

2X800 MW YERMARUS STPP


**TECHNICAL SPECIFICATIONS
FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO.: PE-TS-362-155-A001



BHARAT HEAVY ELECTRICALS LIMITED

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


	TITLE: TECHNICAL SPECIFICATION FOR 2X800 MW YERMARUS STPP	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
		VOLUME-IIB	
		SECTION	
		REV. NO. 00	DATE: 14/12/11

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SECTION - A
INTENT OF SPECIFICATION


	TITLE:	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
		VOLUME-IIB	
		SECTION -A	
		REV. NO. 00	DATE: 14/12/11
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		
	2X800 MW YERMARUS STPP		

1.0 SCOPE:


- 1.1 This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at manufacturer's works, delivery at site including start up and commissioning spares, properly packed for transportation, unloading / handling and storage at site, assembly, erection and commissioning, preparation and submission of "As Built" drawings, carrying out performance guarantee tests at site and handover of Condensate Polishing Units and external regeneration system for **2X800 MW YERMARUS STPP**.
- 1.2 It is not the intent to specify all the details of the design & manufacture. However, the **equipment** shall conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing in continuous commercial operation.
- 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 In case of any deviation, the Bidder shall indicate the same clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid conform strictly to the specification.
- 1.5 General terms & conditions instructions to the bidder and other attachments referred to elsewhere, made part of tender specification.
- 1.6 The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL / Customer.
- 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.

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**SECTION - B
(PROJECT INFORMATION)**

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- 1.0 Owner : Raichur Power Corporation Ltd
22/23, Sudarshan Complex,
IInd floor, Sheshadri Road,
Bangalore-560 009
Karnataka, India
- 2.0 Consultant : M/s Evonik Energy Services (I) Pvt.
Ltd.,A-29, Sector 16
Noida-201301(UP), India
- 3.0 Project Title : 2x800 MW Yeramarus Thermal Power
Station
- 4.0 Location : Yeramarus
Raichur Dist
Karnataka State, INDIA
It is situated at about 8 Kms from Raichur
on the Raichur-Hyderabad State
Highway-13 and 12 kms away from Bank
of river Krishna and about 5 kms from
Raichur Thermal Power Station
- 5.0 Nearest Railway : Chicksugur Railway Station which is
about 2 kms from site.
- 6.0 Nearest Airport : Hyderabad around 200 kms
- 7.0 Nearest Port : Chennai around at about 470 kms from
site.
- 8.0 Latitude and Longitude : Latitude – 16° 16' 55.9"N
Longitude – 77° 20' 38.6"E
- 9.0 Elevation above mean sea level : 350-375 meters
- 10.0 Climatic Conditions
- (a) Ambient Temperature
- i. maximum temperature : 45° C
- ii. minimum temperature : 6° C
- iii. Design Temperature for all : 50° C Ambient
Electrical/ Mechanical
Equipment
- (b) Relative Humidity
- i. Maximum during monsoon : 85%
- ii. Minimum : 20%
- iii. Average : 65%
- (c) Rainfall

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- | | | | |
|-----|------------------------------|---|---|
| | Annual average rain | : | 720 mm |
| | Max. for one day | : | 115 mm |
| | Max. intensity | : | 38 mm/hr |
| | Period | : | June to September |
| (d) | <u>Wind Speed</u> | | |
| | i. Prevailing wind direction | : | West, South-East, North-West,
South-West |
| | ii. Maximum mean wind speed | : | 15.9 Kms / hr
(4.42 m/s) |
| | iii. Average | : | 9.61 Km/hr
(2.67 m/s) |
- 11.0 Wind Load
Calculations for wind effect shall be in accordance with IS:875- (Part-3) latest revision taking into account the following :
- (a) Basic wind speed of 39 m/sec as given in Fig.1 of the code.
- (b) Factor K1 shall be taken as 1.06
- (c) Terrain category shall be 2 and corresponding values shall be taken for K2
- (d) Factor K3 shall be taken as 1.0
- 12.0 Wind Loading for Stack
- (a) For wind pressure as per clause 11.0 above
- (b) For RC stacks as per IS: 4998
- 13.0 Seismic data (as per IS:1893 latest issue)
- (a) Zone : Zone III (as per IS:1893- latest)
- (b) Importance factor (I) : 1.75
- 14.0 Auxiliary power supply : Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following supply system.
- (a) For motors rated above 1500 kW : 11000V, 3 phase, 3 wire, 50Hz medium earthed AC
- (b) For motors rated 175KW and above and below 1499KW. : 3300V, 3 phase, 3 wire, 50Hz medium earthed AC
- (c) For motor rated 174 kW and below : 415, 3 phase, 3 wire solidly earthed AC
- (d) For motor control centre : 415V, 3 phase, 3 wire solidly earthed AC
- (e) DC. motor starters, DC solenoids, DC alarm, control and protections : 220 V DC, 2 wire, unearthed DC

