 Procurement

3.4.1 Source quality control

It is the Owner's intent that the Contractor deal only with Sub-contractors and Manufacturers (Vendors) who have established and demonstrated effective quality assurance and quality control programs. Owner does require, however, that the Contractor perform such normal inspection of Sub-contractors'/ Vendors' work as is necessary to obtain equipment and materials conforming to the project specifications and their supporting documents (applicable codes and industry consensus standards) and good engineering, fabrication practices as described herein. Source Quality Control is also a valuable input for confirmation of delivery performance.

The minimum inspection requirements in respect of major mechanical items have been included in this section. Minimum inspection requirements in respect of electrical and instrumentation/control equipment and civil works are covered in their respective specifications. Prior to finalisation of the contract, the Contractor shall prepare and submit a Project Quality Assurance Plan that covers Procurement and requirements for procured items for the complete Works.

3.4.2 After Award of Subcontract

Once Sub-contractors and manufacturers are established, Owner and the Contractor shall review item-by-item all major engineered equipment and systems and any special fabrication/fitting to reach an agreement on the need for prefabrication/pre-inspection meetings.

3.4.3 Owner's Participation

The Owner reserves the right to audit the performance of the Sub-contractors/Manufacturers and the Contractor's inspection effort. This is normally accomplished by visiting the Sub-contractors/Manufacturers with the Contractor's Inspector at pre-selected points during manufacture. Contractor will identify notification points so that the Owner's representative(s) can be present at particularly important stages of fabrication should the Owner wish to attend. The notification points are not hold points unless specifically identified as such. Should Owner elect not to or fail to attend, the Work shall proceed without interruption. The Owner reserves the right, however, to make announced spot-checks to facilitate evaluation of the Sub-contractor and/or the Contractor's inspection effort. Owner may wish to hold technical meeting with the machinery Sub-contractor during the design and fabrication of the machinery. Should Owner desire to hold technical meetings, the Contractor will be advised at a reasonable notice.



During audit visits to fabricator shops, Owner may elect to spot-check base materials and welds to verify proper metallurgy using whatever methods Owner may wish to utilise, but only in the presence of Contractor's Inspector unless otherwise agreed. Some of these requirements have been identified in the minimum inspection requirements listed in this section.

3.4.4 **Communication**

Direct, timely communication between the Contractor's Inspectors and Owner's auditing Inspectors is mandatory, especially in notification points and in the event of problems, Owner shall be advised in a timely manner of all situations where changes or compromises in specifications are considered or where non-conformances are being encountered. Suggested format for inspection request is enclosed with this section. The Contractor shall give advance notice of thirty (30) days for all overseas travel and fifteen (15) days for travel inside India.

Rejection reports shall be faxed from the Contractor's Inspector to Owner's Representative at the same time as faxed to the Contractor's home office. Reports shall be faxed to Contractor's home office for typing, editing and transmitting to Owner.

3.5 **QA/QC Requirements**

3.5.1 **Inspection plan**

Inspection plans with detailed instructions for the Inspector's guidance shall be provided for each item. QA plans for the components indicated therein are enclosed in Tables 1 to 3 at end of this Section. The Contractor shall develop the QA plans for all other equipment / systems on a similar basis as in Tables above. The Contractor's Procurement Inspection function will begin with the award of the purchase order and concludes when the Inspector (including inspection by client's inspector wherever applicable) has duly released the equipment in the Sub-contractor's shop.

3.5.2 **Inspection office**

The Contractor shall identify the key inspection office located at its engineering and construction office. All inspection assignments, inspection instructions, after placement of the purchase order shall be covered from this designated office.

One individual in the Contractor's key inspection office shall be designated to fill the function outlined in 13.5.3 and must report to the Contractor's Manager of Inspection. Additional staff may be added as necessary, provided they are under the supervision of the individual designated. This individual will hereafter be referred to as the "Quality Control Project Inspector (QCPI)".

For technical problems arising during manufacturing, after purchase orders are placed, the QCPI is responsible for clearing such technical problems with Engineering and/or Owner. All purchase orders shall



have a clause requiring the Sub-contractor to submit all questions of a technical nature concurrently to the QCPI and requisitioning engineer in writing via fax or letter for resolution. The QCPI will be responsible for obtaining replies from engineering, documenting the response to the Sub-contractor and making distribution. The assigned QCPI shall be on distribution for all other correspondence. When technical requests arise from rejection made by the Contractor's source Inspector, the source Inspector's rejection report must be attached to the Sub-contractor's request for engineering evaluation.

3.5.3 **Inspection Co-ordination and Responsibility**

The QCPI shall have the overall coordination responsibility for inspection activities. The QCPI's responsibilities shall include, but not be limited to the following:

- (a) Issue assignments for source inspection
- (b) Issue specific inspection instructions when required to the assigned source inspector
- (c) Indicate the required type of report forms
- (d) Coordinate and respond to questions of a technical nature
- (e) Monitor inspection reports to determine if inspections are being performed as per written instructions
- (f) Forward all related order correspondence to the assigned source Inspector
- (g) Receive inspection reports from the source Inspector and make distribution as required
- (h) Ensure that comprehensive files are maintained for each job.

3.5.4 **Inspectors' qualifications**

The Contractor shall submit with their QA/QC Manual resumes of Contractor's inspectors detailing their experience, education and qualifications for Owners review / approval. The Inspectors shall have sufficient prior experience and qualifications for the equipment assigned.

3.5.5 **Inspector's responsibilities**

After receiving the assignment from the QCPI, the source Inspector shall review the order, conduct a pre-inspection meeting (when instructed), perform the inspections outlined, maintain field file in an organised manner and report the results to the key office and Owner. The following is a more detailed, but not inclusive, list of what Owner typically expects from the Contractor's source QCPI :

- (a) Pre-fabrication meeting - The Contractor's Inspector shall conduct a pre-fabrication meeting with the Sub-contractor prior

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to start of fabrication. The discussion shall include, but not be limited to a review of the following items :

- (i) Purchase order requirements with emphasis on any special requirements (technical and quality)
- (ii) Code Requirements
- (iii) Inspection Agency for ASME Code Requirements/IBR requirements
- (iv) Sub-contractors Quality Control Programs
- (v) Fabrication Schedule
- (vi) Critical Component or Sub-contractor Fabrication
- (vii) Major Sub-contractors
- (viii) Welding Procedure Specification (WPS), Procedure Qualification Record (PQR) and Welder Performance Records (WPR).
- (ix) Special Welding Procedure Requirements
- (x) Qualification of Non-Destructive Testing Personnel
- (xi) Non-Destructive Examination Requirements
- (xii) Heat Treatment Requirements
- (xiii) Testing - Hydrostatic and Pneumatic
- (xiv) Manufacturer's Data Reports
- (xv) Preservation, Packing and Shipping
- (xvi) Extent of Owner / Contractor Inspection
- (xvii) Witness Points and Hold Points and Notice requirements.

(b) Initial inspection visit: The Inspector shall perform as a minimum, the following inspection activities prior to start of fabrication :

- (i) Review fabrication schedule to ensure required Quality Control examinations and other intermediate tests have been included
- (ii) Establish approval of major Sub-contractors
- (iii) Verify that Welding Procedures and Procedure Qualifications have been approved

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- (iv) Verify that all welders assigned to job are qualified
- (v) Review Mill Test Reports to verify materials meet specifications
- (vi) Review Sub-contractor's Examination and Inspection Plan
- (vii) Review Sub-contractor's procedure for identifying and transferring material markings
- (viii) Make a visual examination of major materials, verify Sub-contractor's examination of all materials, and verify proper storage facilities (environment and security).
- (c) Progressive inspection visits: The following minimum activities, where applicable, shall be executed and reported upon by the Inspector:
 - (i) Monitor on a random basis the transfer of material marking throughout the fabrication
 - (ii) Initial and random inspection of edge preparation, root gap and fit up for all vessel and fabricated machinery components
 - (iii) Initial and random witnessing of production welding to verify approved procedures, qualified welders and proper techniques are being used
 - (iv) Ensure that preheat requirements are followed
 - (v) Ensure that welding materials are being properly controlled
 - (vi) Inspect major weld seams, nozzle and attachment welds, overlay welding and any weld repairs
 - (vii) Perform random check of back gouging of pressure retaining welds
 - (viii) Inspect critical/major materials from sub-Sub-contractors
 - (ix) Check nozzles / manways for size, rating and extension
 - (x) Check dimensions and workmanship of internal tubing, coils and components
 - (xi) Examine gaskets and bolting against specifications
 - (xii) Check location and attachment welds for support clips, lugs, brackets and saddles
 - (xiii) Make final visual inspection for quality of work and for damage

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- (xiv) Make complete dimensional inspection
- (xv) Verify post weld heat treatment meets specifications
- (xvi) Witness all hydrostatic and pneumatic testing
- (xvii) Witness routine and special testing as may be outlined in project specifications or data sheets for Electrical and Instrumentation
- (xviii) Assure electrical and instrument function and operational checks have been performed as per project specifications.
- (d) Non-destructive Examination (NDE) - The Inspector shall perform as a minimum the following NDE activities during progressive inspections :
 - (i) Radiographic examination (RE)
 - Review Sub-contractor's radiography procedures for approval
 - Review all radiographs progressively throughout fabrication
 - Evaluate for acceptable film quality and weld quality.
 - (ii) Ultrasonic examination (UE)
 - Review Sub-contractor's procedures and Inspector qualifications
 - Witness at least 25% Ultrasonic examinations
 - Review certified results.
 - (iii) Magnetic particle examination (MPE)
 - Review Sub-contractor's procedures and Inspector qualifications
 - Witness the initial MPE examinations and 10% minimum of all MPE examinations, as well as all examinations after repair.
 - (iv) Liquid penetrant examination (LPE)
 - Same as for MPE
 - (v) Hardness testing - production welds
 - Review procedure and witness initial tests

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- Verify 10% of hardness values during progressive inspections
- Review all hardness readings for acceptance per specifications and require certified results

(e) **Shipping**

- (i) Verify that all shipping requirements related to cleaning, dry out, surface preparation
- (ii) Verify that pressure equipment is appropriately code stamped and all "Manufacturer's Certified Data Reports" are complete and properly signed
- (iii) Verify required documentation for acceptance and record is complete.

3.5.6 **Inspection reports**

Inspection reports for interim inspection visits shall be consecutively numbered and identify non-conformance and exceptions found/ corrected at that time. Final check lists should indicate all items inspected during interim inspections.

Inspection rejection reports shall be by telefax to the key office and Owner when the Sub-contractor's proposed resolution deviates from order specifications, or would require repairing.

Final inspection reports shall be by checkoff for all major equipment and bulk piping components. The checkoff indicates the inspections were performed and would be covered on an interim inspection report.

Inspection release certificate shall be issued by the assigned Inspector only after all the requirements of the purchase order have been met. The Sub-contractor shall be given the inspection release certificate as authorisation to present final billing to the Contractor and a copy of same shall be attached to the packing list to serve as notification to the job site of inspection approval.

3.6 **Construction**

3.6.1 **Owner's Participation**

Owner will have a Quality Assurance/Quality Control organisation to audit the Contractor's QC effort. The assigned Owner's personnel will provide assurance to Owner's management that the Work meets specifications, however, the basic inspection and quality control responsibility is vested with Contractor.



Owner's auditing may include spot checks of materials in the field to assure that inadvertent substitutions have not been made in the fabrication shops or in field ordered materials.

3.6.2 **Communication**

Direct, informal communication between the Contractor's field Inspectors and Owner's auditing Inspectors is mandatory. Further Owner shall be advised when major problems related to design or fabrication are uncovered.

Contractor's in-progress inspection reports, follow up/punch out sheets, records of radiograph inspections, etc. shall be available to Owner's auditing Inspectors during the course of the Work.

At the end of the Work, Contractor's standard inspection reports, check off sheets, radiographs, master copy of loop diagrams, electrical test data sheets, etc. shall be turned over to Owner in an organised, agreed upon format. Contractor shall verify that all of the required documentation of the equipment has been received and placed in the equipment files. The Contractor is responsible for obtaining any outstanding documentation from the suppliers.

3.6.3 **Construction QA/QC requirements**

It is the Owner's intent that the Contractor (and any Sub-contractors employed) provide sufficient qualified Inspectors to assure that facilities are installed in accordance with the plans and Owner's specifications and intents and that the level of quality called for therein is obtained. Prior to finalisation of Contract award, the Contractor shall submit a detailed Field Quality Assurance Program for Owner's review. The program must be tailored to show compatibility with engineering design, compliance with applicable codes, specifications, standards, drawings, support documents, governmental regulations and this document.

For the construction period, the Contractor shall provide a full time, dedicated Quality Assurance Organisation. As a minimum the Contractor's Construction Quality Assurance Program shall include the following:

- (a) **Quality control program**
Details of the program to be implemented, its use, control and identification of hold and inspection points shall be submitted to Owner/ Owner's Representative for approval.
- (b) **Organisation, authority and responsibility**
Delineate the Contractor's Quality Control organisation, responsibility and authority for performance of QC functions by discipline.
- (c) **Inspector qualifications**

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The Contractor's Construction Assurance organisation will consist of people with qualifications similar to the requirements outlined in the Procurement clause 13.5.4. The field QA organisation will be a full time organisation, with no other construction related duties. As with engineering and procurement, Owner will review Construction QA staffing plans.

(d) **Document control**

This system shall ensure that the latest issues of drawings, specifications, standards, and supporting documents are being used for fabrication and installation and that field changes are incorporated into final "As Built" drawings.

(e) **Receiving control**

Procedure for receipt of purchased items delivered at the job site initial identification, qualification and review of supporting documents shall be described. In addition the procedure shall ensure that spare parts supplied by Contractor are properly labeled by the Sub-contractor with description and purchase order number.

(f) **Receiving inspection**

This shall establish the method of notification and inspection to be performed on received items to verify the condition and conformance to the appropriate acceptance standards reference or contained in the purchased documents.

(g) **Sub-contractor non-conformance**

This shall provide for documentation and disposition of non-conformances resulting from Sub-contractor errors and shipping damage to material, fabrications and equipment received at the job site. It also provides for interface with the design engineer when the non-conformance does not comply with the engineering design.

(h) **Storage and Maintenance of Materials and Equipment**

This system shall describe the controls and inspection performed to show that the handling, storage and preservation of materials and equipment are performed to prevent damage or harmful deterioration to the materials and equipment received at the job site.

3.6.5 Inspection, examination and testing of on-site fabrication and installation

This section shall establish the responsibility for performance and recording of examinations, tests and inspections as required by the engineering design.

Inspection of work in progress to determine conformance with drawings, specification, any field definition agreed to shall be included. Some of the inspections are listed below:

- (a) Soil testing

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- (b) Pile driving record data (if applicable)
- (c) Structural concrete
- (d) Performing random dimensional check and visual material verification of field fabricated pressure equipment and of any piping, vessel, electrical and instrument installation.
- (e) Internal checking of all vessels for :
 - (i) Cleanliness
 - (ii) Proper internals. This involves opening the vessel manways and removal of internals.
- (f) Witness testing and installation of items such as :
 - (i) Welder testing and qualifications and maintenance of records thereof
 - (ii) Weld examination and maintenance of records thereof in accordance with applicable codes and specifications
 - (iii) Monitor selected field postweld heat treating
 - (iv) Hydrotests, hydro-pneumatic tests, pneumatic tests, lead and service tests
 - (v) Electrical inspection and testing which includes witnessing of Hipot testing, megger testing, AC power factor testing etc.
 - (vi) Instrument model/name plate data verification
 - (vii) Instrument installation checkout
 - (viii) Instrument loop checks
 - (ix) Mechanical and electrical equipment bearing flushing and filling
 - (x) Mechanical equipment cold alignment checks and rotation verification
 - (xi) Witness verification that piping loads on machinery equipment meet specifications
 - (xii) Pump installation check out
 - (xiii) Coating and lining tests
 - (xiv) Surface preparation, paint application and thickness verification.
- (g) Final checking of installed facilities, completing check out forms, and signing on behalf of the CONTRACTOR documents attesting completion of the Work, as called for in the Contract documents.
- (h) Monitoring or inspecting the work of Sub-contractors This requires pre-award and pre-field start meetings for major subcontracts with Contractor's / Sub-contractor/ Owner participation to establish quality (QA/QC) requirements and how



they will be met. Typical areas/ disciplines may include, but not be limited to the following :

- (i) Foundations
 - (ii) Field fabricated vessel
 - (iii) Tanks
 - (iv) Piping
 - (v) Electrical
 - (vi) Instrumentation
 - (vii) Insulation
 - (viii) Painting
 - (ix) Buildings
- (i) Execute Contractor's standard quality tracking program
- (j) Perform final check of installed facilities with Owner's representatives to verify completeness and accuracy in accordance with P and ID's / Engineering Flow Diagrams and other scope documents as may be required
- (k) "Source" inspect/monitor any field award shop fabrication orders, in accordance with Section 13.0 of this section
- (l) See that proper protective procedures are employed and maintained for early installed equipment and equipment stored in offsite staging areas.

3.6.6 **Non-conformances of on-site fabrication and installation**

This section shall control on-site fabrication and installation items which do not conform to the engineering design or for which the engineering design is incorrect.

3.6.7 **Calibration of test equipment**

Calibration of tools, gauges, instruments and other measuring and testing devices shall be included.

3.6.8 **QA personnel qualification and certification**

The qualification required of QA/QC personnel shall be outlined.

3.6.9 **Quality assurance/Quality control records**

The system which shall ensure that all quality assurance records are maintained for ready reference and shall also provide for the accumulation, evaluation, retention and distribution of QA/QC records.

3.6.10 **Interface with statutory authorities**

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Participation of statutory authorities which require testing, witnessing and inspection shall be provided.

3.6.11 Audits

Requirements for audits to verify implementation of the QA/QC program on a regular basis shall be included.

3.6.12 Mechanical completion acceptance

CONTRACTOR shall perform final inspection of the Work in accordance with the Contract documents.

3.6.13 Periodic reporting of QA/QC activities (once a month or earlier) as required shall be submitted.

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INSPECTION REQUEST FORM

From :

To :

Attn: Mr

Dear Sirs,

Items detailed below are ready for inspection. Please arrange inspection and confirm the date of inspection :

1. OWNER :
2. Project :
3. OWNER's order reference :
4. Consultant's reference :
5. Sub-order reference :
6. Sub-contractor's name and full address :
7. Place of Inspection (full address) :
8. Contact person, telephone no. and fax no. :
9. Description of item and quantity :
10. Nature of inspection required :
11. Proposed date(s) :
12. Weekly holiday :

We confirm that the items have been fully inspected/tested by us at all stages, of inspection as per quality plan, and all material test certificates, QC records., test Reports, calibration records of measuring/testing instruments with tractability to national level are available with us.

Thanking you and awaiting your confirmation,

Yours faithfully,

cc : Sub-contractor

NOTE : 1. Following clear notice periods (date of receipt to date of inspection) are required :

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- (a) Local Inspection (within India) - 15 days
- (b) Overseas Inspection (Outside India) - 30 days

2. Weekly Holidays for OWNER / ENGINEER : 2nd Saturday & Sunday.

3. General Holidays : As per Karnataka State Govt.

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TABLE - 1 MINIMUM INSPECTION REQUIREMENTS FOR PIPING

A.

MATERIALS

PIPES / PIPE FITTINGS
HANGER / SUPPORTS

- | | | |
|-------|---|--|
| (a) | Visual inspection | |
| (b) | Material test certificate verification | |
| (c) | Supplementary tests for SA 335 P91, P22 and P11 pipes, size 8" and above. | Extent of testing for supplementary tests : |
| (i) | Product | 25% pipes per lot |
| (ii) | Analysis Transverse tension test on pipe from one end | (For definition of lot refer Clause 12.1 of SA 335) |
| (iii) | Flattening test on pipe from one end | |
| (d) | Supplementary tests for SA 234 WP91, W P11, WP22 Fittings | |
| (i) | Tension test | Extent of testing for tension test One sample per lot (For definition of lot refer Clause 8.2 of SA 234) |
| (ii) | MT | 100% |
| (e) | Identification, Correlation and stamping | |
| (f) | Cast Fittings | |
| (i) | Carbon steel castings for pressure > 71 Bar | 100% RT |
| (ii) | Alloy steel fittings | 100% RT and 100% MT |
| (g) | Alloy and Carbon Steel pipes | UT for pipes $\geq$ 3.6 mm thickness, 100% eddy current test for pipes < 3.6mm thickness |
| (h) | All forging carbon and alloy steel | 100% UT and 100% MT |
| (i) | All pipes (Carbon and alloy steel) | Hydro static at shop / mills |

B.

IN PROCESS INSPECTION

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- | | | | | |
|-----|---|-------|--|-------------------------|
| 1. | Welding | (a) | Welding procedure qualification as per ASME SEC IX | |
| | | (b) | Welder's and welding operator's, performance qualification as per ASME SEC IX | |
| 2. | Bending Cold / Hot | | Heat treatment chart review as per ASME B 31.1 | |
| 3. | Weld ends | (a) | Weld end preparation | Visual Inspection |
| | | (b) | Weld ends | 100% MT / PT |
| | | (i) | Of carbon steel piping for temperature upto 400 ⁰ C and pressure above 71 bar | |
| | | (ii) | Of all Alloy steel piping | |
| | | (iii) | Of Boiler feed discharge and associated piping | |
| | | (iv) | Naphtha and LNG piping | |
| | | (c) | All other weld ends | 10% MT / PT |
| | | (d) | Butt weld ends | Dimensional Inspection |
| | | (e) | Pre-heating as per Clause 131.4 of ASME B 31.1 | Record review |
| | | (f) | Root run | 100% MT / PT |
| 4. | Heat Treatment | (a) | Stress relief / post weld heat treatment as per ASME B 31.1 / IBR | Records review |
| 5. | Finish Weld | | | |
| (a) | Piping Listed below | | | |
| | (i) Alloy steel piping | | Butt welds | 100% RT |
| | (ii) Piping under vacuum and associated piping | | | 100% MT / PT |
| | (iii) Boiler feed discharge and associated piping | | Nozzle and branch
Size > NB
100 | 100% RT
100% MT / PT |
| | (iv) Main steam and associated piping | | Size ≤ NB 100 | 100% MT / PT |
| | (v) Hot Reheat and associated piping | | All other attachment welds | 100% MT / PT |

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	(vi)	Cold Reheat and associated piping	Removal of weld defects by grinding / machining	100% MT / PT
	(vii)	Naphtha and LNG piping	Weld Repair	Same testing method used earlier
(b)	Carbon Steel Class I piping as per IBR in which any one of the following condition exists:			
	(i)	Design temp. > 218 ⁰ C	Butt welds > NB 100	100% RT and 100% MT/PT
	(ii)	Steam pressure > 17.6 kg/cm ²	Butt welds for ≤ NB 100	10% RT and 10% MT/PT
	(iii)	Feed water pressure > 24.6 kg/cm ²	Nozzle and Branch welds for size > NB 100 and thickness < 19 mm	100% RT and 100% MT/PT
			All other attachment welds	10% MT / PT
			Removal of weld defect by grinding / machining	100% MT / PT
			Weld repair	Same testing standards used earlier
(c)	Carbon Steel Class II piping as per IBR in which none of the following conditions exists:			
	(i)	Design temp. < 218 ⁰ C	Butt welds > NB 100	100% RT and 100% MT/PT
	(ii)	Steam pressure < 17.6 kg/cm ²	Butt welds for ≤ NB 100	10% RT and 10% MT/PT
	(iii)	Feed water pressure < 24.6 kg/cm ²	Nozzle and Branch welds for size > NB 100 and thickness < 19 mm	100% RT and 100% MT/PT
			Removal of weld defect by grinding / machining	100% MT / PT
			Weld repair	Same testing standards used earlier
6.	Final Inspection		Dimensional inspection Internal records review Hydrostatic test (completed welds of shop / site)	

NOTES :

A. **INSPN CATEGORY** :

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- A. WITNESSED BY PURCHASER
- B. WITNESSED BY PURCHASER'S DISCRETION
- C. CERTIFICATES REVIEW BY PURCHASER

B. ACCEPTANCE NORMS

- I. MATERIALS : As per applicable material specifications
- 2. WELDING : As per ASME Section – IX
- 3. NON-DESTRUCTIVE TESTING : As per ASME Section – V / ANSI B 31.1

- C. PT - LIQUID PENETRANT TESTING
- MT - MAGNETIC PARTICLE TESTING
- UT - ULTRASONIC TESTING
- RT - RADIOGRAPHIC TESTING

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TABLE - 2 MINIMUM INSPECTION REQUIREMENTS FOR CAST AND FORGED STEEL VALVES

1.0	MATERIALS	BODY BONNET	a) MTC Verifications b) Identification and Correlation c) Visual Inspection	
2.0	IN PROCESS INSPECTION			
(A)	Carbon Steel and Stainless Steel – Cast valves	600 Rating} and above	a) Radiography inspection for body and bonnet	
	Ferritic Alloy Steel	All rating }		
	For all valves (Including above types)		a) Material particle inspection for body and bonnet for magnetic materials	100%
			b) Liquid penetrant inspection for stellite seats	100%
			c) Welding procedure Qualification and welder performance Qualification Tests	
			d) Procedure Qualification for hard facing	
			e) Hardness test on seat and back seat	
			f) Magnetic particle inspection on other machined components	
	(For ANSI Class 300 and below, carbon steel valves, Radiography inspection for body and bonnet is not applicable).			
(B)	Forged Steel	1500 class and above	a) UT for body and bonnet	100%
		900 class and above	b) MT / PT on machined areas	100%
			For all Class of Valves	
			c) PT on stellite seats	100%
			d) Welding procedure Qualification and Welder's performance Qualification tests	
			e) Hardness test on seat and back seat	
3.0	Final Inspection		a) Hydro test of body b) Hydro test of back seat c) Hydro test of seat d) Pneumatic test of seat e) Performance test of valve with actuator f) Dimensional Inspection	

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NOTES

1. ACCEPTANCE NORMS :
 - (1) MATERIALS : As per applicable material specification
 - (2) WELDING : As per ASME Section IX
 - (3) NON-DESTRUCTIVE TESTING : As per ASME Section – V / ANSI 16.34 requirements
 - (4) VALVE LEAKAGE TESTS : As per ANSI 16.34 / API 598
2. PT - LIQUID PENETRANT TESTING
MT - MAGNETIC PARTICLE TESTING
UT - ULTRASONIC TESTING
RT - RADIOGRAPHIC TESTING

Contractor shall furnish the detailed QAP for BOP & Electrical systems / equipment for owner's review and approval



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001
 VOL- IIB
 SECTION-C1
 REV. NO. 00 DATE: 29/05/13

TABLE - 3

SERIAL NUMBERS	Tests/Check Items / Components	MATERIAL TEST	WPS/PQR/WELDER QUALIFICATION	DPT/MPi	ASSEMBLY FIT UP	DIMENSION	RT	HYDRAULIC /WATER FILL	PNEUMATIC TEST	FUNCTIONAL/OPERATIONAL TEST	BLEEDING RESISTANCE TEST	ADHESION/SPARK TEST	PERFORMANCE TEST	OTHER TEST	ALL TESTS SHALL BE AS PER RELEVANT STANDARDS/APPROVED DATASHEETS	DYNAMIC BALANCING
1	COMPRESSOR	C	A	C	D	D	C	C	C	C			A	A	A	A
2	PRESSURE VESSELS	C	C	C	A	A	C	A						A	A	
3	HDPE TANKS	C	A	C	A	A		A								
4	AGITATORS	C	C	C	A	A	C			A			A	A	A	A
5	PUMPS	C	C	C	A	A	C	A		A			A	A	A	A
6	ELECTROLYZER	C	C	C	A	A	C	A		A			A	A	A	
7	CHILLER	C	C	C	A	A	C	A		A	A	A	A	A	A	
9	RECTIFIER	A	A	C		A							A	A	A	
LEGEND A - WITNESSED BY BHEL. B - WITNESSED BY BHEL IF REQUIREMENT IS SPECIFIED. C - RECORDS VERIFIED BY BHEL WHEREVER APPLICABLE. D - A OR C, AT BHEL'S DISCRETION WHEREVER APPLICABLE.		NOTES: 1) Quantum of check shall be 100% unless otherwise specified. 2) Hydro test shall be 2 times of operating pressure or 1.5 times the design pressure whichever is higher. Duration of test will be 30 minutes and no leakage shall be permitted. 3) Heat Treatment shall be done as per ASME code. 4) UT shall be done for shafts with Dia 50 mm or above.														

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
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C1

REV. NO. 00

DATE: 29/05/13

SECTION – C1
SPECIFIC TECHNICAL REQUIREMENTS
FOR PIPING AND VALVES

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SPECIFIC PIPING REQUIREMENTS

This Section covers the basic requirements for the all the piping systems, valves and specialities and thermal insulation to be provided for the power plant.

1.0 LINE SIZING

- 1.1 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:

Steam	
Superheated steam	75 m/s
Saturated steam	40 m/s
Wet steam/Exhaust steam	30 m/s
Water	
Pump suction	1.5 m/s
Pump delivery	3.0 m/s
Boiler feed pump discharge	6.0 m/s
Service/Potable water	1.5 m/s
Oil	
LFO & HFO	2 m/s
Gas	
Compressed air	15 m/s

- 1.2 Lower values of velocities than those stated above shall be used to determine line size if dictated by considerations of pressure drop, NPSH, surges, water hammer, etc.
- 1.3 The design flows considered in line sizing shall not be less than the rated capacities of equipment to which the piping is connected such as pumps, blowers, compressors, valves, flow limiting orifices, etc., or, the system heat and/or mass balance diagrams.
- 1.4 Sizes of Boiler feed pump suction piping shall be selected to meet the NPSH requirements of the pumps under transient conditions prevailing on loss of steam supply to feed water tank. Similarly for all pumps, NPSH requirements shall be satisfied in line sizing.

2.0 MATERIALS

The material specifications of pipelines of various systems shall be as specified in Data Sheet - A attached to this specification.



3.0 WALL THICKNESS

3.1 The calculation of wall thickness required for pipelines subject to internal and/or external pressure shall be based on the formulae and recommendations as given in the applicable codes. Adequate allowances shall be made towards thinning due to bending, weakening at branch connections, threading, commercial tolerances on pipe wall thickness, corrosion and erosion, etc. and the same shall be subject to approval by ENGINEER. In any case a minimum corrosion allowance of 1.0 mm shall be considered while selecting the thickness.

3.2 In case of carbon steel materials, the nominal wall thickness of pipeline shall be not less than the minimum acceptable values given below:

3.3 For power cycle piping, the thickness shall be as per actual thickness calculation to be carried out during detail engineering & shall be subject to owner's approval.

NB mm (inch)	15 (1/2)	20 (3/4)	25 (1)	32 (1 1/4)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	125 (5)
Min Thick mm	3.2	3.2	3.6	3.6	3.6	3.6	3.6	4.0	4.5	5.4
NB mm (inch)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	
Min Thick mm	5.4	6.3 5	6.35	6.35	7.1	7.1	7.1	8.0	8.0	

> NB 600 mm to NB 950 mm - 10.00 mm

> NB 950 mm to NB 1200 mm - 12.00 mm. Sizes of NB 32(1¹/₄"), NB 65(2¹/₂"), and NB 125(5") shall not be used in the piping system.

4.0 FLEXIBILITY ANALYSIS

4.1 Formal flexibility analysis calculations shall be carried out in case of pipelines subjected to restrained thermal expansions or contractions. The following piping systems shall be analysed :

- Pipelines with a maximum operating temperature equal to or greater than 150°C
- Regardless of their operating temperatures, all pipelines connected to sensitive rotating equipment such as turbines, feed pumps etc. for which limiting values of pipe reaction have been specified by the equipment manufacturer
- Any other pipeline which in the opinion of the OWNER/ENGINEER requires a formal analysis.

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4.2 If it is deemed necessary by the boiler or turbine vendor, a surge analysis shall be carried out by the Contractor to evaluate the effect of closure of valves that are hydrostatically or pneumatically actuated. The pressure rise in the pipeline, additional forces and moments at terminal points and additional stresses shall be calculated. If the stresses or the forces and moments exceed the allowable value, suitable shock absorbers shall be provided by the Contractor.

5.0 LAYOUT AND DETAILING

5.1 All pipelines with size greater than NB 50 mm are considered as shop fabricated piping and detailed piping layout drawings shall be prepared for all such pipelines. The drawings shall be to scale and shall be prepared as plan & sections and shall carry the following minimum details:

5.1.1 Fully dimensioned layout with locating dimensions referred to plant axis and coordinates

5.1.2 Details of all stub connections and other welded attachments as required for anchors, restraints, hangers supports, etc.

5.1.3 Slope, drains and vents, all vents and drains shall be extended to the nearest drain.

5.1.4 Edge preparation details of weld ends

5.1.5 Mounting and orientation of valves and specialties and maintenance space requirements

5.1.6 Location and tag numbers of hangers, supports, restraints, anchors, etc.

5.1.7 Location and magnitude of cold cuts, if any

5.1.8 Pipe sizes, materials, design parameters, shop and field test requirements

5.1.9 Insulation details

5.1.10 Tolerances, if any

5.1.11 Any specific requirements on shop fabrication and/or field erection

5.1.12 Any other detail considered necessary by the ENGINEER.

5.2 Pipelines with a size of NPS 50 mm or smaller are regarded as field routed. CONTRACTOR shall however indicate any specific requirements he may have in regard to the routing of these pipelines.

5.3 Detailed bills of material shall be prepared for all piping systems. In case of shop fabricated piping, the bill of material shall correspond to the layout drawing prepared.

5.4 While routing piping, the following requirements shall be taken into account:

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- 5.4.1 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment, etc. Adequate clearances shall be ensured with respect to the above to accommodate insulation and pipe movements.
- 5.4.2 All piping shall be grouped where practicable and shall be routed to present a neat and aesthetic appearance.
- 5.4.3 The piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance. Layout drawings shall indicate valve orientations and availability of access to valves and specialties. Layout of all piping shall ensure that all valves including motor operated valves are located as to be accessible conveniently for operation. Valves for operation and maintenance shall have 1.0 m clear approach space. If any of the valves are not accessible, suitable access platform shall be provided by the CONTRACTOR.
- 5.4.4 Piping shall generally be routed above ground but, where specifically indicated/approved by the ENGINEER the pipes may be arranged in trenches or buried. Pipes at working temperatures above the ambient shall however not be buried.
- 5.4.5 Where steel piping is required to be buried, the pipe work shall be protected from soil corrosion by suitable anti-corrosive treatment as specified.
- 5.4.6 Overhead piping shall have a minimum vertical clearance of 2.3 metres above walkways and working areas and 8.0 metres above roadways unless otherwise approved by the ENGINEER.
- 5.4.7 Drains shall be provided, at all low points and vents at all high points as per actual layout regardless of whether the same have been shown in the flow diagrams or not. Pipelines shall be sloped towards the drain points.
- 5.4.8 Besides at low points, tell tale drains shall be provided at other points as necessary to remove on-line valves and specialties from piping for repair and replacement. Wherever spray water is introduced into steam piping, at a suitable location downstream, drain pots shall be envisaged along with motor operated drain valves and high and low level switches. The drain valves shall be interlocked with the level switches for automatic operation. For operating temperatures of greater than 400°C, drip leg with drains, operated by a motor operated valve shall be provided. At all other drain locations (operating temperatures less than 400°C) traps shall be provided. All traps shall be provided with strainers, isolating, bypass and free blow valves. Traps shall be thermodynamic type.
- 5.4.9 Provision shall be made while preparing piping layout to accept control valves, flow measurement element and any other on-line speciality or equipment. Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves, desuperheaters and other specialties as required by the respective equipment manufacturer.

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- 5.4.10 At all the screwed valves and screwed connections on equipment, unions shall be provided to facilitate disassembly. Likewise, unions shall also be provided at suitable points on straight length of screwed pipelines.
- 5.4.11 At all points where pipes pass through concrete floors or brick or other walls, suitable floor collars or wall boxes shall be provided. The CONTRACTOR shall design and furnish the details of the floor collars to the ENGINEER/OWNER.
- 5.4.12 In the case of flanged pipe work, boxes shall be large enough to permit the passage of the flange.
- 5.4.13 All pipe racks shall be provided with walkways of 750 mm wide.
- 5.4.14 All pipe bends shall have a radius of five nominal pipe diameter unless other wise specified by the Owner / Engineer.
- 5.4.15 All oil piping shall be arranged such that these shall be below or away from the high temperature steam pipes or other heated steam surfaces.
- 5.4.16 All bearing oil drain lines and cooler outlet flow lines shall be provided with visual indicator with rotational wheel (if possible) for observation of flow from local platform or operating floor.
- 5.5 Hangers and Supports**
- 5.5.1 All piping supports, guides, anchors, turnbuckles, rod hangers, spring hangers, rollers, with incidental structural subframing shall be designed by the CONTRACTOR.
- 5.5.2 The hangers and supports shall be spaced in accordance with standard engineering practice as outlined in applicable codes and standards.
- 5.5.3 The CONTRACTOR shall ensure that the location of the hangers and supports shall not increase the forces and moments on the equipment beyond their allowable values.
- 5.5.4 If severe vibration of piping is encountered in systems over which the CONTRACTOR has control or if the piping system is to be subjected to shock loading, hangers shall be supplemented by vibration-control equipment of an approved design.
- 5.5.5 At locations where lateral or axial movement is expected, the hangers shall be provided with suitable linkages to permit swing. All hangers shall be designed to be vertical in the hot position unless otherwise approved by the ENGINEER.
- 5.5.6 In order to minimise any horizontal force components of the dead- weight or any binding of the pin or rocker joints used on the hangers, the hanger rods should be as long as possible. In critical piping systems, the length of the hanger assembly capable of swinging shall not be less than 20 times the maximum expected pipe movement in the horizontal plane at the hanger location. It is recommended in case

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of main steam piping to provide for a hanger rod length of atleast 5-6 metres wherever feasible.

5.5.7 Constant support type of hangers shall be adopted at all locations on critical piping excepting where the smallness of vertical movements of pipe justifies the use of variable spring hangers.

5.5.8 As far as practicable, connections of hangers to supporting structure shall be achieved without welding to structural members. If welding is inevitable, adequate factor of safety shall be considered in the design and specification of the weld.

5.5.9 The attachment of support brackets to brick walls shall be avoided as far as possible and where this is not possible, details of the attachment shall be furnished to the ENGINEER for his approval. Under unavoidable circumstances, when medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished to distribute the load against the wall. Where the use of a back plate is not practical, the brackets shall, be fastened to the wall in an approved manner.

5.5.10 Diameter of hangers for piping NB 50 mm and smaller shall not be less than 10 mm and for piping with size NB 65 mm and larger shall not be less than 13 mm.

5.5.11 All components for hangers such as turn buckles, clamps, etc. shall be of forged steel.

5.6 **Fittings and Flanges**

5.6.1 Branch connections in piping shall be made by the use of wrought or forged seamless fittings such as tees, laterals and crosses. Small stubs as may be required for instrument, drain and vent connection may be provided in the form of weld outlet fittings or forged couplings. Intersection welds are acceptable only in the event of non-availability of fittings.

5.6.2 Wherever pipe bends are employed for change of direction the same shall be to a radius of 5 times the pipe diameter.

5.6.3 Mitred bends may be adopted for piping systems upto a design pressure 10 bar(g) only. Mitre angle shall not exceed 22.5 degrees.

5.6.4 Slip-on type of flanges may be only upto a maximum pressure rating of ANSI 300 lbs. In case of higher pressure ratings, weld-neck type of flanges shall be employed.

5.7 **Dimensional Standards**

5.7.1 Uniform dimensional standards for all piping components shall be employed to ensure compatibility with each other.

5.7.2 Nominal pipes sizes and pipe outside diameters shall generally be as per ANSI B36.10. In case of deviation CONTRACTOR shall bring it to the specific attention of ENGINEER for prior approval stating reasons for the deviation.

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5.8 **Instrument Connections**

- 5.8.1 Unless otherwise called for by OWNER all thermowell stubs shall have an internal threading to M33 x 2.
- 5.8.2 All stubs for pressure or flow measurement for pipelines with a maximum working pressure equal to or above 62 bar(g) or with a maximum working temperature equal to or above 350°C shall be NPS 25 mm and double root valves shall be used.
- 5.8.3 Stubs for pressure or flow measurement on pipelines with a maximum working pressure less than 62 bar(g) and a maximum working temperature less than 350°C shall be of NPS 15 mm size and single root valves can be used.
- 5.8.4 Measurement stubs on fuel oil lines shall be of NPS 25 mm size and provided with two root valves.

5.9 **Drain and Vent Connections**

- 5.9.1 Drain and vent connections on pipelines shall be atleast of NPS 25 mm size.
- 5.9.2 For pressure and temperature conditions as defined in Clause 5.8.2, double isolating valves shall be used on drain and vent lines. For pressure and temperature conditions as defined in Clause 5.8.3, single isolating valves are considered adequate. Where with single root valve, instrument and root valve are not accessible, double root valve shall be provided with one root valve near the tap off and the second root valve with instrument at accessible point. For fuel oil drain and vent lines double isolation valves shall be provided irrespective of the pressure and temperature.

6.0 **WELDING AND HEAT TREATMENT**

All heat treatment, welding, post and pre weld temperatures shall be as per the code ASME B31.1.

7.0 **INSPECTION & CLEANING**

- 7.1 All pipes shall be hydrotested at shops for pressures as per standards and all erected piping shall be tested 1.5 times the design pressure. All other inspection requirements shall be as per the enclosed data sheet – A1.
- 7.2 All hot bent, forged formed, fabricated and straight pipes shall be chemically cleaned, pickled or wire brushed and purged with air blast or shot/grit blast to remove all sand and scale from the inner surface as applicable.
- 7.3 The Contractor shall carryout the following cleaning after hydrotest.
- All piping shall be mass flushed, in addition to the specific cleaning operations as described below, as required.
 - Main steam, cold and hot reheat piping and HP & LP bypass piping shall be steam blown.

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- (c) Extraction steam, condensate, boiler feed suction and discharge, heater drains and vents shall be alkaline flushed.
- (d) Auxiliary steam piping and associated steam lines, heavy fuel oil piping shall be steam blown.
Compressed air piping shall be blown by air.
Turbine lubricating oil piping shall be pickled

Contactor has to arrange Chemicals,pumps,piping, Valves, dummy devices,oil etc for acid cleaning,steam blowing,alkali boil out, oil flushing etc,.

8.0 PAINTING AND CORROSION ON PROTECTION

8.1 All uninsulated piping systems, hangers and supports shall have two coats of red oxide Zinc Chromate primer (conforming to IS 2074) with minimum dry film thickness (DFT) of 25 per coat and two coats of finish paints using enamel paint to give a minimum total DFT of 100 (after two coats of primer and two coats of finish paint). Shades shall be as per IS 5 or as indicated by Owner /Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.

8.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot, grease, rust etc.

8.3 All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

9.0 UNDERGROUND PROTECTION

9.1 Where pipelines are buried, underground protection shall be provided for the piping system as indicated any one of the methods given below:

- (a) 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.
- (b) With anti-corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93.

9.2 Pipe surfaces shall be cleaned by shot or sand blasting before application.

9.3 Tests to be carried out after application

- (a) Bond/Adhesion test
- (b) Holiday test

10.0 SPECIFIC REQUIREMENTS OF PIPING SYSTEMS

These shall be as detailed out in data Sheet A1

11.0 THERMAL INSULATION

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11.1 CONTRACTOR shall provide thermal insulation for all hot piping and equipment with fluid temperatures greater than 60°C.

11.2 Specific requirements of thermal insulation are detailed out in Data Sheet-A. Further, the insulation thickness indicated in Data Sheet - A shall be regarded as minimum acceptable thickness. These minimum acceptable thickness are OWNER's estimate based on use of mineral wool blankets as insulating material with a surface temperature of 60°C or less over the insulation finish and Contractor is advised to ensure that the thickness envisaged by OWNER are adequate to guarantee a surface temperature measured over the finish of not greater than 60°C. In case the Contractor estimates that higher insulation thickness are required, the same shall be included and clearly indicated in the offer under the 'Schedule of Technical Deviations' of this specification. If Contractor is adopting calcium silicate insulation, the thickness shall be calculated with maximum thermal conductivity as given in IS-8154 and temperature shall be over the finish (aluminium cladding).