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- (f) AC control & protective devices : 110 V 1 phase, 50Hz, 2 wire AC supply. The single-phase 110V AC supply shall be derived by Contractor by providing 415V/110V control transformers of adequate rating with MCCB /MCB on both the primary and secondary sides.
- (g) Uninterrupted power supply : 240 V, 1 phase, 50Hz, 2 wire AC supply from UPS system for I&C (including indicator recorders) and UCMS only
- (h) AC solenoids, indicators/recorders, space heaters (for motors rated 30KW and above) : 240V 1 phase, 2 wire, 50Hz AC system with effectively earthed neutral. The power supply shall be derived by CONTRACTOR by providing 415V/ 240V transformer of adequate rating with MCCB/MCB on primary/secondary sides.
- (i) Winding heating of motors below 30kW : 24 V 1 phase,50Hz, AC with one point earthed. This shall be derived by CONTRACTOR by providing 415V 3 phase, 3 wire, AC supply through an adequately rated step-down transformer of adequate rating with MCCB / MCB on primary/secondary sides.
- (j) Solid state controls (including solenoid valves) : 24 V DC, 2 wire, supply from Battery chargers for instrumentation system only.
- (k) Lighting fixtures : 240 V, 1 phase, 2 wire, 50Hz system.
- (l) Lighting fixtures and space heaters in panels : 240 V, 1 phase, 2 wire, 50Hz system.
- (m) Construction supply : 415 V, 3 phase, 4 wire, 50 Hz AC supply with neutral lead solidly earthed.
- (n) The above voltages may vary as follows :

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

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


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CLARIFIED WATER ANALYSIS


ANNEXURE -1

Physical Properties	Unit	Range
Conductivity	μS/cm	300-1300
Colour	Pt-Co unit	-
Odour		No odour
pH		8.1 to 8.7
Temperature	Deg.C	28-35
Turbidity	NTU	20 to 3000 Avg.250
Total Suspended solids @ 105 deg C	mg/l	32-48
Colloidal Index (SDI – 15)		---
Total dissolved solids @180 C	mg/l	870
OIL & Grease	mg/l	Nil
Surfactants	mg/l	.08
CHEMICAL PROPERTIES (As ppm)		
Alkalinity-m (as CaCO3)	ppm	100-242
Alkalinity-p (as CaCO3)	ppm	2-14
Ammonia (NH3)	ppm	-
Arsenic (As)	ppm	<.05
Barium (Ba)	ppm	<.05
Bromide (Br)	ppm	<.01
Boron (B)	ppm	-
Calcium (Ca)	ppm	32.1
Carbon-di-oxide (CO2)	ppm	-
Chloride (Cl)	ppm	49-254 as Caco3
Dissolved Oxygen (DO)	ppm	4.7
Flouride (F)	ppm	0.78
Hardness Total (as CaCO3)	ppm	100-262
Hardness Calcium(as CaCO3)	ppm	80-144
Hydrogen Sulphide (H2S)	ppm	-
Iron -Total (Fe)	ppm	.05
Iron – Dissolved	ppm	-
Magnesium (Mg)	ppm	28-148 as Caco3
Manganese (Mn)	ppm	.05
Nitrate (NO3)	ppm	2.6
Phosphate (PO4)	ppm	.014
Potassium (K)	ppm	2.3
Sodium (Na)	ppm	62.2
Silica Reactive (SiO2)	ppm	5.52
Silica Total	ppm	6.41
Strontium (Sr)	ppm	<.005
Sulphate (SO4)	ppm	15-181 as Caco3
BOD	ppm	12
COD	ppm	17-43
TOC as C	ppm	BDL
Heavy Metals (Specify if any)		
Additional Parameters if any		
BACTERIOLOGICAL ANALYSIS		
Coliforms (e-coli)	cfu/ml	13
Feacal Coliforms	cfu/ml	01
Total Viable Count at 48 hrs	cfu/ml	29X10

Note: The cycle of concentration (COC) of circulating water is 5.0. Bidder to consider the ionic load accordingly to design Condensate polishing unit for Condenser tube leakage condition as indicated elsewhere in the specification.