11.3 Contractor shall submit with his offer a schedule of insulation thickness proposed by him along with supporting calculations. The calculations shall be based on thermal conductivity values certified and guaranteed by the insulation supplier who shall base his guarantee on actual tests conducted by recognised test houses. Calculation of insulation shall be based on standard BS 5970/IS 3677. No credit would be claimed by the insulation manufacturer over and above those actually recognised by international standards. However, if the CONTRACTOR is offering insulation material with superior thermal conductivity this value shall be suitably substantiated by tests.

11.4 CONTRACTOR shall demonstrate to the OWNER/ENGINEER the surface temperature of the insulation at site. For indoor piping, the temperature shall be measured at the middle of one segment of pipe run at different points. These temperatures shall be taken as representative temperatures for that length of piping. If the temperature measured is higher than that guaranteed, the whole length shall be replaced or additional thickness added to meet the surface temperature. Two measurements shall be taken at the measuring points (one at the top and another at the bottom).

11.5 Contractor should take care while fixing the insulation mats, no welding shall be permitted on HP/LP cylinder & steam chest for fixing nuts, bolts, lugs, for their mats. The strip on the casing, stop valves, where provided and instructed by manufacturer shall be used to weld the insulation pins for thermal insulation.

12.0 VALVES

12.1 DESIGN AND CONSTRUCTION FEATURES

The following design and construction features of valves shall be complied with.

12.1.1 All gate and globe valves shall be of rising stem, outside screw and yoke type. The design of valves shall ensure a streamlined passage and gate valves shall have low pressure drop. The seats and discs shall be easily renewable and/or shall be

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suitable for easy refacing and grinding. Valve discs shall be of such design as to keep the seats tight when the valve body is subjected to pressure, temperature variations and piping stresses. Gate valves shall close in both flow directions.

- 12.1.2 All globe valves shall be capable of being closed against pressure.
- 12.1.3 All valves end details shall be as specified in Data Sheet-A. In the case of all end-welded valves, the stub ends of the valves shall project from the valve body a sufficient amount to ensure that the welding process will not distort the valve body and internal parts.
- 12.1.4 Valves for regulating duties shall be of the globe type with tapered plug type disc.
- 12.1.5 Hardness of disc seating surface shall be minimum of 350 BHN and a minimum differential hardness of 50 BHN shall be provided between disc and seat to prevent galling. This is not applicable for stellite seats.
- 12.1.6 Check valves of sizes 400 mm NB and larger shall have dash pot arrangement.
- 12.1.7 All gate and globe valves shall have back-seating arrangement to facilitate easy replacement of packing with the valve in service.
- 12.1.8 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.
- 12.1.9 Piston lift check valves shall have accurately guided pistons so that the pistons are cushioned in their cylinders as they move up.
- 12.1.10 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:

<u>ANSI PRESSURE RATING</u>	<u>VALVE SIZES FOR WHICH GEAR OP IS REQUIRED</u>
Class 300 and below	350 mm and larger
Class 600 and above	200 mm and larger

- 12.1.11 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 in Data Sheet-A3. The bypass valve shall be hand operated unless otherwise specified in Data Sheet-A3. 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 OWNER/ENGINEER.

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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

- 12.1.12 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.
- 12.1.13 Valves with flexible wedge shall have provision for relieving the pressure in the neck of the valve when the valve is in the closed position.
- 12.1.14 All valves of ANSI pressure rating upto class 600 shall have bolted bonnet construction and class 900 and above shall have bonnet construction of the pressure seal type. Pressure seal valves shall have stainless steel inlay in the gasket area and silver-plated gaskets or other acceptable proven features.
- 12.1.15 All carbon steel valves of ANSI pressure rating upto class 150 and 300 shall have stainless steel trim (13% Cr) unless otherwise specified in Data Sheet and ANSI pressure rating class 600 and above shall have stellited trim.
- 12.1.16 All alloy steel valves shall have stellited seats.
- 12.1.17 All valves of ANSI pressure rating upto class 900 and higher shall have yoke with anti-friction bearing arrangement.
- 12.1.18 Valves that are to be kept in full 'OPEN'/'CLOSE' position shall be provided with a non-detachable locking arrangement. The locking arrangement provided shall be subject to approval by the OWNER.
- 12.1.19 Valves operating under vacuum conditions shall have glands with water sealing. The inlet and outlet connections shall be NB 15mm. The CONTRACTOR shall indicate the maximum and minimum sealing water pressure and the required flow rate.
- 12.1.20 Motor actuators for motor operated valves shall meet requirements indicated elsewhere in the specification.

12.2 CLEANING

Prior to factory inspection, all manufacturing waste, such as metal chips and filings, welding rods and stubs, rags, debris and all other foreign matter shall be removed from the interior of each valve. All mill scale, rust, oil, grease, chalk, crayon, paint marks and other deleterious material shall be removed from the interior and exterior surfaces. At the time of shipment, valves shall be clean inside and outside.

12.3 INSPECTION AND TESTS

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POWER PLANT PIPING, VALVES AND INSULATION

SHEET 12 OF 13

- 12.3.1 Inspection and tests shall be as per the relevant sections Data Sheet – A.
- 12.3.2 Defects in excess of acceptance standards shall be removed by suitable means. If removal of surface defects does not result in reduction in wall thickness below 5% of intended thickness of metal at that location, the area shall be blended smoothly into the surrounding surface. Where defect removal results in a wall thickness below the above, resultant cavity may be repaired by welding. The procedure and operator shall be qualified as per applicable standards. Major weld repairs shall be stress relieved or heat treated in accordance with ASME Section VIII Division I-UCS 56.
- 12.3.3 The required area shall be re-examined and the acceptance standards shall be as in the original examination.
- 12.3.4 Weld repairs made as a result of radiographic examination shall be radiographed after welding. Repairing a particular area more than 2 times is not permitted and the component shall be rejected. The acceptance standards for welds shall be as per ASME Boiler and Pressure Vessel Code, Section VIII, Division I, UW - 51.
- 12.3.5 Prior approval shall be obtained from the OWNER/ENGINEER before taking up major weld repairs (major weld repair - when depth of repair exceeds 20% of thickness or 1 inch whichever is smaller). Mapping of major weld repairs is also required.
- 12.3.6 All valves shall be tested hydrostatically for strength, tightness of seats and tightness of backseating at the pressures indicated in Data Sheet-A, in accordance with MSS-SP 61, "Hydrostatic Testing of Steel Valves". Water used for hydrostatic testing of valves with stainless steel components shall not have chloride content exceeding 20 ppm. Clean potable water may be used for testing of all other valves.
- 12.3.7 All valves except check valves shall be tested for seat tightness by air at a pressure of 6 bar (g) on both sides of seat.
- 12.3.8 All check valves shall also be hydrotested at 25% of the seat hydro test pressure.
- 12.3.9 All valves shall be checked for correctness in respect of specified end details as per applicable standards.
- 12.4 **PAINTING AND CORROSION PROTECTION**
- Two coats of primer of thickness 35 microns for each coat shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion, after release has been given for painting and before despatch. 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.

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	TITLE VALVES AND SPECIALITIES REQUIREMENTS	

1.0 SCOPE

The following paragraphs describe general requirements for valves and specialties. Only the applicable paragraphs for the type of valve or specialty are to be considered along with data sheet-A. These apply unless specified otherwise in data sheet-A.

2.0 CODES AND STANDARDS

Valves and specialties shall be generally as per the following standards:

- | | | |
|------|--------------|---|
| 2.1 | ANSI B16.1: | Cast Iron Valve Ratings |
| 2.2 | ASME B16.34: | Ratings of Valves-Flanged, Threaded and Welding Ends |
| 2.3 | API 594 : | Wafer and Wafer - Lug Check Valves |
| 2.4 | API 600 : | Steel Flanged and Butt Welding End Gate Valves |
| 2.5 | API 602 : | Steel Gate Valves, Threaded and Socket Welding Ends |
| 2.6 | API 609 : | Butterfly Valves |
| 2.7 | BS 1414: | Steel Gate Valves, Flanged and Butt Welding Ends |
| 2.8 | BS 1868: | Steel Check Valves, Flanged and Butt Welding Ends |
| 2.9 | BS 1873: | Steel Globe Valves, Flanged and Butt Welding Ends |
| 2.10 | BS 5156: | Diaphragm Valves |
| 2.11 | BS 5351: | Steel Ball Valves |
| 2.12 | BS 5352: | Steel Gate, Globe and Check Valves, 50 mm and Smaller |
| 2.13 | IS 778 : | Bronze Valves |
| 2.14 | MSS-SP 67: | Butterfly Valves |

3.0 GEAR OPERATORS

Gear operators shall be provided on the following basis:

3.1 GATE AND GLOBE VALVES

- | | | |
|------------------------------------|---|-------------------|
| Up to and including ANSI 300 class | - | 350 mm and larger |
| 600 class and higher | - | 200 mm and larger |

3.2 OTHER VALVES

- | | | |
|---------------|---|-------------------|
| Plug and ball | - | 150 mm and larger |
|---------------|---|-------------------|

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Butterfly 3.3 3.4 4.0 4.1 Classes 150 and 300 Class 600 and higher 4.2 5.0 6.0 7.0 8.0 9.0 10.0 11.0	- 200 mm and larger Gear operators shall be suitable for a differential pressure corresponding to the maximum valve rating at room temperature. All gear operators shall be of the enclosed type. INTEGRAL BYPASS Gate valves shall be provided with integral bypass valve, as per MSS-SP 45, as follows: - 350 mm and larger - 200 mm and larger Type of bypass valve shall generally be the same as the main valve. Bypass pipe shall be at least schedule 80 and material of construction of bypass valve and pipe shall be compatible with the main valve. VALVE STEMS Valve stems shall be of wrought materials. Castings are not acceptable. BACKSEAT All gate, globe and piston valves shall be provided with back seating arrangement to facilitate replacement of gland packing with the valve in service. CHECK VALVES Check valves of sizes 350 mm and larger shall be provided with features to prevent slamming and hammering. These can be in the form of springs or external dash pot. HARDNESS 13% chromium steel seat surfaces shall have a minimum hardness of 250 BHN and a differential hardness of 50 BHN. NAME PLATES The details on name plates shall be as per MSS-SP 25. TAG PLATES Tag plates shall be of stainless steel type 304 or aluminium. TESTING Strength and leak tests shall be as per any of the standards MSS-SP-61, API 598 or BS EN 12266-1 and 2 at the test pressures indicated in data sheet-A. Stainless steel valves shall be tested using potable water.	

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	TITLE VALVES AND SPECIALITIES REQUIREMENTS	

12.0 NDT REQUIREMENTS

12.1 All cast steel valves shall be subject to radiography in all accessible areas, as defined in ASME B16.34, on the following basis:

- | | | |
|--------------------------|---|-------------------------|
| (a) Class 600 and higher | - | All sizes |
| (b) Class 300 | - | Sizes 450 mm and larger |
| (c) Class 150 | - | Sizes 600 mm and larger |

12.2 All cast steel valves of class 600 and higher shall also be subject to magnetic particle or liquid penetrant examination as per ASME B16.34.

12.3 All cast steel valves of class 300 shall have radiography quality castings irrespective of size.

12.4 Acceptable levels of defects shall be as per ASME B16.34.

13.0 FACE-TO-FACE OR END-TO-END DIMENSIONS

13.1 Face-to-face dimensions of flanged-end valves and end-to-end dimensions of butt welding-end valves shall be as per ASME B16.10.

13.2 For valves not covered by ASME B16.10, the dimensions shall be as per applicable valve standards.

14.0 PREPARATION FOR DESPATCH

14.1 COATING

All carbon steel and cast iron exposed surfaces shall be given one coat of primer and two coats of aluminium finish paint after release has been given for painting and before despatch. Machined surfaces shall be coated with an easily removable rust protective except that this is not applicable for austenitic stainless steel components.

14.2 END PROTECTION

After completion of the requirements of para 14.1, body end ports, flange faces and welding ends shall be covered with suitable close fitting protectors to protect the machined ends and prevent ingress of dirt and moisture.

14.3 DISC

The disc shall be closed before despatch except in the case of soft-seated valves where the disc shall be backed off to relieve the pressure on the seal.

14.4 PACKING

Valves and specialities shall be so packed as to minimise the possibility of damage during storage or transit. The packing shall be suitable for tropical conditions.

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DATA SHEET-C
DATA TO BE FURNISHED BY THE VENDOR AFTER THE
ISSUE OF PURCHASE ORDER

- 1.0 List of drawings and documents to be submitted for review, approval or information with scheduled submission dates.
- 2.0 Quality Assurance Plan (QAP)
- 3.0 Drawings showing outline dimensions, clearance dimensions for disassembly, weight, part numbers, materials of construction, test pressures, statutory and any special requirements, sizes, tag numbers and quantities. All information covered in data sheets A and B shall be incorporated in this drawing. The PURCHASER'S identifying tag numbers shall be shown on each drawing or on a sheet attached to the drawing with proper cross-references.
- 4.0 Operation and maintenance manuals

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TITLE

CAST STEEL VALVES

SECTION: D1.15

VOLUME-III

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1.0 SCOPE

This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's Works and delivery to Site of cast steel gate, globe including angle and Y-type and check valves generally for sizes NB65 and larger.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. Valves shall also conform to the latest editions of applicable codes and standards as specified in various clauses of this specification. Nothing in this specification shall be construed to relieve the VENDOR from this responsibility.

2.2 Various codes and standards referred in this specification shall form an integral part of this specification. In the event of conflict between this specification and the codes and standards, the same shall be mutually discussed & sorted out.

3.0 DESIGN AND CONSTRUCTION FEATURES

3.1 The following design and construction features of valves shall be minimum acceptable unless otherwise specified in Data Sheet-A .

3.1.1 All gate and globe valves shall be of rising stem, outside screw and yoke type. The design of valves shall ensure a streamlined passage and gate valves shall have low pressure drop. The seats and discs shall be easily renewable and/or shall be suitable for easy refacing and grinding. Valve discs shall be of such design as to keep the seats tight when the valve body is subjected to pressure, temperature variations and piping stresses. Gate valves shall close in both flow directions.

3.1.2 All globe valves shall be capable of being closed against pressure.

3.1.3 All valves end details shall be as specified in Data Sheet-A. In the case of all end-welded valves, the stub ends of the valves shall project from the valve body a sufficient amount to ensure that the welding process will not distort the valve body and internal parts.

3.1.4 Valves for regulating duties shall be of the globe type with tapered plug type disc.

3.1.5 Hardness of seating surfaces shall be a minimum of 350 BHN and a minimum differential hardness of 50 BHN shall be provided between seats to prevent galling. This is not applicable for stellite seats.

3.1.6 Check valves of sizes 400 mm NB and larger shall have dash pot arrangement.

3.1.7 All gate and globe valves shall have back-seating arrangement to facilitate easy replacement of packing with the valve in service.

3.1.8 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.

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CAST STEEL VALVES

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3.1.9 Piston lift check valves shall have accurately guided pistons so that the pistons are cushioned in their cylinders as they move up.

3.2 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

3.3 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 in Data Sheet-A. The bypass valve shall be hand operated unless otherwise specified in Data Sheet-A. 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 PURCHASER.

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

3.4 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.

3.5 Valves with flexible wedge shall have provision for relieving the pressure in the neck of the valve when the valve is in the closed position.

3.6 All valves of ANSI pressure rating upto class 600 shall have bolted bonnet construction and class 900 and above shall have bonnet construction of the pressure seal type. Pressure seal valves shall have stainless steel inlay in the gasket area and silver-plated gaskets or other acceptable proven features.

3.7 All carbon steel valves of ANSI pressure rating up to class 150 and 300 shall have stainless steel trim (13% Cr) unless otherwise specified in Data Sheet-A and ANSI pressure rating class 600 and above shall have stellited trim.

3.8 All alloy steel valves shall have stellited seats.

3.9 All valves of ANSI pressure rating up to class 900 and higher shall have yoke with anti-friction bearing arrangement.

3.10 Valves that are to be kept in full 'OPEN'/'CLOSE' position shall be provided with a non-

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detachable locking arrangement. The locking arrangement provided shall be subject to approval by the PURCHASER.

3.11 As specified in Data Sheet-A, valves operating under vacuum conditions shall have glands with water sealing. The inlet and outlet connections shall be NB 15mm. The VENDOR shall indicate the maximum and minimum sealing water pressure and the required flow rate.

3.12 Motor operators shall be designed to close the valve within the time shown in Data Sheet-A.

3.13 Y-globe valves shall have flow area designed for minimum turbulence and pressure drop.

3.14 Stop check valves shall have full floating and accurately guided discs.

3.15 When chain wheels are specified for valves, they shall be constructed to give good traction for the chain. Roller guides shall be provided to hold the chain to a greater part of the circumference of the wheel, to increase traction and to prevent the chain from jumping off the wheel.

3.16 Extension stems where specified, shall be of extra strong pipe with suitable coupling, fastened by locknuts and set screws. Floor stands shall be of sturdy construction and shall be at least one metre high from the floor. They shall be provided with chromium-plated scales and valve movement indicators. Where lateral and/ or vertical movements of valve are indicated in Data Sheet-A, the floor stand and extension spindle shall be designed to permit these movements. Adequate greasing facilities shall be provided for all pedestals and extended operating spindle attachments.

3.17 Flow direction shall be clearly embossed on the valve body for globe and check valves.

3.18 Wherever special class valves as per ANSI B16.34 "Steel Valves" are specified in Data Sheet-A, all requirements of ANSI B16.34 for this class of valves shall be met in addition to the requirements given in this specification.

4.0 WELDING REQUIREMENTS

All welding procedure qualifications and welder performance qualifications shall be in accordance with Section-IX of the ASME Boiler and Pressure Vessel Code. Hard facing operations require procedure qualification.

5.0 CLEANING

Prior to factory inspection, all manufacturing waste, such as metal chips and filings, welding rods and stubs, rags, debris and all other foreign matter shall be removed from the interior of each valve. All mill scale, rust, oil, grease, chalk, crayon, paint marks and other deleterious material shall be removed from the interior and exterior surfaces. At the time of shipment, valves shall be clean inside and outside.

6.0 INSPECTION AND TESTS

6.1 Inspection & tests shall be as per the agree standard procedure

6.2 Defect Removal and Repair in Castings

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6.2.1 Defects in excess of acceptance standards shall be removed by suitable means. If removal of surface defects does not result in reduction in wall thickness below 5% of intended thickness of metal at that location, the area shall be blended smoothly into the surrounding surface. Where defect removal results in a wall thickness below the above, resultant cavity may be repaired by welding. The procedure and operator shall be qualified as per applicable standards. Major weld repairs shall be stress relieved or heat treated in accordance with ASME Section VIII Division I-UCS 56.

6.2.2 The required area shall be re-examined and the acceptance standards shall be as in the original examination.

6.2.3 Weld repairs made as a result of radiographic examination shall be radiographed after welding. Repairing a particular area more than 2 times is not permitted and the component shall be rejected. The acceptance standards for welds shall be as per ASME Boiler and Pressure Vessel Code, Section VIII, Division I, UW - 51.

6.2.4 Prior approval shall be obtained from the PURCHASER before taking up major weld repairs (major weld repair - when depth of repair exceeds 20% of thickness or 1 inch whichever is smaller). Mapping of major weld repairs is also required.

6.3 All valves shall be tested hydrostatically for strength, tightness of seats and tightness of backseating at the pressures indicated in Data Sheet-A, in accordance with **MSS-SP 61**, "Hydrostatic Testing of Steel Valves". Water used for hydrostatic testing of valves with stainless steel components shall not have chloride content exceeding 20 ppm. Clean potable water may be used for testing of all other valves.

6.4 All valves except check valves shall be tested for seat tightness by air at a pressure of 6 bar (g) on both sides of seat.

6.5 All check valves shall also be hydrotested at 25% of the seat hydro test pressure.

6.6 All valves shall be checked for correctness in respect of specified end details as per applicable standards.

7.0 PAINTING AND CORROSION PROTECTION

Unless otherwise specified in Data Sheet-A, two coats of primer of thickness 35 microns for each coat shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion, after release has been given for painting and before despatch. 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 DRAWINGS

The BIDDER shall furnish, along with his Bid, drawings giving outline dimensions, clearance dimensions for disassembly and weight of valve with actuator.

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CAST STEEL VALVES

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9.0 NAME PLATES

All valves shall have permanent stainless steel name plates indicating details as per "Standard Marking Systems for Valves, Fittings, Flanges and Unions".Also for all carbon steel valves of ANSI pressure rating class 600 and above, the pressure containing castings shall be marked with melt identification number. In addition, they shall have a permanent stainless steel tag fixed on the valve body indicating the PURCHASER's valve tag number and service.

10.0 DATA SHEETS

As specified in Data Sheet-A, the BIDDER shall submit details about valves.

11.0 INFORMATION TO BE FURNISHED AFTER THE AWARD OF CONTRACT

The VENDOR shall furnish all the information as called for in Data Sheet-C.

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CAST STEEL VALVES

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DATA SHEET - C

DATA TO BE FURNISHED BY THE VENDOR AFTER THE AWARD OF CONTRACT

The VENDOR shall submit, in the manner and within the time set forth in the Purchase Order/Letter of Intent the following :

- 1.0 Drawings showing Purchase Order number outline dimensions, clearance dimensions for disassembly and weight (valve and actuator). The VENDOR's drawings identified by character, number and date, when reviewed by the PURCHASER, will be considered a part of this specification. The PURCHASER's identifying tag numbers shall be shown on each drawing or on a sheet attached and referenced to the drawing.
- 2.0 Quality plans as per the format enclosed elsewhere in the specification, covering also the inspection requirements as indicated in this specification, as minimum.
- 3.0 Operation and maintenance instruction manuals.
- 4.0 Test Certificates/reports for:
 - a) Physical and chemical analysis and metallurgical tests for all components of valves.
 - b) Hydrostatic and pneumatic tests.
 - c) Non-destructive tests.
- 5.0 Test certificates as required by statutory regulations.
- 6.0 If specified in Data Sheet-A/Section-C, the details of all valves and valve list as per enclosed formats.

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1.0 SCOPE

This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's Works and delivery to Site of forged steel valves comprising gate, globe including angle and Y-type, needle and check valves generally for sizes NB 50 and smaller.

2.0 CODES AND STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The Valves shall also conform to the latest editions of applicable codes and standards as specified in various clauses of this specification. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.
- 2.2 Various codes & standards referred in this specification shall form an integral part of this specification. In the event of conflict between this specification and the codes and standards, the same shall be brought to the attention of the OWNER for resolution.

3.0 DESIGN AND CONSTRUCTION FEATURES

- 3.1 The following design and construction features of valves shall be minimum acceptable unless otherwise specified in Data Sheet-A and/or Section-C.
 - 3.1.1 All gate and globe valves shall be of rising stem, outside screw and yoke type. The design of valves shall ensure a streamlined passage and low pressure drop. The seats and discs shall be easily renewable and/or shall be suitable for easy refacing and grinding. Valve discs shall be of such design as to keep the seats tight when the valve body is subjected to pressure, temperature variations and piping stresses. Gate valves shall close in both directions.
 - 3.1.2 In the case of all end-welded valves, the stub ends of the valves shall project from the valve body a sufficient amount to ensure that the welding process will not distort the valve body and internal parts.
 - 3.1.3 Valves for regulating duties shall be of the globe type with tapered plug type disc.
 - 3.1.4 Hardness of seating surfaces shall be a minimum of 350 BHN and a minimum differential hardness of 50 BHN shall be provided between seats to prevent galling. This is not applicable for stellite seats.
 - 3.1.5 All gate and globe valves shall have back-seating arrangement to facilitate easy replacement of packing with the valve in service.
 - 3.1.6 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.
 - 3.1.7 Forged steel needle and Y-type valves shall have extra long thread chambers and a plug type disc which shall be resistant to wear and foreign matter. The stuffing box shall be adequately deep and shall be fitted with a high grade packing. Stems shall have fine pitch

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threads to permit fine adjustment. The discs and seats shall be cone shaped.

- 3.2 All valves of ANSI pressure rating up to class 600 shall have bolted bonnet construction and class 900 and above shall have bonnet construction of integral or welded type.
- 3.3 All carbon steel valves of ANSI pressure rating class 600 and 800 shall have stainless steel trim (13% Cr.) unless otherwise specified in Data Sheet-A and ANSI pressure rating exceeding class 800 shall have stellited trim.
- 3.4 All alloy steel valves shall have stellited seats.
- 3.5 Valves that are to be kept in full 'OPEN'/'CLOSE' position shall be provided with a non-detachable locking arrangement. The locking arrangement provided shall be as per standard practice and shall be subject to approval by the PURCHASER.
- 3.6 As specified in Data Sheet-A, valves operating under vacuum conditions shall have special glands designed for such conditions.
- 3.7 Motor operators shall be designed to close the valve within the time shown in Data Sheet-A
- 3.8 Wherever extension stems are specified, these shall be of extra strong pipe with suitable coupling, fastened by locknuts and set screws. Floor stands shall be of sturdy construction and shall be at least one metre high from the floor. They shall be provided with chromium-plated scales and valve movement indicators. Where lateral and/ or vertical movements of valve are indicated in Data Sheet-A, the floor stand and extension spindle shall be designed to permit these movements. Adequate greasing facilities shall be provided for all pedestals and extended operating spindle attachments.
- 3.9 Flow directions shall be clearly embossed on the valve body for globe and check valves.

4.0 WELDING REQUIREMENTS

All welding procedure qualifications and welder performance qualifications shall be in accordance with Section-IX of the ASME Boiler and Pressure Vessel Code. Hard facing operations require procedure qualification.

5.0 CLEANING

Prior to factory inspection, all manufacturing waste, such as metal chips and filings, rags, debris, welding rod stubs, and all other foreign matter shall be removed from the interior of each valve. All mill scale, rust, oil, grease, chalk, crayon, paint marks and other deleterious material shall be removed from the interior and exterior surfaces. At the time of shipment, valves shall be clean inside and outside.

6.0 INSPECTION AND TESTS

- 6.1 Inspection & tests shall be as per mutually agreed standard procedure
- 6.2 All valves shall be checked for correctness in respect of socket dimensions as per standard.
- 6.3 All valves shall be tested hydrostatically for strength, tightness of seats and tightness of backseating at the pressures indicated in Data Sheet-A. Water used for hydrostatic testing of valves with stainless steel components shall not have chloride content exceeding 20 ppm.

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Clean potable water may be used for testing of all other valves.

6.4 All valves shall be tested for seat tightness by air at a pressure of 6 bar (g)except for check valves.

6.5 All check valves shall also be hydrotested at 25% of the seat hydro test pressure.

7.0 PAINTING AND CORROSION PROTECTION

Unless otherwise specified in Data Sheet-A/Section-C, two coats of primer of thickness 35 microns for each coat shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion, after release has been given for painting and before despatch. All parts shall be adequately protected for rust prevention. 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 DRAWINGS

The BIDDER shall furnish, along with his Bid, dimensioned outline and cross sectional drawings.

9.0 NAME PLATES

All valves shall have permanent stainless steel name plates indicating details as per "Standard Marking Systems for Valves, Fittings, Flanges and Unions". In addition, they shall have a permanent stainless steel tag fixed on the valve body indicating the PURCHASER's valve tag number.

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	TITLE FORGED STEEL VALVES	

DATA SHEET C

DATA TO BE FURNISHED BY THE VENDOR AFTER THE AWARD OF CONTRACT

The VENDOR shall submit, in the manner and within the time set forth in the Purchase Order/Letter of Intent the following:

- 1.0 Drawings showing Purchase Order number outline dimensions, clearance dimensions for disassembly and weight (valve and actuator). The VENDOR's drawings identified by character, number and date, when reviewed by the PURCHASER, will be considered a part of this specification. The PURCHASER's identifying tag numbers shall be shown on each drawing or on a sheet attached and referenced to the drawing.
- 2.0 Quality plans as per the format enclosed elsewhere of the specification, covering also the inspection requirements as indicated in this specification, as minimum.
- 3.0 Operation and maintenance instruction manuals.
- 4.0 If specified in Data Sheet-A/Section-C, the details of all valves and valve list as per Purchaser's formats.



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C1

REV. NO. 00

DATE: 29/05/13

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS

FOR PRESSURE VESSELS

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS,UNIT-3 OF 700 MW TITLE WELDED UNFIRED VESSELS	SECTION: D1.13 VOLUME-III SHEET 1 OF 8
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1.0 SCOPE

This specification covers the general design, preparation of detailed fabrication drawings for review and approval, supply of materials, fabrication, stage-wise inspection, final inspection, testing, packing, forwarding, transportation and delivery at site of welded unfired pressure vessels.

2.0 CODES AND STANDARDS

2.1 The design, materials, fabrication, inspection, testing and performance of welded unfired pressure vessels shall comply with all currently applicable design codes and standards, statutes, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also conform to the latest applicable Indian or equivalent standards. Other international standards are also acceptable, if these are established to be equal, or superior to the listed standards. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

2.2 If statutory approvals are specified in data sheet A, the VENDOR shall be responsible for obtaining all approvals on design, materials, stage-wise inspection, final inspection and testing of the vessel.

3.0 MATERIALS

3.1 All materials used in the fabrication of pressure vessels shall be as specified in the data sheets. Equivalent materials are acceptable only when approved by the PURCHASER in writing.

3.2 All plates 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
- (d) All thicknesses, when used for body flanges

3.3 The VENDOR shall ensure that code mandatory requirements of impact testing are met in accordance with the minimum design temperatures specified in the data sheets.

3.4 Any non-pressure parts such as cleats, pads at support lugs or legs, wear plates at saddles and pads at pipe supports etc., welded directly on to the pressure parts, shall be of the same material as the pressure parts.

3.5 Reinforcement pads at nozzles and other load bearing locations shall be of the same material and nominal thickness as the pressure part.

3.6 Material for skirt in case of alloy steel vessels and columns shall be the same as that of pressure part at least for a minimum length of 500 mm from bottom tan-line.

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3.7 ALLOY STEEL PROTECTIVE LINING AND CLADDING

3.7.1 Lining is defined as loose strip lining and bush lining. Cladding may be by weld deposit overlay or explosion bonding or roll bonding.

3.7.2 Clad plate or lining shall conform to the following requirements:

- (a) Clad plate thickness shall be minimum 3 mm, unless specified otherwise.
- (b) Clad plate made either by the explosion bonding process or reduction roll bonding process is acceptable.
- (c) Clad plate shall meet the ASME code requirements of SA263, SA264, SA265 including bond test or AD-Merkblatter W-8. The shear bond test shall be executed as per SA264. Ultrasonic inspection shall be carried out in accordance with SA 578, acceptance level S-6.
- (d) For the purpose of ensuring that cladding thickness of reduction roll-bonded clad plates is not less than 3 mm, each plate shall be inspected at the mill using a "coating gauge". Plates shall be scanned on at least three edges and one across the width of the plate. Thickness shall be plotted at points not more than 600 mm apart. The VENDOR shall furnish a mill certificate, showing an outline of the plate and the points at which readings were taken together with the results.
- (e) Instead of lining, weld deposit overlay may also be considered.
- (f) At weld deposit overlay or clad-restoring welds, at least the same chemical composition shall be present at 3 mm depth, to be analysed by the welding procedure qualification in advance.
- (g) Weld deposit overlay and clad-restoring welds shall be dye penetrant tested and crack-free.
- (h) Weld deposit overlay and clad-restoring welds as a minimum shall be qualified as per ASME Section IX.

3.7.3 Alloy steel lining shall not be used when cladding is specified. Alloy steel lining, when specified, shall be so designed that the distance between attachments does not exceed 150 mm.

3.7.4 The minimum required thickness of pressure parts shall exclude cladding or lining.

3.7.5 Cladding or lining requirements discussed in this specification are using low and high alloy steels only. For cladding or lining using non-ferrous and other materials, when specified, the VENDOR shall furnish on his drawings all details, including Welding Procedure Specification (WPS), for review and approval.

4.0 MINIMUM THICKNESS

4.1 The thicknesses of the pressure parts as shown in the data sheets or drawings are the minimum acceptable thicknesses after manufacture, even though the code may permit a lesser thickness. The minimum acceptable thickness includes specified corrosion allowance.

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	TITLE WELDED UNFIRED VESSELS	

4.2 The VENDOR shall be responsible for proper selection of plate thickness considering the fabrication and forming allowances, mill under-tolerances etc., to meet the minimum thickness requirements as specified.

5.0 SHELLS

Shell courses shall be of the largest possible dimensions to minimise the number of weld seams.

6.0 HEADS AND REDUCING SECTIONS

6.1 Heads shall be of 2:1 ellipsoidal or equivalent ellipsoidal type (crown radius $R = 0.9D$, knuckle radius $r = 0.17D$), unless specified otherwise, where D is the inside diameter of the shell.

6.2 Reducing sections or conical bottoms shall have a knuckle radius of $r = 0.06D$, unless specified otherwise. However, knuckle radius shall not be less than 50 mm.

6.3 Dished ends shall be seamless or 100% radiographed when made from more than one piece.

7.0 AGITATOR ASSEMBLY

7.1 Agitator assembly shall be complete with drive motor, mechanical seal with seal housing, bearings, gear box, agitator shaft with impellers, foot-step bearing with support, rigid coupling between agitator shaft and gear box output shaft with spool piece, flexible couplings between gear box and drive motor, suitable base plate and supporting structure for agitator drive arrangement and necessary fasteners etc. so as to make it complete in all respects.

7.2 Drive motor and gear box shall be mounted on a common base frame and duly coupled and aligned through flexible couplings.

7.3 Agitator shaft and gear box output shaft shall be coupled through a rigid coupling with split ring locking arrangement in order to ensure that agitator shaft does not fall into the vessel during operation.

7.4 Agitator, shaft and impeller assembly shall be statically and dynamically balanced.

7.5 The VENDOR shall obtain necessary approvals from the seal manufacturer regarding arrangement of assembly and application of API cooling plan etc. for the mechanical seal.

7.6 The gear box shall be rated for heavy duty agitator service, continuously working for 24 hours a day and shall be suitable to withstand static and dynamic loads and bending moment on the gear box due to agitator shaft.

7.7 Drive motor and gear box unit shall be provided with a suitable lifting eye hook.

7.8 There shall be no oil spillage from gear box on to the vessel.

7.9 Base frame shall be provided with suitable lifting lugs suitably designed for lifting complete agitator assembly.

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8.0 NOZZLES AND MANHOLES

- 8.1 Nozzles fabricated from plates are acceptable for sizes larger than 250 mm NB in case of carbon and low alloy steels and 150 mm NB in case of high alloy steels. However, this is to be done with prior approval and subject to all welds being 100% radiographed.
- 8.2 All nozzle sizes and quantities indicated in the data sheets are tentative and for bid purpose only. Final sizes and quantities are subject to confirmation during review of drawings. The BIDDER shall include and confirm in his BID, that changes, to the extent of one size lower or higher for each nozzle and quantities plus or minus one number for each size, are acceptable at no extra cost to the PURCHASER.
- 8.3 All nozzles with butt-welding end connections shall have edge preparation as per ANSI B16.25 suitable for connected piping inside diameter. Such nozzles shall have 100 mm extra stub length with pipe caps for hydro test purpose.
- 8.4 All nozzles of sizes 40 mm NB and below shall be gusseted as per the specification appearing elsewhere.
- 8.5 All openings in pressure parts shall be compensated for the area of opening as per code. Minimum width of pad shall be 50 mm.
- 8.6 All load bearing areas in pressure parts shall be verified for buckling and local stresses. Adequate reinforcement shall be provided.
- 8.7 Nozzle and manhole necks shall be flush with the inside surface of vessel, unless specified otherwise. Inside edges of manholes shall be smooth and rounded-off with a radius of 3 mm.

9.0 FLANGES

- 9.1 Unless specified otherwise, all nozzles shall be provided with rated flanges only, from consideration of interchangeability, as per the dimensional standards indicated in the data sheets.
- 9.2 Bolt holes shall straddle the main vessel axes, unless specified otherwise.
- 9.3 All flanges on nozzles shall be of forged construction with integral hubs. Plate or plate type forged flanges are not acceptable in place of forged flanges with integral hubs.
- 9.4 All slip-on type flanges of sizes larger than 50 mm NB and girth flanges shall be provided with adequate venting arrangement during welding.
- 9.5 Girth flanges, if made out of multiple plates, shall be a maximum of three segments. All welds shall be 100% radiographed. Pre-heating and post weld heat treatment shall be carried out as per code.
- 9.6 Companion flanges specified with alloy steel liner shall be supplied with 100 mm long alloy steel stub ends with butt-welding edge preparation to suit connected pipe thickness.
- 9.7 When companion flanges are of welding neck type, the same shall be to suit bore of connected pipe. However; this information shall be provided by the PURCHASER, during review of drawings.

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9.8 Blind flanges and covers intended for inspection or access openings shall be provided with adequate arrangement to facilitate opening and closing without undue effort.

9.9 Unless specified otherwise, seating surfaces for non-metallic gaskets shall have stock or serrated finish. For other types of gaskets, the type of finish shall be furnished by the VENDOR on the drawings for review and approval.

9.10 When flanges specified are of tongue and groove or male and female type, groove or female face shall be on the nozzle flanges and tongue or male face on the companion flanges.

10.0 SUPPORTS

10.1 All skirt supports shall have at least one access opening and adequate vent holes at the top of skirt.

10.2 Skirt shall be provided with adequate holding and climbing rungs inside, above and below the skirt opening. Details shall be furnished by the VENDOR on the drawings for review and approval.

11.0 MISCELLANEOUS

11.1 The sizing of vessel internals shall be such that all removable parts can be removed through manholes.

11.2 Wherever applicable and unless specified otherwise in data sheets all support rings, bolting bar for internals such as trays, tower pickings, down comers etc. shall be in the scope of the VENDOR.

11.3 Internal baffles, tray support beams of other internals spanning a chord or diameter of the vessel shall be provided with a means for allowing differential expansion between the part and the vessel shell.

11.4 Unless specified otherwise, baffles or weir plates shall not be welded directly to the shell or dished end of the vessel. These shall be bolted to the support attachments which are welded to the shell or dished end.

11.5 The BIDDER shall include two (2) numbers stainless steel name plates in his scope. This requirement is exclusive of manufacturer's name plate. The details on name plate shall be furnished during review of drawings

11.6 Lifting lugs shall be provided for all vessels. Details are subject to review and approval.

11.7 Earthing cleats as per specification appearing elsewhere shall be provided at the approved locations.

11.8 All pads at nozzles, supports etc. shall be provided with a tell-tale hole at the bottom-most location, which shall be tested with air at 1.0 kg/cm²(g) and checked with soap solution for leakage. Such tell-tale holes shall be plugged after satisfactory testing.

11.9 For insulated or fire proofed vessels, insulation or fire proofing supports as per enclosed specification shall be provided by the VENDOR.

11.10 Wherever platforms and ladders are specified in the data sheets, necessary supports shall be provided by the VENDOR as per details which shall be made available during

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review of drawings.

- 11.11 Where materials are “free issue” as indicated in the enquiry specification or data sheet, the BIDDER shall furnish along with the technical BID, a firm Bill of Materials (BOM) of all “free issue” items and also indicate cutting and wastage allowances both accountable and unaccountable.

12.0 ANCHOR BOLTS

Anchor bolts are not included in the scope of supply of the VENDOR, unless specified otherwise in the data sheets.

13.0 FABRICATION

- 13.1 All welders, WPS and Procedure Qualification Records (PQR) shall meet the requirements of the specified code irrespective of pressure service or non-pressure service.

- 13.2 Before welding, edges shall be checked in order to ascertain the absence of flaking, irregularities or serious defects.

- 13.3 Stainless steel and high alloy steel fabrication shall have independent set of tools, grinding wheels and wire brushes etc.

- 13.4 Welding shall be executed by qualified welders.

- 13.5 Butt-welds shall have full penetration. Single sided welds shall be chipped back to sound metal and rewelded from the other side. Wherever chipping is not possible, root run shall be by TIG. Backing strip shall not be used without prior approval.

- 13.6 Openings, reinforcing pads and attachments shall clear longitudinal and circumferential weld seams.

- 13.7 Circumferential welds shall be situated 100 mm above or below the support rings and packing support rings meant for supporting internals, if specified.

- 13.8 Circumferential and longitudinal weld seams shall clear saddles and support lugs. Longitudinal seams, in case of horizontal vessels, shall be at least 150 mm above saddle wear plate.

- 13.9 Nozzle and reinforcement pads, where applicable, shall be set-in type and attached to the vessel by full penetration welds.

- 13.10 Skirt to vessel heads joints shall have continuous flat-faced weld matching with outer diameter of the vessel. The width of the weld shall be equal to skirt thickness and height of weld shall be twice the width.

- 13.11 All welds shall be deburred, free from under cuts, overlap ridges and valleys.

- 13.12 No welding shall be carried out after stress relieving and/or postweld heat treatment. All flange faces shall be suitably protected against oxidation during heat treatment.

14.0 FIELD ERECTION

- 14.1 Where size or shape of vessel makes it impossible to ship it in one piece for erection by others, the VENDOR shall ship largest shop fabricated sections suitable for shipment and ease of handling for field erection and assembly. Fabrication and erection shall be completed at the site by the VENDOR.

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14.2 All pieces shall be shop fit-up into sections and each sections shall be fit to adjacent section and all pieces shall be match marked.

14.3 The width of permissible gap during fit-up shall be in accordance with approved drawings and welding procedures and shall generally be 3 mm maximum with a tolerance of plus 0.8 mm to minus 0.0 mm.

14.4 Flame cut edges shall be ground by the VENDOR as required to remove slag, detrimental discoloration and non-uniformity of edges.

14.4 All radiographic requirements for welds completed in shop shall be made by the VENDOR before the parts of section leave the shop.

15.0 PAINTING

All carbon steel exteriors shall be descaled, edges deburred and wire brushed. Subsequently, all such surfaces shall be painted with two coats of red oxide primer.

16.0 ESSENTIAL AND RECOMMENDED SPARES

16.1 The BIDDER shall include following essential spares in his scope of supply :

- (a) Two (2) gaskets as spares for each nozzle
- (b) Three (3) gaskets as spares for body flanges
- (c) 10% spare fasteners of each size and length. However, the minimum quantity shall be four (4) for each size and length.

16.2 In addition to essential spares as indicated in para 16.1, the BIDDER may recommend additional spares considered necessary by him, for three (3) year trouble-free operation.

16.3 The BIDDER shall include essential spares as indicated in para 16.1 and recommended spares as considered necessary in "Schedule of Essential and Recommended Spares". Total value of such spares shall not be included in the quoted price for supply of equipment. This value shall be considered for the purpose of BID evaluation.

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	TITLE WELDED UNFIRED VESSELS	

DATA SHEET - C

DATA TO BE FURNISHED BY THE VENDOR AFTER THE ISSUE OF PURCHASE ORDER

1. Schedule of complete design calculations, drawings and documents to be submitted along with submission dates
2. Quality Assurance Plan (QAP)
3. Complete design calculations
4. General arrangement drawing indicating overall dimensions, complete design data, general notes, BOM, specifications of each of the pressure and non-pressure parts, nozzle schedule with nozzle tag number, service, size, nozzle wall thickness, complete end connection details, nozzle elevations, locations, and orientation, support details, locations and orientation etc. Operating weight, erection weight and weight filled with water shall be indicated.
5. Detailed fabrication drawing for each part and welding details
6. Details of internals
7. Details of external cleats and structurals
8. Welding procedure



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C1

REV. NO. 00

DATE: 29/05/13

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS FOR HORIZONTAL CENTRIFUGAL PUMPS

KPCL/BTPS/03/EPC



KARNATAKA POWER CORPORATION LIMITED

BELLARY TPS, UNIT-3 OF 700 MW

TITLE

HORIZONTAL CENTRIFUGAL PUMPS

SECTION: D1.19

VOLUME-III

SHEET 1 OF 4

1.0 SCOPE

This specification covers the general design, materials, construction features, manufacture, shop inspection and testing at manufacturer's works and delivery at site of Horizontal Centrifugal Pumps.

2.0 CODES AND STANDARDS

The design, materials, construction, manufacture, inspection, testing and performance of horizontal centrifugal pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The equipment shall also conform to latest applicable Indian or equivalent standards. Other international standards are also acceptable, if these are established to be equal or superior to the listed standards. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

3.0 DESIGN REQUIREMENTS

3.1 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be inter-changeable.

3.2 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.

3.3 The shut-off head shall be at least 110% of the differential head.

3.4 The required NPSH at duty point shall be at least one (1) metre less than the available NPSH.

3.5 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.

3.6 The corrosion allowance for pressure parts shall be 3 mm.

3.7 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 1.86 metres from the source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1.