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**SECTION – C1
(MECHANICAL)**

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1.0 GENERAL

The Condensate Polishing Units with a common external regeneration system and associated accessories shall conform to the technical specification for **2X800 MW YERMARUS STPP**.

2.0 DESIGN CONDITIONS FOR CONDENSATE POLISHING PLANT

- 2.1 There shall be three service vessels (3X33.33%) for each 800 MW unit each polishing 33.33 % of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up. (Flow through each service vessel indicated in the data sheet).
- 2.2 For condensate polisher service vessel the design pressure has been indicated in the datasheet – A. For all other pressure vessels design pressure shall be at least 8 Kg/cm² (g).

3.0 BRIEF DESCRIPTION OF THE SYSTEM

The proposed condensate plant shall treat the entire condensate of the turbine generator of each unit of power station. The proposed schematic arrangement of the condensate polishing plant and its regeneration facility shall be as per the enclosed P&I Diagram. Arrangement of piping and valves shown in them are for guidance only and bare minimum. The bidder shall propose the complete system including regeneration facility as per their standard design and as elaborated in this specification meeting the basic functional requirements.

The condensate polisher service vessel shall be located in the TG hall of corresponding units. The resins shall be transferred to and from the common regeneration facility by sluicing through a pipeline. Arrangement of vessels, piping and valves shown in regeneration area are for reference only. Actual regeneration process shall be supplier specific.

The regeneration process offered by the bidder shall be of proven design and shall essentially be the same process by virtue of which the bidder is qualified and shall give resin-separation compatible with the desired effluent quality.

4.0 SALIENT DESIGN DATA


4.1 NORMAL RUN

The following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system.

The ionic concentrations indicated below are as such.

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	100	---
Total dissolved solids	Ppb	100	25
Conductivity	Micro S/cm	-	< 0.1 (after removal of ammonia & amines at 25 ^o C)
Silica (dissolved)	ppb	30	5
Iron (dissolved)	ppb	50	5
Sodium	ppb	10	2
Chloride	ppb	10	2
pH		8 – 8.5	----

For temperature 50^o C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

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Under the above operating and design flow through the polisher units, each service vessel shall be designed to operate continuously for at least 30 days in Hydrogen cycle. 2 ppb sodium in effluent shall be guaranteed for entire cycle for each service vessel per unit.

In addition to the dissolved solids, the influent condensate shall also contain some quantities of suspended solids (crud) derived from the corrosion of water and steam carrying pipelines, turbine condenser, and steam side of the feed water heater. Normally this concentration will not exceed about 50 ppb and the polisher beds shall provide sufficient filtering action to restrict the effluent crud content to less than 5 ppb.

4.2 START-UP CONDITION

During start up conditions, quality of the influent may deteriorate to:

TDS, ppb	2000 Max
Silica, ppb	150 Max
Crud, (Mostly black oxide of Iron) ppb	1000 Max

For design purposes, average crud loading shall be considered as 500 ppb. Under such conditions, total crud content of the effluent shall not exceed 150 ppb.

Useful service run under this condition shall not be less than 50 hours for each service vessel before regeneration.

4.3 CONDENSER TUBE LEAKAGE CONDITION

Under condenser tube-leakage condition, the plant shall be designed for 2000 ppb TDS in addition to the normal influent contaminants stated in clause 4.1 above. The Cation and anion loads in 2000 ppb TDS shall be based on the clarified water analysis (Annexure 1) attached with the specification. Under such condition, sodium content in the effluent shall be limited to 20 ppb maximum.


Useful service run under this condition shall not be less than 50 hours for each service vessel before regeneration.

4.4 The bed cross section in the service vessels shall be such that the average velocity of condensate through it shall not exceed 2 meters/min (120 M3/hr/M2) at the design flow rate. Internal diameter of service vessel (excluding the rubber lining) of cylindrical type shall be selected meeting the above mentioned velocity criteria. For vessels of spherical shape, where the bed cross section vary, diameter (excluding the rubber lining) of the vessel shall be selected considering velocity not exceeding 1.75 meters/min (105 M3/hr/M2). The effective depth of mixed bed in condensate polisher service vessel shall not be less than 1100 mm.

4.5 Bidder to note that at the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.1 kg/cm². This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drop under dirty conditions will be restricted to about 3.5 kg/cm² including the pressure drop across effluent resin traps.