3.8 In case of fire water pumps, pumps and drivers with all the accessories shall meet the requirements of Tariff Advisory Committee (TAC) or any other standard as called for in data sheet A. Pump type shall be as approved by TAC.

KPCL/BTPS/03/EPC



KARNATAKA POWER CORPORATION LIMITED

BELLARY TPS, UNIT-3 OF 700 MW

TITLE

HORIZONTAL CENTRIFUGAL PUMPS

SECTION: D1.19

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SHEET 2 OF 4

4.0 CONSTRUCTION FEATURES

- 4.1 In addition to static balancing, impeller and balancing drum shall be balanced dynamically at or near the operating speed.
- 4.2 Pump shall be provided with renewable type casing ring. Pump having capacity 1,000 M³/Hr and above shall be provided with impeller ring in addition to casing ring. The hardness of impeller ring shall be 50 BHN higher than that of casing ring.
- 4.3 Pump casing shall be provided with drain and vent connection with plugged or valve connection.
- 4.4 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.
- 4.5 Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box.
- 4.6 Stuffing box shall be of such design that it can be repacked without removing any part other than the gland and lantern ring.
- 4.7 Mechanical seals shall be provided if called for in data sheet - A. If required, a flushing line shall be furnished, complete with strainer and orifice, from the pump discharge to the sealing face. When pumping liquid is not suitable for this purpose, a flushing connection shall be provided so that it can be connected to an external source.
- 4.8 The allowable loads on the pump nozzles shall be at least twice the values listed in the relevant tables of API 610 without reference to any other criterion. The base plate shall be designed to cater to the above increased loads.
- 4.9 All pumps, except for back-pull out type, shall be provided with flexible coupling. Back-pull out type pumps shall be provided with spacer type coupling.
- 4.10 Coupling guard made of expanded metal and bolted to the base plate shall be furnished for all coupled pumps.
- 4.11 In addition to accessories listed in data sheet A, any other accessories required for safe and efficient operation of pump shall be provided.
- 4.12 All incidental piping and valves required for sealing, lubrication and cooling for stuffing box packing and/or bearing of pump shall be furnished by the VENDOR.
- 4.13 Leakage from the pump shall be led to the nearest surface drain by OTHERS. Pump VENDOR shall provide necessary arrangement like drip tray, base plate drain connection etc.

5.0 TESTS AND INSPECTION

- 5.1 Hydrotest pressure on casing shall be 1.5 times maximum discharge head or twice differential head whichever is higher. (Maximum discharge head = shut-off head + maximum

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suction head). Unless otherwise stated in data sheet A, the hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

5.2 The pumps shall be tested as per IS 5120, at rated speed at MANUFACTURER's works to measure capacity, total head, efficiency and power. The negative tolerance on efficiency shall be limited to 2.5% and not 5% as indicated in IS

5.2.1 These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one (1) hour. Minimum five (5) readings approximately equidistant shall be taken for plotting the performance curves.

5.3 After installation, the pumps shall be subjected to testing at site also. If the site performance is found not to meet the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the VENDOR, at no extra cost to the PURCHASER.

6.0 PERFORMANCE GUARANTEE

Performance parameters to be guaranteed by the VENDOR and tolerances permitted shall be as indicated in section C and/or data sheet A. BIDDER shall confirm acceptance of these by indicating values in data sheet B. Pump or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters.

KPCL/BTPS/03/EPC



KARNATAKA POWER CORPORATION LIMITED

BELLARY TPS,UNIT-3 OF 700 MW

TITLE

HORIZONTAL CENTRIFUGAL PUMPS

SECTION: D1.19

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DATA SHEET -C

DATA TO BE FURNISHED BY THE VENDOR AFTER THE ISSUE OF PURCHASE ORDER

1. List of drawings and documents to be submitted for review, approval and information with scheduled submission dates
2. Quality Assurance Plan (QAP)
3. Detailed dimensioned general arrangement drawing of pump and driver. This drawing shall indicate all the design data and information furnished in data sheets A and B.
4. Foundation drawing of pump and driver with static and dynamic loads, details of fixing, grouting and all relevant data required for design of foundation
5. Cross-section drawing of the pump with complete part list, materials of construction and relevant standards for each part
6. Pump performance curves flow rate Vs head, BkW, efficiency, NPSHR from zero flow to maximum flow and torque-speed curve
7. Scheme for pump sealing, lubrication and cooling
8. Driver dimensional drawing
9. Surface preparation and painting procedures
10. Catalogues, data sheets and drawings for instruments
11. Installation, operation and maintenance manual along with lubrication schedule



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 00

DATE: 29/05/13

SECTION C2

SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL



TECHNICAL SPECIFICATION FOR
OZONE GENERATION PLANT SYSTEM
(ELECTRICAL PORTION)

SPEC NO. PE-TS-367-174-14000-A001

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ELECTRICAL EQUIPMENT SEPCIFICATION FOR OZONE GENERATION PLANT

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 -C2 [Electrical Scope between BHEL & Vendor].
- 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 415V AC loads required for the system 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. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3& 4.4 below.

3.0 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 Ozone Generation plant 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.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical Scope Matrix between BHEL & vendor (Annexure-I).
- 4.2 Technical specification and Data Sheets for 415V Electric Motors.
- 4.3 Technical Specification for Power, Control, Instrumentation Control Cable & Miscellaneous electrical item
- 4.4 Quality Plan for motors, Power, Control & Screened control cables.
- 4.5 Load data format (Annexure-II).



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 00

DATE: 29/05/13

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

ANNEXURE – I TO SECTION -C2 : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 1x700MW BELLARY-3 TPS

PACKAGE: OZONE GENERATION PLANT (CIVIL IN BHEL SCOPE)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	415 V AC(3-Ph, 4Wire)/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. Any other voltage level shall be in the scope of vendor. - Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	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 BHEL	- 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. Vendor shall provide lugs & glands accordingly. - Laying of cables by BHEL except for cabling in vendor scope. - Termination at BHEL equipment terminals by BHEL. - Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	- Double compression Ni-Cr plated brass cable glands - Solder less crimping type heavy duty tinned copper lugs for power cables - Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.

ANNEXURE – I TO SECTION -C2: STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 1x700MW BELLARY-3 TPS

PACKAGE: OZONE GENERATION PLANT (CIVIL IN BHEL SCOPE)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. For skid mounted system, 2 nos. (1W+1S) supply of 415 V, 3 phase 4-wire AC shall be provided by BHEL. Complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 00

DATE: 29/05/13

ELECTRICAL LOAD FORMAT

[illegible]



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C2

REV. NO. 00

DATE: 29/05/13

QUALITY PLAN FOR MOTORS

THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER											
													BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
SHEET 1 OF 9		SECTION VOLUME III			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									
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 COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		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	10			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	FOR DIA OF 55 MM & ABOVE
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	
		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			

THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

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

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(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN				CUSTOMER :			PROJECT TITLE			SPECIFICATION NUMBER		
		SHEET 4 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		
1.10	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			
1.11	SLIP RING (WHEREVER APPLICABLE)	3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2			
		1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-			
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-			
1.12	OIL SEALS & GASKETS	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.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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(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION : NUMBER			
			BIDDER/ VENDOR			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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			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'R'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-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
		SHEET 6 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	
									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	
		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	FOR MV MOTOR	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN	
		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				

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(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
		SHEET 7 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	10			11	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY	
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.9	COMPLETE ROTOR ASSEMBLY	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
2.10	ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
1.ALIGNMENT		MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-			
2.WORKMANSHIP		MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-			
3.AXIAL PLAY		MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1			
4.DIMENSIONS		MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-			
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. 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 COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER		PROJECT		SPECIFICATION				
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		NUMBER				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE				
SHEET 8 OF 9								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		
									P	W	V	
1	2	3	4	5	6	7	8	9	10 11			
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1*	1	* NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1*	1	* NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1*	1	* NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1*	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY * NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :				
SHEET 9 OF 9				BIDDER/			TITLE			NUMBER :				
				VENDOR			QUALITY PLAN			SPECIFICATION :				
		SYSTEM			NUMBER PED-506-00-Q-007, REV-03			TITLE						
		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		
									P	W	V			
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					

THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN SHEET 1 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	10	11	12	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./MFG. SPEC.	MFG. DRG./MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	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 COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ :			TITLE			NUMBER :		
				VENDOR			QUALITY PLAN			SPECIFICATION :		
		SHEET 2 OF 2		SYSTEM			NUMBER PED-506-00-Q-006, REV-01			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
									AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			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
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 00

DATE: 29/05/13

SECTION C3: SPECIFIC TECHNICAL REQUIREMENTS FOR C&I

SCOPE OF C&I FOR OZONE GENERATION PLANT

1. The controls for Ozone generation plant shall be realized in PLC based control system.
2. The requirements given below are to be read in conjunction with detailed Technical specification & data sheets-A, B & C enclosed elsewhere in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
3. PLC based control system shall be provided with hot redundant processors. The Switch over from one processor to another processor shall be bumping less and the switch over time shall be within 50 msec. The processor shall be of 32 bits minimum.
4. In addition to the PLC based system, a control panel shall be provided to locate 1 No. of OWS, mouse etc.
5. 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.
6. The PLC based control system shall include all Primary and Secondary Instruments, Local control panels. All instruments required for the package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.
7. Time synchronization of PLC with DCS is to be carried out. Necessary hardware/software for same at PLC ends to be provided by vendor.
8. PLC shall be connected to DCS through OFC with MODBUS Protocol for monitoring.
9. Vendor shall provide at least 20% or minimum one no. spare channels as hot-on-rail spares in each configured cards/modules. In addition to this 10% or minimum one no. extra assigned complete spare cards mounted on rails in sub-racks for each type of I/O modules shall also to be provided.
10. Each PLC has to be accompanied by a LIU (Light interface unit/Fibre patch chord) which has multimode SC couplers / adapters.
11. All bidirectional drives are with integral starter, typical Hook-up diagram of drives is attached for reference.
12. Bidder to provide redundant UPS, battery charger, switches & battery bank (lead Acid PLANTE type) for minimum 60 minute back up at 100 % load.
13. Soft link communication between PLC & DDCMIS shall be redundant Bi-directional OPC link. Bidder shall include required hardware at PLC end. the protocol between PLC & DDCMIS shall be TCP/IP Ethernet & the maximum communication time for receipt of signal at DDCMIS end should not exceed 2 seconds.
14. Bidder shall provide redundant UPS with 60 minutes UPS battery back-up & necessary redundant power packs for PLC panel & PC,OWS, printer etc.
15. In PLC based system annunciation system shall be driven by PLC

16. For PLC system with OWS shall also include laser printer & control desk.
17. LPB station for start/stop & open/close shall be provided for testing & maintenance facility.
18. Connected data cable for PLC to remote I/O panels shall be through redundant cable/optic fibre with redundant I/O.
19. All instruments/Drives shall be terminated on JB/Panel in field & instrument/Drives & JB/Panel & connecting Instrument & control cable is in bidder scope.
20. Bidder shall provide at least 20% wired spare capacity of I/O modules over and above system requirement.
21. Bidder shall include 10% or 1 No. (whichever is higher) each type of module, which shall include controller card, communication card, I/O card, Power supply card/unit, relays, push button, lamps etc.
22. Bidder shall maintain redundancy in all the I/O's.
23. 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.
24. All the valves corresponding under sequence shall be automatic valves.



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

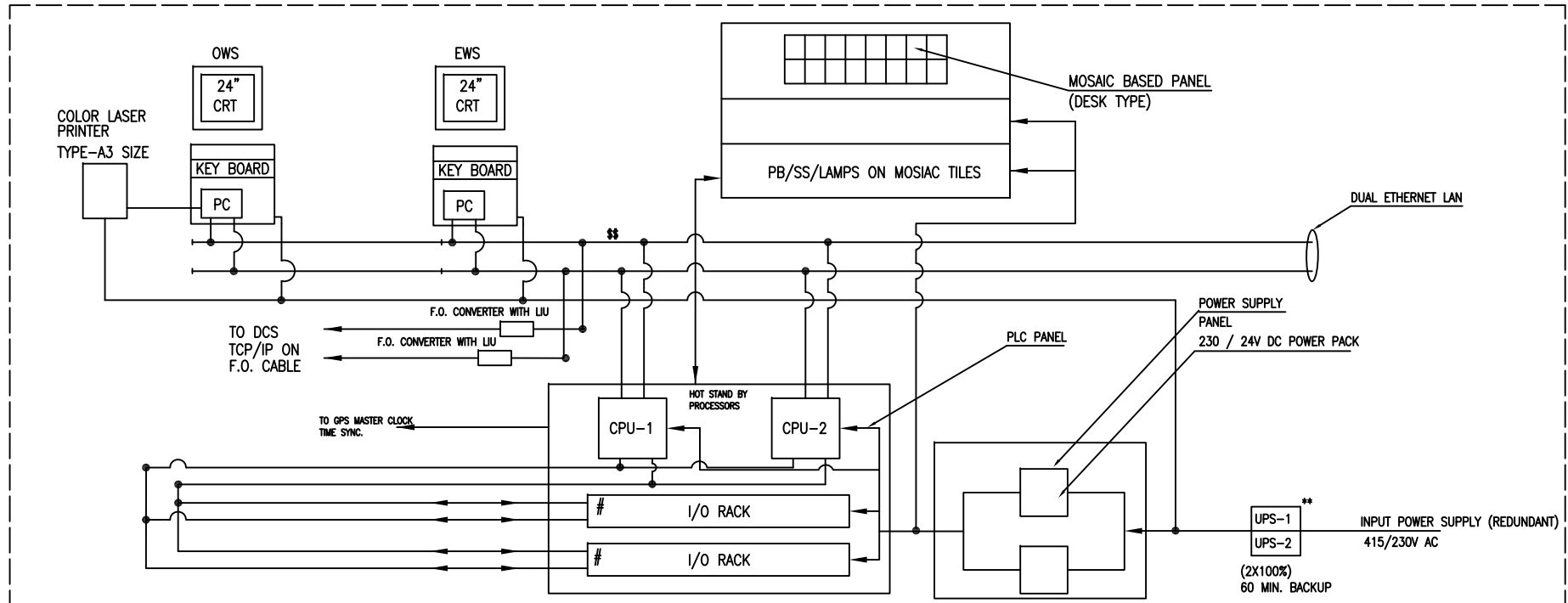
SECTION –C3

REV. NO. 00

DATE: 29/05/13

PLC SYSTEM CONFIGURATION DIAGRAM

THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)



Notes:

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

** : For details kindly refer UPS scheme included in C&I Specification.

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

JOB No. : 367		KARNATAKA POWER CORPORATION LTD.	
STATUS: CONTRACT		BELLARY TPS UNIT#3, 1 X 700 MW	
DISTRIBUTION		BHARAT HEAVY ELECTRICALS LTD	
TO		POWER SECTOR	
No. OF		PROJECT ENGINEERING MANAGEMENT	
REV		NOIDA	
01		DATE 20.09.2012	
		TITLE	
		SYSTEM CONFIGURATION DIAGRAM FOR OZONE GENERATION PLANT	
		DEPT. SCALE DRAWING No.	
		SIGN	
		DATE	

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SHEET 123 of 277
REV 00



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 00

DATE: 29/05/13

SPECIFIC TECHNICAL REQUIREMENT FOR C&I ITEMS

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/CW/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 39 of 46
	Operator's command execution time : 1 sec DAS data update time : 1 sec Closed loop control update time of 200 m sec for critical loops & 500 m sec for other loops (from change of output of the sensor of the transmitter/ temperature element to the corresponding control command output). Open loop control update time of 50-100 m sec. However, for SG/TG protections higher speed shall be considered as per manufacturer's requirement. Controller loading : Max. 60% Data bus loading : Max 50% Overall system availability : 99.7% 5.6.02 <u>Worst Loading Conditions :</u> For distributed control system the worst loading condition shall include the following tasks : (a) All process inputs scanning and processing is in progress and all the data is transmitted over the main data bus every one second. (b) All closed loop controls in operation (c) All open loop controls in operation (d) All output devices are in operation with rated performance/speed. (e) Control/information request is initiated on control VDU. (f) In burst mode operation, 100 digital alarms are generated per second for a period of 10 seconds. 6.0.00 <u>General Guidelines for Provision of Instruments/Instruments to be provided for Systems/Equipment:</u> 6.1.00 Bidder shall provide the various field instruments, in- line instruments directly mounted on pipe and panel mounted instruments including the accessories as required for different systems/equipment of the plant as per the guide lines given in clause of this section below. 6.1.01 Bidder shall include the field sensors/transmitters/ initiating devices for the following : 1. Sensors/transmitters required for all closed loop controls shall be provided considering the sensor level redundancy for controlled parameters and parameters required for compensation. 2. Sensors/initiating devices required for all open loop controls shall be provided considering the sensor level redundancy as required and as called for. 3. Sensors/transmitters required for measurement system. 4. Sensors/Initiating Devices shall be provided for status indication on CRT of various drives required for the plant. 5. Initiating Devices/contacts shall be provided for fault/abnormal conditions of the process/equipment/ systems for Sequence of events recording and Annunciation System. 6. Necessary field sensors, smart converters, smart transmitters, temperature elements, probes, transducers, process switches viz, pressure, temperature,	

SPECIFIC TECHNICAL REQUIREMENT

KPC/WT/PS/05/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 20 of 46
level, flow & limit switches etc, required for functional completeness and/or otherwise felt necessary by Bidder, with all necessary stubs, bosses, first isolation (Root) valves, cocks, manifolds, instrument isolation & drain valves, impulse pipes & tubes, mounting stands & brackets, protection covers, racks & canopies, mounting accessories etc, terminated to local junction boxes / proximeter housings with suitable type of cables, glands, lugs and sleeves, conductor marker /ferrule. Technical specifications provided elsewhere, as part of this specification shall apply as the technical guideline. 7. Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively. Scales and charts of all instruments shall have linear graduations. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark. 6.2.00 <u>Selection of Ranges for Instruments:</u> 6.2.01 The ranges of the instruments shall be selected based on the philosophy indicated below: 1. For pressure and draft measurements, the maximum operating pressure will be within 70 to 80% of the maximum scale range. All pump suction measurement and steam pressure measurements in extraction steam and in heaters will cover the negative pressure range also and all draft gauges will cover the negative pressure as well as the positive pressure as the case may be. 2. For temperature measurement, the maximum operating temperature will be within 80 to 90% of the maximum scale range. 3. For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected. 4. All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable. 5. For level measurement, the maximum of the range will cover the overflow point or six inches from the top of the vessel and the minimum of the range will be six inches above the bottom of the vessel. Also, the gauge glasses will be stacked with overlap to cover permissive, alarm and trip levels. 6. For flow measurement, the maximum range shall be fixed at about 10 to 15% above the maximum operating flow. 7. For electro-chemical measurements (conductivity, pH, dissolved O₂, Silica etc.), the maximum range will be around 10 to 15% higher than the recommended alarm settings. 6.2.02 <u>Engineering units:</u> The following system of units shall be followed for various displays and scales Unless otherwise mentioned shall be 1. Pressure: Kg/cm²		

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/02/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 21 of 46
	2. Differential Pressure: mm of H₂O column / Kg/cm² 3. Draught: mm of H₂O column 4. Vacuum : mm of H₂O column 5. Temperature : Degree Celsius (O C) 6. Flow (Steam, Water): Tonnes / hr. 7. Flow (Oil) : Tonnes/hr 8. Flow Air : Tonnes / hr 9. Density : gms/c.c 10. Level : mm 11. Conductivity : Micro-mho / cm 12. Gas Analyzer: Percentage by weight or as specified in respective case. 13. Dissolved Oxygen / Silica / : ppm or ppb Sodium / Hydrogen 14. Coal flow : Tones / hr 15. Speed : RPM 6.3.00 The general guidelines for various instruments, which have to be provided on Plant equipments/systems are elaborated below. 6.3.01 <u>Pressure indicators</u> shall be provided for 1. Suction and discharge lines of pumps/fans, including on suction/discharge header if two or more pumps are employed for the same service. 2. All input and output lines of process equipment. 3. Inlets and outlets of heaters, heat exchangers and desuperheaters. 6.3.02 <u>Pressure Switches</u> shall be provided 1. On all process lines/Equipment where parameter abnormality/status including pre trips alarms to be communicated to the operator in control room. 2. For all permissive conditions governed by safety operation of the equipment. eg. pr. adequate, conditions. 3. For all protection conditions. Eg. pr. very high/very low conditions 4. For all interlock conditions which governs starting of standby equipment or subsequent equipment for safety operation of the system. 5. 3 switches shall be employed for protection in case of critical applications 6. Inlet and outlet of filters/strainers. 6.3.03 <u>Differential Pressure Switches</u> shall be provided 1. Across filters/strainers for remote monitoring 2. Across condenser CW line for remote monitoring and interlocks 6.3.04 <u>Differential Pressure Indicators</u> shall be provided (a) Across filters/strainers for local monitoring (b) Across condenser CW line for local monitoring 6.3.05 <u>Pressure Transmitters</u> shall be provided 1. At suction and discharge of all major pumps/fans. 2. For all control and monitoring applications as demanded by the process. It shall be noted that for all critical analog/binary controls applications 3	

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/CS/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 22 of 46
	transmitters shall be provided. 3. Pressure conditions of all major vessels/tanks like Deaerator, Hotwell, Boiler Drum etc. 4. All inputs for equipment/unit performance calculation. 6.3.06 <u>Differential Pressure Transmitters</u> shall be provided, 1. For all the requirements of differential pressure, flow and level measurements. For critical control applications 3 transmitters shall be provided. 2. All inputs for equipment/unit performance calculation. 3. Auxiliary cooling water services flow measurement instead of variable area flow meters. 6.3.07 <u>Temperature indicators (Thermometers)</u> shall be provided 1. On all process lines where local indication is warranted by the system either for monitoring or testing. 2. On the inlet/outlet equipments such as heaters, desuperheaters, Heat Exchangers & Coolers for both the fluid media. 3. Capillary type temperature indicators shall be used in vibration prone areas. 4. Thermowell shall be provided for all temperature indicators. 6.3.08 <u>Temperature Switches</u> shall be provided 1. For all process lines where parameter abnormality to be communicated to the operator in control room where redundant transmitters are not provided 2. For all permissive & interlock conditions governed by the safety operation of the equipment where redundant transmitters are not provided and for protection of the equipment. 3. For all critical services 3 nos. shall be provided for protection application. 6.3.09 <u>Resistance temperature detectors(RTD's)</u> shall be provided for all services where maximum temperature does not exceed 150 degrees centigrade. 1. The element shall be 3 wire type/4 wire, duplex with all thermowell. 2. The RTD is employed for remote display for providing necessary information to the operator about the performance of the related equipment such as pumps, fans, Motors..etc <u>Eg</u> : Suction/Discharge of pumps and fans inlet/outlet of heat exchangers, fans / pumps bearings, motor windings, motor bearings etc. 6.3.10 <u>Thermocouples</u> shall be provided for all services where normal operating temperature exceeds 150 deg C. 1. The element shall be duplexed integral with thermowell. K-type for temperature upto 600 degC and R- type for temperature above 600 degC. 2. The thermocouple is employed for remote display, for control applications, density correction for flow measurements. 3. All thermocouple shall be directly connected to the respective input modules in DDCMIS through Extension/Compensating cables. The extension/compensating cables shall be laid from T/C till DDCMIS	

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/C/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 23 of 46
	cabinets and the cold junction compensation shall be carried out at DDCMIS. Extension cables shall be supplied for K & T type Thermocouples and Compensating cables for all R & S Type Thermocouples. 4. Metal temperature thermocouples shall be provided for the services like pipe metal, separator/Drum, SH/RH tube metal temperature. For metal thermocouples suitable pads with clamps etc., shall be provided. The termination of these thermocouples shall be at low temperature area with adequate extension length of thermocouples. 6.3.11 <u>Thermo wells</u> shall be provided along with Temperature elements of RTD & Thermocouples except for metal/bearing/winding temperature measurements. 1. For measurement of flue gas temperature, Inconel coated with tungsten carbide or suitable abrasion resistant thermo wells shall be provided. 2. For measurement of pulveriser outlet temperature tungsten carbide block thermo wells abrasion resistant not tungsten carbide coated thermowell shall be used. Also the terminals of Thermocouple shall not be at the top of Mills itself. The thermocouple wires are to be laid up to JB through SS tubing of required diameter and the head shall be placed nearer to the JB. Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of Mill. 3. For measurement of water & steam temperature SS thermo wells or better, shall be used. <u>Temperature Transmitters</u> are not envisaged. 6.3.12 <u>Level gauges</u> shall be provided 1. On all tanks and the maximum length of one gauge glass shall not exceed 1 metre. The gauge glasses shall be stacked to cover the complete height of the tanks including over flow level. There shall be an overlap of minimum 150 mm, when more than one level gauge is required. Suitable platforms shall be provided for purpose of taking measurements during maintenance.. 2. All high pressure vessel shall be provided with level gauges on either end as per Boiler statutory requirement. 6.3.13 <u>Level switches</u> shall be provided, 1. On all equipment (storage vessel) where parameter abnormality/status to be communicated to the operator in the control room. 2. All permissive and interlock conditions governed by the safety operation of the equipment and for protection conditions. 3. For all critical services, 3 switches shall be provided for protection application. 4. The instrument shall be external cage type with SW connection with isolation facility for surface mounted tanks and top mounted with still pipe for all sumps. 6.3.14 <u>Level transmitters</u> shall be provided on process equipment where continuous remote monitoring and/or control of level is envisaged.	

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/CS/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 2 of 46
	- The instrument shall be displacement type for all pressure/vacuum applications involving two phase media like Hotwell, LPH services..etc - The instrument shall be differential pressure type for other applications with pressure. - Other type of level transmitters viz., Ultrasonic, RF Type, Radar Type, capacitance Type ..etc for special applications. 6.3.15 Flow Glasses at the outlet of the pipe line shall be employed under the following conditions: - Coolant from the equipment (coolers) - The instrument shall be rotary type with glass mounted for indication. - Upto 4 inch on-line flow glasses shall be supplied and above 4 inch bypass type flow glasses shall be provided. 6.3.16 Flow Switches shall be provided at different outlet header of identical equipment to alarm in the event of inadequate coolant requirement (or) lube oil, cooler outlet on cooling water line. 6.3.17 Speed Measurement shall be provided, where variable speed drives are to be controlled from remote e.g., BFP, ID fans, Feeders etc. 6.3.18 Coriolis type mass flow Meters shall be provided for the measurement of HFO, LFO and DM Water flow measurement. 6.3.19 Flow Elements shall be provided as mentioned below. - Orifice plate shall be provided for spray water, condensate, makeup water, DM water, soot blowing system. - Flow nozzle shall be provided for BFP suction, Feedwater, HP Bypass, Aux. steam system. - Impact head type element (Annubar) type/Orifice shall be provided for condenser cooling water system. - Aerofoil for secondary air flow - Venturi for primary air flow measurement or as per proven standard and practice of boiler supplier. - The flow element connection shall be Butt welded except for applications, where flanged connection have to be used. - Flow elements shall be provided with three (3) sets of tap points with independent root valves. 6.3.20 Control valves shall be provided - For all control application as required and in line with the system requirement. - If the process demands any other control, then control valves shall be provided for those applications also. - Where a single control valve can not meet the turned down ratio as dictated by the process, control valves with split range application, shall be provided. - All bypass valves of control valves as detailed in section - D1 shall be suitable for inching operation and provided with position transmitters. - Control valves for HP & LP Bypass system shall be hydraulic operated.	

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS/03/EPC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SECTION: D3.3 VOLUME-IV Sheet 25 of 46
	6. Control valves for modulating shall be pneumatically operated. Control valves in high pressure services shall have welded end connections. Control valves and actuators shall be equipped with standard accessories like air filter regulator with pressure gauge, valve positioners with E/P converter & pressure gauges, position transmitters, handwheel, limit switches, air failure lock etc. The general specification of the control valves is detailed in Section-D3.4. 6.3.21 Solenoid valves shall be provided with pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below 1. Two (2) way solenoid valves shall be provided, where process line of less than 2 inch with low pressure & temperature application. Eg : ACW overhead tank make up line. 2. Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder. Eg: Pneumatic operated spray water block valve. 3. Four (4) way solenoid valve shall be provided for operating double acting cylinders. Eg: Pneumatically operated on-off type dampers 4. Dual coil solenoid valves shall be supplied for protection application and single coil for open/close application. 6.3.22 Control Dampers (Modulating) shall be provided for air & flue gas control application. If process demands any other control, the necessary control dampers shall be provided for those applications. 6.3.23 Valve/Damper Actuators Accessories: All pneumatic actuators (valves/dampers) included in the scope of BIDDER for ON/OFF and regulating services shall be complete with all accessories including the following: Hand wheel with lock, Air filter regulator, Air lock relay, Pneumatic tubing from nearest air header to the actuator complete with all necessary fittings, Positioner for regulating services, End position (open/close) limit switches, Local position indicator and non contact type position transmitter with 2 wire 4-20mA DC output for regulating services, Necessary solenoid valves required for open/close operation & interlock functions, Electro-pneumatic (E/P) converters for the regulating services, suitable for accepting 4- 20mA DC signal, Junction box near the valve for terminating the limit switch/position transmitter/E-P converter signals. 6.3.24 Position Transmitters shall be provided for all control valves, control damper and bypass valves/dampers, where modulating/inching operation is required. Position transmitters shall be non-contact type. The general specification is given in Section-D3.4. 6.3.25 Electro-Pneumatic Converters shall be provided for all pneumatically	

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operated control valves, control dampers, power cylinders etc., for converting controller output of 4-20 mA to 3-15 PSI for interfacing with pneumatic actuators. In case of single E/P converter is driving more than one positioner, then its air out put shall have sufficient capacity.

6.3.26 **Air Filters Regulators** shall be provided in the

1. Air supply line to valve positioners/power cylinders
2. Air supply line to electrical to pneumatic converters
3. Air supply line to pneumatic interlocked block valves
4. For each Instrument Rack/Local panel field instruments enclosure for purging.

6.3.27 **Analytical Instruments:**

a. Steam and water quality measurement:

The various analytical instruments complete with their sampling system and sampling racks shall be provided for continuous monitoring of the quality of the process fluid as per Table-3.

These analysers shall be kept in an air conditioned room. The specification details for analysers, sample coolers and sampling racks shall be as per section-D3.4.

b. Gas Analysers:

The following gas analysers shall be provided at the location indicated below:

1. Economiser outlet or Each of Air preheater Inlet : Oxygen
2. Each of Air preheater outlet : Oxygen
3. ID fan outlet : Particulate Emission Analyser.
4. Stack : i) Sample Extractive type SO₂, NO_x, CO
ii) Particulate emission.

Bidder shall also provide Oxygen measurement in high temperature zones of boiler for combustion control and performance analysis, if required.

The specification details for gas analyser is given in section-D3.4.

6.3.28 **Interposing Relays** shall be provided,

1. For all drive commands, (HT,LT,BIDIRECTIONAL, SOLENOID, DC DRIVE etc.,)
2. Potential free contacts required between systems for unit / equipment trip, protection & interlocks applications...etc

The Interposing relays' provided are independently mounted in MCC/Integral starter/DDCMIS cabinets or in separate cabinets.

6.3.29 **Transmitter Racks**

All the pressure, flow and level transmitters shall be grouped depending on the geographical locations and mounted on Transmitter Racks. The general specification of transmitter racks is given in Section-D3.4.

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	also 2 sets to be mounted on Unit control desk. 3.00.06 The alarm windows and group alarms shall be freely configurable without wiring changes from PC based OWS. 3.00.07 Contact multiplication (Buffer terminal cabinets)cabinets with optical isolation input cards required for UCP & ECP alarm points shall be provided as per requirement. 4.00.00 <u>TECHNICAL SPECIFICATIONS FOR FIELD INSTRUMENTS, PLC, VMS, CCTV AND OTHER EQUIPMENT/SYSTEMS</u> All instruments offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven as mentioned in design criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications. The Contractor shall furnish all Instrumentation/ Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these transmitters shall be furnished, even if not specifically asked for, on as required basis. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm. 4.00.01 <u>Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):</u> 4.00.02 Micro-processor based indicating type (LCD display), rack mounted with accuracy of +/- 0.1% of span, Repeatability : +0.05% of FSR or better, Linearity :+0.1% of FSR or better. Hysteresis: +0.1% of FSR or better. external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4- 20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ haste alloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter. In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDT type is not acceptable. 4.00.03 Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable	

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for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

4.00.04 In Detail Technical Specification:

- 1) Type of Transmitter: Microprocessor based 2 wire type HART protocol compatible,
- 2) Accuracy : - +/- 0.1 % of span
- 3) Output Signal Range: 4-20 mA DC (Analog) *Superimposed digital on HART protocol*
- 4) Turn Down Ratio : 10:1 for vacuum/very low pressure applications
30:1/100:1 for other applications
- 5) Stability: +/- 0.1% of calibrated span for 6 months up to 70 KSC & +/- 0.25% for range more than 70 KSC(g).
- 6) Zero and Span Drift: +/- 0.015% per Deg.C at max. span and 0.11% per Deg.C at Minimum Span
- 7) Load Impedance: 500 ohm (Min)
- 8) Housing: Weather proof as per IP-65 with durable corrosion resistant coating
- 9) Over Pressure - 150 % of Max. operating pressure
- 10) Connection (Electrical)- Plug and socket type
- 11) Process Connection - 1/2 inch NPT (F)
- 12) Span and Zero: Continuous, tamper proof, Remote Adjustability as well as manual from instrument with zero suppression and elevation facility.
- 13) Accessories
 - a) Diaphragm seal, pulsation dampeners syphon etc. as required by service and operating condition.
 - b) 2/3/5 Valve manifold as applicable
- 14) Diagnostics: Self Indicating Feature
- 15) Power Supply: 24 V DC +/- 10%
- 16) Adjustment : Calibration facility via Centralized PC based HART management system

In addition to the transmitters 3 Nos. of hand held calibrators for configuration shall be provided for maintenance of units.

5.00.00 Coriolis Type Smart Mass Flow Meter :

Bidder shall provide Coriolis type Mass Flow Meter for flow measurement of HFO (Main & Return), LDO and DM water flow to Unit. The technical details are Accuracy - 0.2% of FS, Repeatability - 0.1%, Output - 4-20 mA, Protection - IP-65 and Hazardous Area- Flame proof Classification for LFO/HFO.

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6.00.00	Displacement Type Level Transmitters:	
6.00.01	Displacement Type Smart Electronic Level Transmitters shall be provided for level measurement of condenser hotwell level, LP Heaters, HP Heaters and other vacuum services, shall be considered by the bidder. If any more transmitters over and above the quantity indicated are required for the safe and efficient operation and maintenance the same shall be included. The type/ranges/make of transmitters and services for which these transmitters are required shall be as decided and approved by the owner during detailed engineering.	
6.00.02	Microprocessor based smart type, displacement type level transmitters of float length of 14 inches or 32 inches with an accuracy of +/-0.5% of span, 4-20 mA DC output (2 wire system), +24 V DC supply, isolated and ungrounded electrical circuits, zero adjustment (100% of sensing element) for control application and measurement purposes for all services of condensate and drains, particularly where two phases of steam and water are present. IP 65 or equivalent degree of protection for enclosure. Displacer/float material of 316SS. The material of accessories will be SS.	
7.00.00	<u>Impact Head Type Flow Element:</u>	
7.00.01	The impact head type element (annubar) shall be tubular insert type with minimum four impact ports facing upstream direction, located precisely for determination of average flow velocity. The material of the sensor shall be 316 SS. Accuracy shall be +/- 1.0 % of actual value or better. Repeatability shall be +/- 0.01 % of actual value or better.	
7.00.02	The elements shall be supplied complete with mounting hardware, end support plugs and CS valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including OWNER's instrument Tag No. for the flow element shall be punched on a stainless steel plate and affixed to the element.	
7.00.03	On line retracting facility and flushing arrangement shall be provided. Anubar Type flow element shall be used for measurement of C W flow. Bidder shall submit all sizing calculations, precise flow calculations, fabrication and assembly drawings, installation drawings for all the flow elements for OWNER's review and approval.	

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8.00.00	<u>Digital Display Unit</u> To display the digital value of any analog process parameter with sign and decimal point of any analog input assigned though operator. Accuracy shall be $\pm 0.25\%$ of reading; shall be of size 2". type of display - LED; Seven segment or dot matrix type; five digits, sign and decimal point; colour of display shall be Green ; enclosure shall be IP32 or equal; all DDU's shall be mounted on the Unit Control Panel. For outdoor applications, the size shall be 6". DDU used outside control room shall be of Dot matrix type. 9.00.00 THERMOCOUPLE ASSEMBLY WITH THERMOWELL Duplex type with accuracy of $\pm 0.5\%$ of span (as per IEC-584 class-I for turbine applications) response time of 2 to 6 sec, Spring loaded mineral insulated thermocouple assembly with 316 SS thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread or 150 RF flanged. Material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly ungrounded. Thermowell material shall be solid tungsten carbide for mill outlet temperature measurement. For Air & Flue Gas measurements, thermowells shall be made of Inconel. For metal temperature measurement, thermocouple pads weldable to M.S pipes shall be provided with 15 m thermocouple extension wires. Element size shall be 18 AWG. Insulation resistance at 540°C shall not be less than 5 M ohms. For Turbine applications process connection shall be welded as per DIN 43763. Temperature devices provided with thermowell shall be calibrated with the associated thermowell as an assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements. Thermocouple termination head shall be 300 mm above the pipe insulation to avoid cable damage in hot zones. <u>Thermo wells</u> shall be provided along with Temperature elements of RTD & Thermocouples except for metal/bearing/winding temperature measurements. 1. For measurement of flue gas temperature, Inconel coated with tungsten carbide or suitable abrasion resistant thermo wells shall be provided. 2. For measurement of pulveriser outlet temperature tungsten carbide block thermo wells abrasion resistant not tungsten carbide coated thermowell shall be used. Also the terminals of Thermocouple shall not be at the top of Mills itself. The thermocouple wires are to be laid up to JB through SS tubing of required diameter and the head shall be placed nearer to the JB. Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of Mill. 3. For measurement of water & steam temperature SS thermo wells or better, shall be used	

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	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	SECTION: D3.4 VOLUME-IV SHEET 15 OF 73
10.00.00	RESISTANCE TEMPERATURE DETECTORS (RTD) WITH THERMOWELL: Duplex type with accuracy of $\pm 0.5\%$ of span, response time 1-2 seconds; Spring loaded mineral insulated three (3) wire RTD assembly with 316 SS Thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread or 150 RF flanged. IP 65 or equivalent degree of protection for enclosure. Material of accessories will be SS. Thermowell with hex head with screwed cover & SS chain, barstock assembly. Element lead size will be 18 AWG. The insulation resistance at 540° shall not be less than 5M ohms. Repeatability over full range shall be better than 0.02%. RTDs shall be ungrounded. RTD shall be supplied as an assembly complete with thermowell meeting ANSI 19.3-1994 (latest) requirements. 11.00.00 Test Thermowells: Pipe/equipment mounted temperature test wells of 316 SS with a process connection of M33x2 thread, except for Turbine applications process connection shall be welded as per DIN 43763. Material of accessories will be SS. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements. The thermowells shall be hardfaced/sterilized to avoid erosion for boiler area applications 12.00.00 <u>Pressure Indicators:</u> Direct reading, pipe mounted Pressure gauges of aluminium casing with six (6) inch phenolic dial (white dial with black numerals), 316 SS Bourdon tube, AISI304 /nylon movements and micrometer type adjustable pointer with an accuracy of $\pm 0.5\%$ of span including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate. Material of accessories will be SS. IP65 or equivalent degree of protection for enclosure. Over range protection will be 50% above maximum pressure. 13.00.00 <u>Pressure Switches:</u> Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and accuracy of $\pm 1\%$ of span, including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate. Material of accessories will be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided.	

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14.00.00 **Differential Pressure Indicators:**

Direct reading type, pipe mounted, bellows or diaphragm operated differential pressure indicators; aluminium casing (epoxy coated) with six (6) inch dial (white dial with black numerals), with micrometer type pointer, 316 SS pressure element; an accuracy of $\pm 0.5\%$ of span including accessories like snubbers for pump discharge application, chemical diaphragm with 15 m PVC covered SS armoured capillary for each limb for corrosive and oil services and 5 way manifold. Material of accessories will be SS. IP 65 or equivalent degree of protection. Over range protection will be 50% above maximum pressure.

15.00.00 **Differential Pressure Switches:**

Bellows or diaphragm operated non-indicating field mounted type; aluminium casing (epoxy coated); 316 SS pressure element nylon movement; an accuracy of $\pm 1\%$ of span with an adjustable contact including accessories like snubbers for pump discharge applications, chemical diaphragm with 15 m capillary for each limb for all corrosive and oil services and 5 way manifold. Material of accessories will be SS. Auto reset micro switch with adjustable set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection over range protection 50% above maximum pressure. Repeatability shall be $\pm 0.5\%$ FSR.

16.00.00 **Thermometers:**

Indicating type, field mounted, filled system with 5 metre capillary and six (6) inch dial housed in aluminium casing (epoxy coated) with an accuracy of $\pm 1\%$ of span, response time of 2-4 seconds, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Thermowell with Hex head of fabricated assembly for air and flue gas system for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements.

17.00.00 **Temperature Switch:**

Non Indicating type, field mounted, filled system with 5 metre capillary housed in Aluminium casing (epoxy coated) with an accuracy of $\pm 1\%$ span, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33x2 thread. Micro switch with reset type with adjustable set values with 2 SPDT contacts rated for 0.2 A, 220 DC. IP 65 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. Material of accessories will be SS. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements.