4.6 Cation resins shall be regenerated by technical grade hydrochloric acid to IS: 265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS: 252 available as 48% lye.

4.7 Rinse water outlet header of each condensate-polishing unit shall be provided with a pressure reducing valve and orifice plate, suitably designed to enable the water entry to the condenser hot well under all operating condition of condenser. The pressure reducing station shall consist of either a pressure reducing valve (reducing the pressure from design pressure of service vessel to condenser vacuum) or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm² and a pressure reducing valve from 2 kg/cm² to condenser vacuum.

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5.0 SYSTEM REQUIREMENT

5.1 The regeneration process offered by bidder shall be of proven design and shall essentially be the same process by virtues of which the bidder is qualified and shall give resin separation compatible with the desired effluent quality.

5.2 In case, after separation of resins, there are undesired contaminant resins, the bidder shall provide a system either to eliminate this cross contamination or resins or to nullify the detrimental effect of entrapped resins to the effluent quality.

5.3 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 12 m. The detailed pipe routing shall be furnished during detail engineering.

5.4 EXCHANGE RESINS

5.4.1 Cation-anion resin ratio shall be 1.5 parts Cation to 1.0 part anion by volume. In case the process require any non ionic resin the same shall represent at least 10% of the bed volume, but not less than 15 cm of the bed depth in the resin separation / cation regeneration tank of the external regeneration facility.

5.4.2 The bidder shall include with the plant adequate resins for each condensate polisher service vessels along with one (1) spare charge of resin in the mixed resin storage tank i.e. seven (7) complete charges of resin. A separate charge of resin shall also be included for using the resins during commissioning of Condensate Polishing unit. Therefore total number of charges supplied by the bidder shall include total resin charges for TG units plus one spare charge plus one commissioning charge i.e. eight (8).

5.4.3 Resin shall be macroporous type of CPU grade.

5.4.4 The resin shall contain a minimum of metallic and organic impurities consistent with good processing. The processing procedure will include rinsing the resins with Demineralised water before packing, so that further rinsing will not be required before use. Foreign objects in the resin shall constitute a basis for its rejection.

5.4.5 The resins used for the Condensate Polishing Unit are of the spherical form. Base of the ion-exchange resins shall be copolymer of styrene and divinyl benzene forming a macro porous or macrorecticular structure. Other details are as follows:

Cation Resin	:	Strong acid, with sulfonic acid as functional group.
Anion Resin	:	Strong base, with quaternary amines functional group
Inert Resin	:	Non ionic, compatible with the above resin types

5.4.6 Cation resins shall be supplied in hydrogen form and anion resin shall be supplied in hydroxide form.


5.4.7 The total wet volume Exchange Capacities will not be less than

- Cation in Hydrogen form : 1.7 eq/L
- Anion in Hydroxide form : 1.0 eq/L

5.4.8 All resins when wet screened with US standard Sieves will pass through a No. 14 sieve, no more than 2% will be retained on a No. 16 sieve, more than 2% will pass through a No. 40 sieve. The particle size and density will be carefully controlled to facilitate clear separation between the resins during regeneration processes.

5.4.9 The average force required to fracture individual bead of cation resin in Hydrogen form, anion resin in Hydroxide form and inert resin will exceed 350 grains. Not more than 5% of the beads tested in each batch would get fractured by forces less than 200 grams.

5.4.10 Manufacturer – It is not the intent to pre-select any specific brand name for this application. Resins will be accepted by the owner strictly on their merits. The resin shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application.

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5.4.11 Bidder shall submit all necessary data and information in this regard along with the proposal.

Make of Resins shall be:


- Rohm and Hass 252c & IRA-900C/BAYER /Lanxess/Purolite./Equiv.
- Double –26 TR & A0161 Tr/Baye/Equiv
- Dowex MSC-1, MSA-1C grades/Bayer/Equiv
- Inert resin:-Double S-3, Rohm and Hass 395 / Dowe Buffer Beads/Equiv

The above listing is by no means exhaustive, and shall not be construed to be a recommendation for their selection for this plant.

5.5 CONDENSATE POLISHING UNITS

5.5.1 Condensate polisher vessel shall consists of following

- Condensate Polisher vessels complete with condensate inlet and outlet connections, connections for resin transfer to and from the vessels, bed support cum drain system, inlet water distributor, air distribution arrangement for resin mixing, all fittings and appurtenance etc as specified and as required.
- External resin traps at the outlet of each of the polisher vessel, designed for in-place manual back washing.
- Condensate inlet and outlet headers with pipe connections to the condensate polisher vessels.
- Resin transfer header connecting the common external regeneration facilities to the condensate polisher vessels of each installation.
- Rinse water outlet headers from condensate polisher vessels of each installation up to the condenser hot well.
- All necessary valves and fittings for the installations with actuators necessary for their remote operation. These shall include suitable foolproof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it which are designed for pressure much lower than that of the polisher service vessels.
- A common drain header for the condensate polisher service vessels of each unit up to the condenser hot well.
- All necessary drains, vents and sampling points, with valves as specified and as required.
- Gland sealing water piping for the valves in the rinse water line.
- Emergency bypass between the condensate influent and effluent headers with its automatic valve, isolation valves on both the sides and controls for each condensate polisher mixed bed.
- Two (2) nos. (1W + 1S) oil free type air blowers with electric motor drives for each unit for supplying air required for mixing the resins in the service vessels. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided as required. Acoustic hood for each air blowers shall also be provided by the bidder.
- Complete instrumentation, control etc for automatic operation.
- Operating platforms, ladders, supports and other structural works for each Condensate Polisher vessel to facilitate accessibility for operation and other equipments etc. shall be provided by the bidder.

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5.6 EMERGENCY BYPASS SYSTEM

- Each condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a set of butterfly type control valve and wafer type butterfly isolation valves (resilient material seated, to ensure bubble tight shut off) on the upstream and downstream sides of the control valve.
- In the event of excessive pressure differential between the condensate inlet and outlet headers, this control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when three vessels, two vessels, one vessel or no vessel is in operation.
- When condensate temperature exceeds 50 deg C the bypass valve shall be 100% opened automatically and the inlet / outlet of the condensate polisher mixed bed shall be closed to protect elements and resins inside the polisher.
- Either 2X50% capacity valves or 1X100% capacity control valve shall be provided to achieve proper control under all operating conditions. The isolation valve shall be provided with geared operators for manual operation and shall be located at a height which can be easily operable.
- Complete instrumentation and controls for this system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, and actuator for the control valve with position indicator shall be furnished. All tubing, wiring, air sets, and other fittings, required to complete the system shall be installed.
- The isolation valve shall be provided with geared operators for manual operation.
- The entire system shall be designed for an internal pressure of at least the design pressure of service vessels and for a maximum condensate flow of not less than total design flow of all the working service vessels.
- The control system shall be so designed that the control valve is able to bypass 50 % of rated flow when any of the service vessel is out of service, and 100% of flow when both the service vessels are out of service.


5.7 EXTERNAL REGENERATION FACILITY

5.7.1 One common facility for regeneration of the resins from the condensate polishers of all the TG units shall be provided by the bidder and consisting of following:

- a. Resin Separation & Cation Regeneration Vessel.
- b. Anion resin regeneration vessel.
- c. Mixed resin storage vessel

The vessels indicated against sr. no. a, b and c above are for reference only. Bidder may make suitable modifications in the equipment to make the system complete in all respect without changing the Contractual requirement.

- d. Resin injection hopper complete with water ejector system for resin make up. Resin injection hopper shall be sized to handle up to minimum 150 liters of as received new resins.
- e. All integral pipe works, valves, internals, fittings, hangers, supports and appurtenances etc for these vessels.
- f. Common waste effluent header with one resin trap designed for in place manual backwashing.

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- g. Two (2) nos. (1W+1S) oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the resins and their regeneration processes. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided by the bidder as required. Acoustic hood for each air blowers shall also be provided by the bidder.
- h. Two (2X100%) nos DM water regeneration/resin transfer pumps with electric motor drives, for water supply for chemical.
- i. One no hose station for transfer of hydrochloric acid (30-33% HCl). The hose station shall have two (2) nos each 80 mm NB rubber hose connections.
- j. One no hose station for transfer of Alkali (48% NaOH). The hose station shall have two (2) nos each 80 mm NB rubber hose connections.
- k. Two nos Bulk Acid storage tank complete with integral pipe works, valves, level transmitters and all other accessories required.
- l. Two nos Bulk Alkali storage tank complete with integral pipe works, valves, level transmitters and all other accessories required.
- m. Two nos (2X100%) Acid unloading pumps each complete with electrical drive motor and all other accessories as required.
- n. Two nos (2X100%) Alkali unloading pumps each complete with electrical drive motor and all other accessories as required.