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18.00.00 <u>Level gauges:</u> Tubular type level gauges for low pressure upto 7 kg/cm² & reflex type for high pressure water & steam services & vacuum services with automatic ball check valves, illuminator (240 AC), pyrex / borosilicate glass, mica shield, brass guard rods & brass holders. Material of accessories (name plate, etc.) will be SS. Tubular glass OD will be 5/8". Vent & drain valves shall be provided. Connection shall be screwed or flanged (ANSI class 150 RF). Enclosure shall be IP 65. 19.00.00 <u>Level Switches:</u> External float operated level switches for tanks and vessels and top mounted level switches and underground tanks. The top mounted level switches shall be supplied with steel tubes to suit Purchaser's requirement. Micro switch with 2 SPDT contacts rated for 0.2 A, 220 V DC. Material of float & float chord will be 316 SS & cage material shall be fabricated steel and the material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Accessories like name plate, drain valve for external case type level switches, mating flange, gaskets (asbestos), fasteners, bolts & nuts, etc. shall be supplied. 20.00.00 <u>Flow Glasses:</u> Online flow glasses for pipe size up to 4" with a rotary wheel (not a flapper type) suitable for installation on vertical or horizontal pipe lines, material pyrex tempered glass. Body material will be carbon steel, rotor & wetted parts will be bronze. The material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Upto 50 NB size, connection shall be screwed above 50 mm NB size it shall be flanged - ANSI, 150 RF. Accessories like name plate, mating flanges with gaskets (neoprene), bolts & nuts, etc. shall be supplied. Enclosure shall be IP65. 21.00.00 <u>Flow Elements:</u> SS 316 flow nozzles for all steam and feed water services with D and D/2 pressure tapplings; 316SS flow orifice plate assembly for all water services with flange tap connections; B ratio of 0.5 & 0.7. Element material of SS 316. The material of accessories will be SS. All the flow elements shall have 3 pairs of differential pressure tapplings complete with root valves. Orifice plate shall not be less than 3 mm thick for nominal pipe diameter upto 300 mm & not less than 6 mm thick for pipe diameter > 300 mm. The flow elements shall be supplied as assemblies with High/low pressure tapplings, root valves as required. Performance Guarantee flow elements shall be provided		

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	separately. Butt welded edges shall be prepared as per ANSI 16.25 & flanged connections shall be as per ANSI 16.5 standards. Orifice assembly complete with nipples & valves to be supplied by Bidder shall be one metre long with ANSI class 150 RF SS flanges at the ends including gaskets, bolts & nuts. Isolating valves shall have SW end connection. Accessories like name plate, gaskets, bolts & nuts, reservoirs (condensing chambers), 6 nos. shut off valves per assembly, nipple, welding adapters, etc. shall be supplied. Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for OWNER's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for OWNER's approval. Bidder shall provide three Tappings per flow elements. 22.00.00 <u>Flow Switches:</u> Indicating, Differential pressure, flapper type on line flow switches for line sizes up to 80 mm with an accuracy of $\pm 2\%$ of span and dial size of min. 50 mm having 316 SS flapper housed in die cast aluminium. Micro switch with adjustable range with 2 SPDT contacts rated for 0.2 A, 220 V DC. IP 65 or equivalent degree of protection for enclosure. The material of accessories will be SS. 23.00.00 <u>Flow integrators(Electronic Type):</u> Flush mounted receiver type electronic digital flow integrators with accuracy 0.2%; linearity within 0.2%; six (6) digits, 24 V DC power supply. IP65 or equivalent degree of protection for enclosure; Accessories like square root extractor shall be provided. 24.00.00 <u>Air Filter Regulator (AFR):</u> Constant bleed type AFR with an accuracy of $\pm 0.1\%$, inlet pressure range of 5-8 kg/cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves, transmitter purging lines etc; Filtering particles above five microns having phosphor bronze filter element. Material of accessories will be SS. Built in blow down valve shall be provided. AFR shall have automatic drain feature. All accessories shall be supplied. Degree of protection shall be IP65 25.00.00 <u>Electro-Pneumatic Converters (E/P):</u> Two wire type E/P converters with an accuracy of $\pm 0.25\%$ accepting 4-20 mA DC signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminium casing (with polyurethane paint); IP65 degree of protection for enclosure. Material of accessories will be SS. Direct/reversing acting, 4 SCFM and above capacity	

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26.00.00	<u>Position Transmitters:</u> 24 V DC operated Non contact type electronics/LVDT type, 4-20 mA, 2 wire system with an accuracy of +/-1%; range adjustment and zero adjustment to be provided; IP65 or equivalent degree of protection for casing. The output shall be linear. All accessories shall be SS.	
27.00.00	<u>Solenoid Valves:</u> Direct operated single/dual coil solenoid valves with shut off class (leakage) IV or better, body material of bronze, plunger material of 316 SS rated for continuous duty. IP 65 or equivalent protection class for enclosure. Insulation class of 'F' for the solenoid. Body ratings shall suit the pressure and temperature conditions. The operating voltage shall be for 24VDC/ 220VDC/230VAC/110VAC depending on the service.	
28.00.00	<u>MAGNETIC FLOWMETER :</u> Inline type with indicating top mounted transmitter with flange connection. Accuracy: 0.5% of flow rate or volume flow. Repeatability 0.1% of flow rate/volume flow. Transmitter shall be smart with LCD display and superimposed HART on 4-20mA DC output. Data storage shall be in EEPROM. Shall have diagnostic capabilities. Touch control facility on the indicator for checking the rate/volume and diagnostic messages. Material: Case-Al.alloy with corrosion resistant, flow tube and extension pipe-Stainless steel (SS 304) and Lining-fluro carbon. The flow rate shall be available in DCS/PLC and flow integration shall be implemented in DCS/PLC to indicate volume flow.	
29.00.00	<u>Local Instrument Enclosure & Racks/CICB.s:</u> Transmitters mounted in the field shall be suitably grouped together and mounted in Local Instrument Racks (LIR). These local instrument racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument-rack shall be as finalised during detailed engineering stage subject to Employer's approval. The internal layout shall be such that the impulse piping/ blowdown lines are accessible from backside of the rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads especially designed to provide isolation from process line vibration shall be installed	

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on instrument racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each rack. The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalised during detailed engineering stage. The junction box for racks also shall conform to IP 65 protection class. Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided. Each transmitter rack housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubings and individual purge meters for each purge line etc. as required. A 15 mm NB service air header shall be furnished in each rack housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and valve quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates. The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the racks. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within, the racks and shall be subject to Employer's approval. All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blowdown into a drain. The material of the blow down header shall be carbon steel as per ASTM A 106 Gr C.		

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS03/EDC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	SECTION: D3.4 VOLUME-IV SHEET 51 OF 73
30.00.00 <u>Junction Boxes:</u> Wall/column mounted junction boxes having 12/24/36/48 terminals and cable entry only at the bottom and sealed with fire proof compound; Cage clamp terminals suitable for cable terminations up to 2.5 sqmm.; IP 65 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signal signals. Separate JB's for different voltage levels shall be supplied. Removable gland plate shall be supplied. JB shall have single lockable door with gasket, able to open side ways, with common keys. Painting inside will be glossy white & outside - IS-5 shade 631. Shield bus for screw connection shall be provided. Terminal size shall be suitable for 0.5 mm² to 2.5 mm² wire. Terminal blocks shall be vertical. JB shall have provision to add 20% additional terminals. Accessories like metal tag (SS), clamps, fixtures, bolts (SS), nuts (SS), gaskets (neoprene), lock & key, fire proof compound for sealing, etc. shall be supplied. The grouping of instruments in JB's is subject to Purchaser's approval. All the field Junction boxes shall have double doors. All JB's shall be provided with individual canopies to avoid ingress of water. The case, cover/door constructed from cold rolled sheet steel of 3 mm thick and shall have gland plate of 3 mm CRCA at the bottom. 31.00.00 <u>Inter Posing Relays (IPR):</u> Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.2A 220 V DC. Free wheeling diode across relay coil(copper) and self reset type status indicator flag (electronic) shall be provided. Neon/LED indicating lamps shall be provided to indicate energise condition of relay. All commands to the Drives viz., Unidirectional drives, Bi-Directional drives, Solenoids and critical output contacts between systems for interlock and protection shall be through IPR. All relays shall be mounted on relay base (silver plated) internally wired to the external cabling termination block in cabinet. Wiring connection shall be screwed & termination shall be suitable for 0.5 mm² to 2.5 mm² size wiring. Facility to simulate relay operation manually shall be provided. Relays of different contact interrogation voltages shall be separated by a barrier in IPR cabinet. Accessories like name plate (SS) with tag & service inscription, relay base mounting rail/channel, nuts & bolts, etc. shall be supplied. Three nos. change over contacts shall be wired to external TB with screwed terminations only. Status lamps shall be provided.		

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SPECIFIC TECHNICAL REQUIREMENT

	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D3
	TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	VOLUME-IV SHEET 52 OF 73

32.00.00 **System Cabinets:**

These cabinets shall house signal conditioning cards, input/output cards, processor cards & associated power supply units. Indoor located, free standing vertical type system cabinets with 2 mm thick sheet metal of cold rolled steel; double doors with neoprene gaskets; keylocks; antivibration pads of 15 mm thick; Fluorescent lighting; fan in each cabinet with louvers, brass wire mesh, door switches, removable gland plate of 3 mm thick, cable glands, cubicle earthing, lifting bolt.; fire proof compound (50 mm thickness) for sealing cable entry; fire detector for each section; space heater for each section (strip type). Lamp shall be provided in each cabinet to indicate the cabinet having fault condition. The racks in system cabinets shall have provision along with plug in sockets/back plane to house at-least 20% additional cards, to accommodate for engineering flexibility or future expansion. The protection class shall be IP-32. The paint shade and thickness etc shall be as decided during engineering. Doors shall have concealed type of hinges and swing of 100 degrees. The doors shall be provided both at the front and rear. Power supply distribution shall be provided on per cabinet basis with all associated MCBs, protections, etc. The system cabinets, racks in system cabinets, slots in the racks & the terminals shall have identification numbers. A stainless steel metal tag (plate) shall be fixed to the inside of the door & the layout of the racks, slots & details of the card type/service shall be inscribed on this metal tag. Each cabinet shall be provided with one each 3pin receptacles for 240 V, 1P 50 C/S. Smoke detector shall be mounted in each system panel and shall be connected to the plant Fire detection and Alarm system.

33.00.00 **Local Panels:**

Indoor/Outdoor located, free standing vertical type local panels with 3 mm thick sheet material of cold rolled steel; antivibration pads of 15 mm thick; fluorescent lighting; Double doors with neoprene gaskets at every 1.5 m; blower & louvers in each section with brass mesh; fire proof compound (50 mm thick) for sealing cable entry (bottom); fire detector for each section; space heater with thermostatic control for each section (strip type). IP 65 degree of protection for enclosure. Removable cover plates with locking facility shall be provided along the bottom of the front desk continuously to facilitate maintenance work. The length of each cover plate shall not exceed 1 m. CFL of 40 W shall be provided from one end of the panel to the other end at continuous length and shall be operated by the door switches as well as by manual switches. Name plates shall be provided for all instruments/inserts with Tag. No. & short description of service engraved. These shall be phenolic overlays (1.6mm thick), black background with white lettering & shall be fixed to the panel by stainless steel screws (counter sunk). Each section of the panels shall be provided with one each 3 pin receptacles for 240V, 1P 50 c/s & 110 V, 1P, 50 c/s. Panel shall be delivered totally wired. All instruments, inserts and annunciation windows shall be mounted & wiring connections at these hardwares shall be terminated at site by

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS03/ETC 	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	SECTION: D3.4 VOLUME-IV SHEET 33 OF 73
	vendor. Quantity shall be as required. 34.00.00 <u>Vibration Monitoring System (VMS) and Analysis System.:</u> 34.01.01 Vibration pickups and transducers shall be provided on Y-axis for all 3.3/11KV equipments with isolated 4-20 MA DC outputs and 2 Nos. SPDT alarm contacts for high and very high condition & fault for each pickup. The system shall be complete with transducers, monitors, redundant power supply, isolators mounted inside the cabinet. The sensors, mounting pads, brackets, special cables etc. shall be included. 34.01.02 The Vibration Monitoring System shall be furnished on a system basis including vibration transducers with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier/ electronics mounted in local weatherproof boxes(IP-65) vibration monitors & mounting racks/cabinets. The Vibration-monitoring system shall include all power supplies, inter-connecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories required for monitoring of Vibration at each point. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement. 34.01.03 Transducers shall be furnished in weatherproof housing suitable for field conditions. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field programmable)for each measurement point in both horizontal & vertical planes. The vibration monitor racks with power supplies shall be mounted in unit control panel. However, for CWP/ACWP the rack cabinet shall be located in CW pump house. 34.01.04 The functional requirement for vibration monitoring system shall include but not be limited to the following: - Vibration monitor front face status indications shall be available for indications of healthy conditions of pick-up circuit, monitor circuit and power supply. Also set point indication with set point adjustment facility for setting alarm & trip levels shall be provided. - The facility shall be available from front of mounting rack for functional checking of monitors with inhibition of alarm of alarm and trip contact outputs during test. - All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & inter-connection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes and standards. 34.01.05 For turbine and generators vibration pickups and transducers shall be provided on both X & Y axis as part of turbo supervisory system. The monitoring system	

SPECIFIC TECHNICAL REQUIREMENT

	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	SECTION: D3.4 VOLUME-IV SHEET 2 OF 73
32.00.00	System Cabinets: These cabinets shall house signal conditioning cards, input/output cards, processor cards & associated power supply units. Indoor located, free standing vertical type system cabinets with 2 mm thick sheet metal of cold rolled steel; double doors with neoprene gaskets; keylocks; antivibration pads of 15 mm thick; Fluorescent lighting; fan in each cabinet with louvers, brass wire mesh, door switches, removable gland plate of 3 mm thick, cable glands, cubicle earthing, lifting bolt; fire proof compound (50 mm thickness) for sealing cable entry; fire detector for each section; space heater for each section (strip type). Lamp shall be provided in each cabinet to indicate the cabinet having fault condition. The racks in system cabinets shall have provision along with plug in sockets/back plane to house at-least 20% additional cards, to accommodate for engineering flexibility or future expansion. The protection class shall be IP-32. The paint shade and thickness etc shall be as decided during engineering. Doors shall have concealed type of hinges and swing of 100 degrees. The doors shall be provided both at the front and rear. Power supply distribution shall be provided on per cabinet basis with all associated MCBs, protections, etc. The system cabinets, racks in system cabinets, slots in the racks & the terminals shall have identification numbers. A stainless steel metal tag (plate) shall be fixed to the inside of the door & the layout of the racks, slots & details of the card type/service shall be inscribed on this metal tag. Each cabinet shall be provided with one each 3pin receptacles for 240 V, IP 50 C/S. Smoke detector shall be mounted in each system panel and shall be connected to the plant Fire detection and Alarm system.	
33.00.00	Local Panels: Indoor/Outdoor located, free standing vertical type local panels with 3 mm thick sheet material of cold rolled steel; antivibration pads of 15 mm thick; fluorescent lighting; Double doors with neoprene gaskets at every 1.5 m; blower & louvers in each section with brass mesh; fire proof compound (50 mm thick) for sealing cable entry (bottom); fire detector for each section; space heater with thermostatic control for each section (strip type). IP 65 degree of protection for enclosure. Removable cover plates with locking facility shall be provided along the bottom of the front desk continuously to facilitate maintenance work. The length of each cover plate shall not exceed 1 m. CFL of 40 W shall be provided from one end of the panel to the other end at continuous length and shall be operated by the door switches as well as by manual switches. Name plates shall be provided for all instruments/inserts with Tag. No. & short description of service engraved. These shall be phenolic overlays (1.6mm thick), black background with white lettering & shall be fixed to the panel by stainless steel screws (counter sunk). Each section of the panels shall be provided with one each 3 pin receptacles for 240V, IP 50 c/s & 110 V, IP, 50 c/s. Panel shall be delivered totally wired. All instruments, inserts and annunciation windows shall be mounted & wiring connections at these hardware shall be terminated at site by	

	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	SECTION: D3.4 VOLUME-IV SHEET 2 OF 73
	vendor. Quantity shall be as required. 34.00.00 Vibration Monitoring System (VMS) and Analysis System: 34.01.01 Vibration pickups and transducers shall be provided on Y-axis for all 3.3/11KV equipments with isolated 4-20 MA DC outputs and 2 Nos. SPDT alarm contacts for high and very high condition & fault for each pickup. The system shall be complete with transducers, monitors, redundant power supply, isolators mounted inside the cabinet. The sensors, mounting pads, brackets, special cables etc. shall be included. 34.01.02 The Vibration Monitoring System shall be furnished on a system basis including vibration transducers with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier/ electronics mounted in local weatherproof boxes (IP-65) vibration monitors & mounting racks/cabinets. The Vibration-monitoring system shall include all power supplies, inter-connecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories required for monitoring of Vibration at each point. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement. 34.01.03 Transducers shall be furnished in weatherproof housing suitable for field conditions. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field programmable) for each measurement point in both horizontal & vertical planes. The vibration monitor racks with power supplies shall be mounted in unit control panel. However, for CWP/ACWP the rack cabinet shall be located in CW pump house. 34.01.04 The functional requirement for vibration monitoring system shall include but not be limited to the following: - Vibration monitor front face status indications shall be available for indications of healthy conditions of pick-up circuit, monitor circuit and power supply. Also set point indication with set point adjustment facility for setting alarm & trip levels shall be provided. - The facility shall be available from front of mounting rack for functional checking of monitors with inhibition of alarm of alarm and trip contact outputs during test. - All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & inter-connection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes and standards. 34.01.05 For turbine and generators vibration pickups and transducers shall be provided on both X & Y axis as part of turbo supervisory system. The monitoring system	

SPECIFIC TECHNICAL REQUIREMENT

KPCL/BTPS03/EEC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D3.4 VOLUME-IV SHEET 66 OF 73
	TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED	
	displayed in the form of bar charts and alarms shall be generated on occurrence of tube leakage. One speaker, power supply failure alarm and steam leak alarm shall be provided.	
	The system shall be capable of operating in presence of soot blowers in operation and insensitive to the presence of nearby echo-inducing surfaces. Separately isolated 4-20mA DC analogue signals shall be provided for monitoring acoustic level for tube leaks. Bidder shall provide necessary acoustic signal generator, signal receiver, transducer with microphone, amplifier, required cables/junction box, remote control panel, 24" TFT monitor, alarm contacts to DDCMIS and all other accessories. air purging system, signal processor & controller, dust, water & weather proof control cabinet, connecting cables and interface to SBC system.	
48.00.00	Master Clock System:	
	The existing master clock system of unit-1 shall be used for providing synchronising signal to DDCMIS. Provision of additional 20 ports and 20 nos slave display units shall be provided. The required hard ware and software including cables for connectivity from unit-1 and slave display units shall be considered.	
49.00.00	Control Valves:	
49.00.01	Multistage, anticavitation, Balanced, modulating, globe type, cage guided, single ported, diaphragm type of actuator with hand wheel, Pneumatic positioners, air filter regulator, air lock device, solenoid valve, limit switches and position transmitters completely tubed with junction box. E/P converters suitable for accepting 4-20mADC signal. Pneumatic (copper) tubing complete with accessories, fittings, positioners shall be provided with input/output/bypass gauges. Local position indicator & LVDT type position transmitter with 2 wire, 4-20mA DC output. All limit switches/position transmitters, E/P converter signals etc., shall be wired out to external block of actuator and respective junction boxes.	
49.00.02	Control valves shall be sized to have an opening of 15% at minimum flow condition and 85% at maximum flow condition. Noise level shall not exceed 85 dB at a distance of about 1.5 M from the valve. In case of predicted noise level above 85dBA, suitable low noise trim shall be provided.	
49.00.03	Leakage class for double seated valve shall not exceed 0.05%, and single seated valve shall not exceed 0.01%. Either extended type bonnet or cooling fin type bonnet shall be provided for service above 200°C and for other service the bonnet type shall be standard.	
49.00.04	The end connections shall be socket welded for sizes below 50 NB and butt	

KPCL/BTPS03/EEC	KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW	SECTION: D3.4 VOLUME-IV SHEET 67 OF 73
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	welded for sizes 50 NB and above. Flanged connection shall be provided for DM water services, with suitable rubber lined interfaces. Water seal shall be provided for valves that could be subjected to below atmospheric conditions.	
49.00.05	Generally stem and guide material(trim) shall be SS 316 sterlited, and plug and seat material will be 17-4 PH SS, except for specific applications like DM water, HP bypass services. Refer to Table-5 for selection of control valve body material and actuator type. The noise abatement shall be obtained by valve body and trim design and not by use of silencer. The trims supplied shall be suitable for quick changing. Actuator housing shall be of pressed steel construction.	
49.00.06	In Vibration prone areas, positioners shall be located away from the control valve/damper and location shall be approved by OWNER/ENGINEER. Position transmitter shall be non-contact type.	
49.00.07	The control valve design shall be suitable for the required fail-safe conditions, of process / equipment. The valves shall be supplied and commissioned as per the fail-safe philosophy required for the process. Wherever the required turndown is not possible with a standard single valve, specially designed trims shall be customised and used. Pressure regulators upstream of control valves would not be envisaged.	
49.00.08	All final Control elements (Control valves & control dampers) shall be with pneumatic or electric actuators. All actuators would be sized so that the final control elements operate properly even when the upstream pressure exceeds 110% of maximum value. Pneumatic actuators would be provided with air failure lock and remote release, limit switches, adjustable minimum and maximum stops, load position indicators, positioners, non-contact type electronic position transmitters and solenoid valves in accordance with the system requirements.	
49.00.09	SMART positioners shall be provided for all pneumatic operated control valves/dampers. For the services in heat prone area Integral type positioners shall be offered. The type of actuator shall be pneumatic type except Governing valves, HP/LP bypass services for which hydraulic actuator shall be used.	
50.00.00 50.00.01	Programmable Logic Controllers (PLC): For systems mentioned in Table-1: 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.	

SPECIFIC TECHNICAL REQUIREMENT

KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D3 VOLUME: IV SHEET 68 OF 73
TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED		
50.00.02	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.	
50.00.03	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.	
50.00.04	Independent redundant UPS with 1 hour Battery back up shall be provided for each of local PLC systems. PLC system with MMI, laser printer shall be included. For PLC system with out MMI OWS, a hand held programmer shall be provided.	
50.00.05	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).	
50.00.06	Bidder shall provide at least 20% wired spare capacity of input/output modules over and above the system requirement. Bidder shall provide built in diagnostic for easy fault detection.	
50.00.07	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 (AHS & CHS) PLC panels/I-O racks shall be provided with air condition with suitable protection class. Ash handling and Coal handling control room will be air conditioned. Bidder 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 or as required basis.	
50.00.08	For coal handling and Ash handling control systems, where a Large Video Screen display system is to be provided, shall be suitably integrated with PLC control system. Bidder shall provide electronic grounding for PLC which shall be separate from Electrical grounding as per IS or IEEE Standard.	

KARNATAKA POWER CORPORATION LIMITED BELLARY TPS, UNIT-3 OF 700 MW		SECTION: D3.4 VOLUME: IV SHEET 69 OF 73
TITLE SPECIFICATIONS FOR DDCMIS/INSTRUMENTS TO BE SUPPLIED		
50.00.09	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.	
50.00.10	Essential Spares: Bidder shall include 10% or 1 No (whichever is higher) each type of module, which shall include controller card, Communication card, Input, Out put card, Power Supply card/Unit, Relays, push buttons, lamps..etc	
51.00.00	Instrumentation Cable Specifications:	
51.00.01	All the instrumentation cables i.e. twisted and shielded multipair cables, compensating cables, pre fabricated cables etc. shall be flame retardant low smoke (FRLS) type. All the cables shall be armoured.	
51.00.02	The cables shall be provided in non returnable drums. The drum length shall be 1000 m (+/- 5%) and 500 m (+/- 5%) except for the last drum or if the ordered quantity itself is less than 500 mtrs. The cables covered under this specification shall be suitable for crimping, screw termination or cage clamp type screw less terminals blocks.	
51.00.03	All instrumentation cables covered in this specification shall comply with Latest Edition of following standards along with the amendments shall be referred for manufacturing these cables: VDE 0815, VDE 0207 Part-4, Part-5, DVE 0816, VDE 0472, ANSI-MC 96.1, IS 5831, IS 10810, IS-8784, IS-3975, ASTM-D-2863 & 2843, IEC-754-1, IEEE-383, SEN 4241475. Voltage grade of the instrumentation cables shall be 600 V (peak value).	
51.00.04	The conductor shall be of minimum 7/0.3, 0.5 Sq.mm size, high conductivity, multi-stranded copper for all types of instrumentation cables, except the thermocouple extension cables which shall be 1.31 mm Sq. solid alloy type.	
51.00.05	The insulation of individual conductor shall be extruded PVC. Y 13 meeting the requirements of VDE 0207 part 4. The inner and outer sheath of cables shall be extruded PVC type YM-1 as per VDE 0207 part 5 and shall be flame retardant low smoke type (FRLS). The thickness of inner sheath (inner sheath only for armoured cables) shall be 0.3 mm minimum and the outer sheath shall be as per the guidelines given in VDE 0816, however the thickness of outer sheath shall not be less than 1.8mm in any case. Insulation thickness over conductor shall be 0.4 mm nominal. Allowable tolerance of overall diameter of the cable shall be $\pm 2\text{mm}$ max. over the declared value in technical data sheet. The variation in diameter and the ovality at any cross section shall not be more than 0.1 mm.	



TITLE:
TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT
1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION –C3

REV. NO. 00

DATE: 29/05/13

QUALITY PLAN FOR C&I ITEMS

 PEM :: C&I		STANDARD QUALITY PLAN FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES						QUALITY PLAN NO.: PE-QP-999-145-I026				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 16.05.2007				
								SHEET 1 OF 2				
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	Material / Components											
1.1	Casing, Bourdon tube and Movement	1. Chemical composition	MA	Chemical Test	One Sample from each lot	Approved drg. / data sheet / BHEL Spec.	Relevant raw material std.	Test Certificate	3/2	---	2,1#	# Compliance certificate to be verified.
		2. Workmanship, finish and dimensions	MA	Visual, Measurement	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report / Log Book	3/2	---	2,1#	
1.2	Switch⊕	Contact type & number	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate/ Inspection Report	3	---	2,1#	⊕Applicable for gauge with switch device
2.0	Assembly	1. Marking – Tag No., Model, Range	MA	Visual	100%	- do -	- do -	Inspection Report	2	1	---	**10% of total quantity with minimum of 2 piece / type & size
		2. Workmanship	MA	Visual	100%	- do -	- do -	- do -	2	1	---	
		3. Dial size, scale graduation	MA	Visual	100%	- do -	- do -	- do -	2	1	---	
		4. End connections	MA	Measurement	100%	- do -	- do -	- do -	2	1**	1	
		⊕5. Switch – contact type & nos.	MA	Visual	100%	- do -	- do -	Inspection Report	2	1	---	
3.0	Routine Test	1. Calibration, accuracy, Hysteresis, overload, set point adjustment⊕ / repeatability	CR	Measurement	100%	- do -	- do -	- do -	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

 PEM :: C&I		STANDARD QUALITY PLAN FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES							QUALITY PLAN NO.: PE-QP-999-145-I026			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01		DATE: 16.05.2007	
									SHEET 2		OF 2	
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. Hydraulic Test	CR	Measurement	100%	Approved drg. / data sheet / BHEL Spec.	No Leakage	Inspection Report	2	1**	1	
		⊕3. IR, HV	CR	Measurement	100%	Relevant standard	Relevant standard	- do -	2	1**	1	
4.0	Type Test	1. Enclosure Protection Class	CR	Verification	Each type	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	2	---	1•	•Type Test Certificate to be verified
		2. Blow out disc	CR	Verification	Each type	- do -	- do -	- do -	2	---	2•	
		⊕3. Switch contact rating	CR	Verification	Each type	- do -	- do -	- do -	2	---	2•	
5.0	Painting	Shade & Finish	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec. / Manufacturer's std.	Approved drg. / data sheet / BHEL Spec. / Manufacturer's std.	Inspection Report	2	---	2	
6.0	Packing	Soundness	MA	Visual	100%	- do -	- do -	- do -	2	---	---	

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

 PEM :: C&I		STANDARD QUALITY PLAN FOR TEMPERATURE GAUGE AND THERMOWELL							QUALITY PLAN NO.: PE-QP-999-145-I027					
									VOLUME		IIB			
									SECTION		D			
									REV. NO.		01		DATE: 16-05-2007	
		SHEET		1		OF		4						
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks		
									P	W	V			
1.0	Raw Material / Component													
1.1	Capillary Bulb and Thermowell	1. Chemical composition	CR	Chemical analysis	one sample/ lot	BHEL spec. / approved data sheet	Relevant raw material std.	Test report	3/2	---	2,1	Relevant compliance certificate to be verified by BHEL		
		2. Marking,	MA	Visual	100%	BHEL spec. / Mfr. Standard	BHEL spec. / Mfr. Standard	Log Book	2	---	---			
		3. Dimensions	MA	Measurement	100%	BHEL spec. / approved doc	BHEL spec. / approved doc	Log Book	2	---	---			
1.2	Casing and Bezel	1. Material	MA	Chemical analysis	Sample	BHEL spec.	BHEL spec.	Test report	3/2	---	2,1	Relevant compliance certificate to be verified by BHEL		
		2. Defects	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Log Book	2	---	---			
		3. Dimension	MA	Measurement	Sample	BHEL spec. / approved doc.	BHEL spec. / approved doc.	Log Book	2	---	---			
		4. Threading	MA	Thread matching	100%	-----do-----	-----do-----	Log Book	2	---	---			
1.3	Dial	1. Size, range, scale length, least-count, spacing and graduation.	MA	Measurement and Visual	Sample	BHEL spec.	BHEL spec.	Log Book	2	---	---			
		2. Colour	MA	Visual	100%	BHEL spec.	BHEL spec.	Log Book	2	---	---			
		3. Resistance to dry heat and hot water	MA	Oven & Bath	Sample	Mfr. Standard	Mfr. Standard	Test report	3/2	---	---			

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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	
1.4	Complete sensing element	1. Correct assembly and workmanship.	MA	Visual	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	---	---	
		2. Dimensions	MA	Measurement	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	---	---	
		3. Welding & other defects	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Log Book	2	---	---	
1.5	Thermowell ⊕	1. Dimensions of wall thickness, concentricity of bore OD & Length.	MA	Measurement	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Log Book	2	1	1	BHEL to witness 10 % random samples.
		2. Leak Test	CR	Hyd. test at 1.5 times of design pressure.	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Inspection report	3/2	2,1	1	⊕ IBR cert. wherever specified to be verified.
		3. Threading	MA	Thread matching	100%	BHEL spec. / approved data sheet / Drg	BHEL spec. / approved data sheet / Drg	Inspection report	2	2,1	1	BHEL to witness 10% samples.
2.0	Final Inspection											
2.1	Assembly	1. Correct assembly, workmanship and finish	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Inspection report	2	1	---	

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									P	W	V	
		2. Mounting and connection	MA	Visual ad measurement	100%	-----do-----	-----do-----	Inspection report	2	1	---	
		3. Dial Scale	MA	Visual	100%	-----do-----	-----do-----	Log Book	2	1	---	
		1. Cleanliness	MA	Visual	100%	-----do-----	Free from scratches, dirt etc.	Log Book	2	---	2	
		5. Marking (S.No., Tag No.)	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Log Book	2	1	---	
2.2	Routine Test	1. Accuracy	MA	Measurement	100%	BHEL spec. / Approved data Sheet.	BHEL spec. / Approved data Sheet.	Test Report	2	1	1	BHEL to witness 10% random Samples.
		2. Overload	CR	Measurement	10%	125% of FSD for range upto 400 Deg. C. 110% of FSD for range between 400 to 500 Deg. C. 100% of FSD for range above 500 Deg. C.	No Damage	Test Report	2	1	---	

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		3. Response Time	MA	Measurement	10%	ASME PTC19.3	ASME PTC19.3	Test Report	2	1	1	BHEL to witness 10% random samples.
2.3	Type Test	1. Ambient temperature compensation 0-60 Deg. C	MA	Measurement	Sample	Bulb at constant temp. & case temp varied 0-60 Deg. C	No variation in measurement	Test Certificate	2	---	1	Existing test certificate (Not more than 5 year old) shall be furnished.
		2. Weather proofness	CR	Measurement	Sample	BHEL spec. / Approved data sheet.	BHEL spec. / Approved data sheet.	Test Certificate	3/2	---	1	---do---
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	Refer Note-1

Note: 1. In the absence of BHEL specification for painting, vendor to obtain BHEL's approval on their painting specification / procedure.

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									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		

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									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		

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									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	

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									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/Desktop 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	

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THIS IS A PART OF TECHNICAL SPECIFICATION FOR COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

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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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

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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.

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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.

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									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics												
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		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
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									P	W	V		
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---		
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s 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 COOLING WATER OZONE GENERATION PLANT
(TECHNICAL SPECIFICATION NUMBER: PE-TS-367-174-14000-A001 REV 00)

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME IIB			
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									REV. NO. 01 DATE: 22-02-2008			
									SHEET 5 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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										SHEET 7 OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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TITLE:
**TECHNICAL SPECIFICATION FOR
COOLING WATER OZONE GENERATION PLANT**

1X700 MW BELLARY 3 STPP

BHEL DOCUMENTS NO.: PE-TS-367-174-14000-A001

VOLUME **II-B**

SECTION -D

REV. NO. 00

DATE: 29/05/13

GENERAL TECHNICAL REQUIREMENT

D1: GENERAL TECHNICAL REQUIREMENTS FOR MECHANICAL

D2: GENERAL TECHNICAL REQUIREMENTS FOR ELECTRICAL

D3: GENERAL TECHNICAL REQUIREMENTS FOR C&I



TITLE:
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GENERAL TECHNICAL REQUIREMENT-MECHANICAL



TITLE:
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SECTION –D1

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1. DESIGN PHILOSOPHY:

Ozone treatment is to be done for Cooling Water to prevent growth of biological substances. Ozonisation plant shall comprise of the Ozone generating plant as a whole 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 ozone generation plant shall consist of following sub systems:

- OXYGEN GENERATION PLANT
- OZONE GENERATION PLANT
- COOLING WATER PLANT
- OZONE DOSING SYSTEM
- 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**: Three numbers (3X50%) screw type air cooled compressors of suitable capacity along with electrical motor, instruments, 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 3.0 M3.
 - **Dryer Unit**: Two numbers (2X100%) Dryer unit per stream (total four nos) 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 four nos) 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 2.5 M3.
- **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 Generation plant shall consist of following equipments:
 - **Ozone electrode**: Ozone generating module shall be a modular vertical tubular form of MOC SS316 Ti/equivalent based on supplier recommendations.
 - **Dielectric glass tube**:
 - A. **Material** : Borosilicate glass/ equivalent based on supplier recommendations
 - B. **Type**: Cylindrical.
 - C. **Construction**: Closed at one end.
- **COOLING WATER PLANT**: Cooling water plant is provided for removal of excess heat generated during ozone generation from ozone producing cells. Suitable capacity air cooled Chiller 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. Portable water is used for removal of excess heat from the ozone producing cells.



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- **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.
- **MEASURING & MONITORING DEVICES:**
 - a. Outlet ozone gas of each ozone-generating module shall be measured by a common ozone analyser.
 - b. Residual ozone measuring device / ORP meter shall be placed at the location after condenser.
 - c. 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.

2.0 CAPACITY SELECTION:

Total CW Flow	=	82109 m ³ /hr
Ozone dosing rate	=	0.2 ppm
Ozone requirement	=	16.42 Kg/Hr.
Ozone Dosage rate selected	=	18 Kg/hr.

3.0 PLANT OPERATION AND CONTROL

The operation of the CW Ozonization Plant shall be from PLC based complete automatic control system. 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. For Automatic operation all the related valves shall be automatic operated through PLC.

All the Control systems and monitoring / interlock instruments shall be minimum dual redundant. UPS supply for PLC shall be provided.

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.

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



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4.0 LAYOUT CONSIDERATIONS

- Ozone generation plant will be located indoor in a separate building as indicated in the drawing number PE-DG-367-100-M003 REV 04, T.G. EQUIPMENT LAYOUT PLAN AT EL 0.0 M . The maximum space available for complete ozone generation plant is 22.5 m X 12m.
- The air receivers will be located outdoors adjacent to the Ozone generation plant building.
- Complete Air Drying Plant and Oxygen generation plant equipment shall be mounted on a skid and located indoor.
- 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 ozonation plants shall be equipped with ventilation at floor level actuated automatically by the gas detectors. Ventilation shall guarantee at least three complete changes of air per hour. All air conditioning and ventilation systems etc are in bidder's scope.

5.0 PG TEST PROCEDURE

The Test Procedure shall cover the performance test and specified guarantee tests 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 receiver, chiller, all pumps, atmospheric tanks, analyzers, air conditioning and ventilation system, all piping and valves, Electrical and Electronic controls including PLC.

5.1 Objective of the Test: The following minimum objectives will be checked during PG test:

- 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.

5.2 Condition of conductance of Test:

- PG Test at site shall be conducted by accredited representatives of bidder and witnessed by BHEL and owner. 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 and record the data jointly with BHEL & the owner's representatives.
- The entire responsibility for conducting the test rests with the bidder.

5.3 Test Instruments:

- All instruments required for PG 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 for BHEL & Owner approval at least 15 days before the start of PG Test.



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- 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 PG Test as per the objectives of the test shall also be arranged by the bidder free of cost.

5.4 PG test procedure:

The PG 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.

Note: The above mentioned PG test requirement 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.

6.0 SPARES:

- 6.1 The Bidder shall include in his scope : (a) Start-up / commissioning spares as necessary and (b) A detailed list of recommended spares shall also be furnished by the Bidder.
- 6.2 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.

6.3 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 Owner. 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 Owner can be carried out without hindrance and delay.

6.4 Recommended Spares

In addition to the spares mentioned above, the Bidder shall also furnish in the Schedule of Recommended Spares a list of recommended spares parts for three (3) years normal operation with unit prices. These recommended spares shall be those considered necessary by the Bidder on a stand alone basis. The Owner reserves the right to buy any of the recommended spare parts as considered necessary by him. The prices of recommended spares shall be consistent with those of the commission spares.



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7.0 MAINTENANCE TOOLS AND TACKLES

- 7.1 The Bidder shall include all necessary special maintenance tools required for maintenance of the plant supplied by him. The tools included by the Bidder shall cover the minimum maintenance tools listed in this specification as well as additional tools considered necessary by the Bidder. A comprehensive list of maintenance tools included in the Bid shall be furnished in the Schedule of Maintenance Tools and Tackles. Bidder shall necessarily supply these tools in addition to other tools and tackles as required.
- 7.2 The Bidder shall note that if any other tools are found to be necessary during the engineering and erection stage of the contract, the same shall be supplied by the Bidder without and price and delivery implication to BHEL.

GENERAL

- o In the event of any equipment being changed during engineering, the Bidder shall supply start up spares, essential spares and maintenance tools pertaining to this equipment.
- o The Bidder shall also note that the Owner, if required, shall approach directly the individual equipment manufacturers / suppliers for procuring recommended spare parts. The Owner shall not necessarily procure these spare parts through the Bidder.



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GENERAL TECHNICAL REQUIREMNET FOR
HORIZONTAL CENTRIFUGAL PUMPS
&
COMPRESSORS



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1.00.0 SCOPE

1.01.0 This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps & compressors.

2.00.0 CODES AND STANDARDS

2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps & Compressors shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

2.02.00 LIST OF APPLICABLE STANDARDS.

1	IS : 6595	Horizontal Centrifugal Pumps for clear cold fresh water.
2	IS : 5120	Technical requirements of roto dynamic special purpose pumps.
3	API : 610	Centrifugal pumps for general refinery service.
4	IS : 5639	Pumps Handling Chemicals & corrosion liquids.
5	IS : 5659	Pumps for process water.
6	HIS	Hydraulic Institute Standards, USA
7	ASTM-1-165-65	Standards Methods for Liquid Penetration Inspection.
8	ISO: 1217	Testing standard of Compressors

2.03.0 In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

3.00.00 DESIGN REQUIREMENTS

3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets. The capacity & head of each pump will be selected with 20% over all margin. For pump head calculation the maximum static head will be considered as 14 meters.

3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.



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3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron
3000 rpm	50.0 micron	65.0 micron

3.05.00 The noise level shall not exceed 80 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

4.00.00 DESIGN CONSTRUCTION OF HORIZONTAL CENTRIFUGAL PUMPS

4.01.00 Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

4.02.00 Pump Casing

4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

4.03.00 Impeller

4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.

4.03.02 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.



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4.04.00 Impeller/Casing Wearing Rings

4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

4.05.00 Shaft

4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

4.06.00 Shaft Sleeves

4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

4.07.00 Bearings

4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished

4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

4.08.00 Stuffing Boxes

4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.

4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

4.09.00 Mechanical Seals

4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially



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moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

4.10.00 Pump Shaft Motor Shaft Coupling

4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

4.11.00 Base Plate

4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

4.12.00 Assembly and Dismantling

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

4.13.00 Drive Motor (Prime Mover)

4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps. All the drive motor of each pump will be Energy Efficient-1 as per IS 12615.

5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

5.01.00 Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

5.02.00 Performance Tests

- (a.) All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent



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- (b.) The test shall be preferably conducted with the actual motor being furnished.
- (c.) Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.
- (d.) The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

5.03.00 Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

5.04.00 Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

5.05.00 NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

5.06.00 Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

- (a.) The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:6051 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

- (b) Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

5.07.00 Material Test Certificate

- (a) Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.
- (b) Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.



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5.08.00 Non Destructive Testing

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.
- (c) No weld repair shall be allowed on cast iron.

5.08.00 Field Testing

- 5.08.01 After installation, the pumps offered shall be operated to prove satisfactory performance as as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Voice and vibration tests shall also be repeated at site.
- 5.08.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

6.00.00 DESIGN CONSTRUCTION OF AIR COOLED SCREW COMPRESSORS

- 6.01.00 Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
- 6.02.00 Air compressors will be multi stage oil free, screw type, air cooled.
- 6.03.00 Testing of compressor will be as per ISO: 1217.
- 6.04.00 Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.
- 6.05.00 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.
- 6.06.00 Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.
- 6.07.00 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 has 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.
- 6.08.00 Compressed air velocity shall be 10 m/sec.

6.09.00 ROTORS

- a) 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.
- b) The rotors will have an asymmetric profile, so as to keep leakage losses to a minimum and ensure high efficiency.
- c) Highly precise timing gears will be mounted on the rotor shafts to maintain the rotors in correct relative position.
- d) These gears will be designed to counteract the axial forces incurred in compression.
- e) Rotors shall be dynamically balanced.

6.010.00 INTAKE FILTER

- a) 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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**GENERAL TECHNICAL REQUIREMENT FOR
PIPING, VALVES & FITTINGS**



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1.00.00

CODE & STANDARDS

1.01.00

The Design, manufacture, shop testing, erection, testing and commissioning of piping and valves shall conform to the latest revisions of the following codes and Indian Standards, in addition to other standards mentioned elsewhere in the tender documents subject to any modification and requirement as specified hereinafter.

- | | | |
|------------|---|---|
| IS : 778 | - | Gunmetal gate, globe and check valves for general purpose. |
| IS : 1239 | - | Mild steel tubes and fittings - Part I & II. |
| IS : 1536 | - | Centrifugally cast (spun) iron pipes for water, gas and sewage. |
| IS : 1537 | - | Vertically cast iron pressure pipe for water, gas and sewage. |
| IS : 1538 | - | Cast iron fittings for pressure pipes for water, gas and sewage. |
| IS : 1703 | - | Ball valves (horizontal) plunger type including floats for water supply purposes. |
| IS : 2379 | - | Colour for the identification of pipe line. |
| IS : 2685 | - | Code of practice for erection, installation, and maintenance of sluice valves. |
| IS : 14846 | - | Sluice valve for water works purposes (150 to 1200 mm). |
| IS : 3042 | - | Single faced sluice gates (200 to 1200 mm). |
| IS : 3589 | - | Electrically welded steel pipes for Water gas & sewage (200 to 2000 mm). |
| IS : 4038 | - | Foot valve for water works purposes. |
| IS : 4984 | - | High Density polyethylene pipes. |
| IS : 4985 | - | Unplasticised PVC Pipes. |
| IS : 5312 | - | Swing check type reflux (non-return) valve Part-I. |
| IS : 458 | - | Concrete pipes (with and without reinforcement). |
| IS : 3952 | - | Cast Iron butterfly valves for general purposes. |
| ASTM-A 106 | - | Gr.C Seamless carbon steel pipe. |
| ASTM - 53 | - | Seamless carbon steel. |
| AWWA-C-504 | - | Standard for butterfly valve. |
| BS : 5156 | - | Standard for Diaphragm valve. |
| IS : 554 | - | Pipe thread for pressure tight joints. |
| IS : 1363 | - | Black hexagon bolts, nuts and lock nuts. |
| IS : 1364 | - | Precision and semi-precision hexagon bolts, screws, nuts and lock nuts. |
| IS : 2062 | - | Structural steel fusion welding quality. |
| IS : 4736 | - | Hot dip zinc coating on steel tubes. |



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- IS : 2825 - Code of unfired pressure vessels.
- IS : 2712 - Gaskets.
- IS : 4192 - Part-I Rubber lining.
- IS : 3006 - Acid resistant SWG Pipe.
- IS : 783 - Code of practice for laying RCC pipes.
- IS : 3114 - Code of practice for CI Pipes.
- BS : 5142 - CI globe valve.
- ANSI:B 16.5 - Steel pipe flanges and flanged fittings.
- ANSI:B 31.1 - Power Piping code.

2.00.00 DESIGN, CONSTRUCTION AND ERECTION

2.01.00 Piping and Fittings (General)

2.01.01 Design

All piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. The minimum thickness for pipes and fittings shall be adhered to. Higher thickness in equivalent material is acceptable. However, no credit will be given for higher thickness.

2.01.02 All the piping systems, fittings and accessories supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 25 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

2.01.03 All piping systems shall be properly designed to take care of hydraulic shocks and pressure surges which may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolts, etc. for the safeguard of the piping systems under above mentioned conditions. External and internal attachments to piping shall be designed so as not to cause flattening of pipes, excessive localised bending stresses or harmful thermal gradients in pipe walls.

2.01.04 Piping and fittings shall be manufactured by an approved firm of repute. They should be truly cylindrical of clear internal diameter specified, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects. They shall allow ready cutting, chipping or drilling, welding etc.

2.01.05 All rubber lined pipes shall be seamless or bead removed ERW pipes.

2.01.06 Inspection holes shall be provided at suitable locations for pipes 800 mm NB and above as required for periodic observations and inspection purposes.

2.01.07 The portion downstream of the isolation valves of pipe lines conveying flushing water shall be of the material & type as that of the chemical pipelines which is being flushed.

2.01.08 Pipeline under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

2.01.09 The following " C" Value shall be used in WILLIAM & HAZEN formula for calculating the friction loss in piping systems.

- I) Carbon Steel pipe - 100