o. Alkali Solution Preparation Facility:


Complete facility for preparing alkali solution from alkali flakes shall be included in Bidder's scope. This will consist of at least the following:

- One number alkali solution preparation tank to hold 120% of alkali required for one regeneration complete with electrically driven stirrer, dissolving basket, integral pipe works, valves and all other accessories required.
- Two (2) nos. (1W+1S) alkali solution transfer-cum-recirculation pumps. These pumps shall be provided with a pulsation dampener at the outlet header of each pump.
- One (1) no. Activated carbon filter for alkali complete with internals, integral pipe works, valves and all other accessories as required.
- All interconnecting piping, valves and fittings as required for the system.
- The alkali solution preparation facility shall also be capable of receiving 48% alkali lye.

p. Chemical (Acid and Alkali) Dosing System:

The Acid and Alkali dosing equipment for regeneration of condensate polishing resins shall be mounted on skid, which shall consist of at least the following:

- Two (02) numbers (1W+1S) positive displacement type metering pumps with electric motor drive & all other accessories as required for dosing acid. These pumps shall be provided with a pulsation dampener at the outlet header of each pump.
- Two (02) numbers (1W+1S) positive displacement type metering pumps with electric motor drive & all other accessories as required for dosing alkali. These pumps shall be provided with a pulsation dampener at the outlet header of each pump.
- Diluent water supply separately, for acid and alkali, each provided with an automatic on-off valve, a throttling valve for setting of flow, a local flow indicator, and a mixing tee where the chemicals get injected into the water stream.

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- A hot water tank with electric immersion adequately insulated to restrict the outside temperature to 60 deg. C with 25 mm thick (mm) mineral wool insulation on all external surfaces, covered with 16 gauge galvanized iron sheet jacketing.
 - An acid measuring tank of adequate capacity to hold 120% acid required for one regeneration complete with integral pipe works, valves and all other accessories required.
 - An Alkali measuring tank of adequate capacity to hold 120% alkali required for one regeneration complete with integral pipe works, valves and all other accessories required.
 - All the equipment, piping etc. shall preferably be assembled on two structural steel skids one for acid and one alkali dosing equipment.
 - All necessary suction and discharge piping for these pumps including strainers, valves and fittings as required. Both the chemical dosing lines shall be provided with a pulsation dampener at the outlet header of the pumps.
- q. One no acid measuring tank and one no alkali measuring tank for Neutralization pit.

r. Ammonia Dosing Equipment (If required)


Complete system for off-stream ammoniation of the resins, using ammonium hydroxide, shall be included in the offer if felt necessary by the bidder to meet the system requirements. The system, if offered, shall include two (2) nos. bulk ammonia storage tank (total one month storage), two (2) nos. motor driven feed and recirculation pumps (each with 100% capacity), regenerant dilution tank, instrumentation and controls and all other appurtenances mounted on a separate structural steel skid. This equipment shall also be controlled from the panel of the external regeneration facility and shall provide the operator with the options of ammoniating the resins, either off stream prior to their use in the service vessels, or on stream by bypassing this external ammoniation step. In addition, if so recommended by the bidder, this can be used to elute the sodium from the Cation resin carried over into the anion regeneration tank.

s. Piping

All piping within each of the above skids/equipment including the resin transfer piping between the service vessels and the common external regeneration facility, DM water piping from each DM water storage tanks and regeneration area (including re circulation lines), DM water piping from each DM water storage tanks and service vessel area, effluent disposal piping from N- pit in CPU regeneration area upto the central monitoring basin , all the piping inside the regeneration area etc. shall be designed, supplied, and tested by the bidder.

Similarly, all piping between the external regeneration facility and the skids for chemical dosing and acid/alkali preparation shall also be designed, supplied, and tested by the bidder. These shall include demineralized water piping to the chemical dosing, acid /alkali piping from external bulk storage tanks to respective preparation skids, the alkali preparation skids from the external regeneration facility, alkali solution from its preparation facility to the alkali dosing skid, dilute chemical solution piping for acid and alkali from the dosing skids to the external regeneration facility, piping to the preparation/dosing facilities, instrument air piping and power supply for immersion heaters of the diluent water tank from the regeneration facility, and all instrumentation and control wiring between these skids, etc.

All piping from CPU regeneration area to service vessels of both the units and back to regeneration vessels for transfer of resin is also in bidder's scope. The piping distance between service vessel area and regeneration area (one way) shall be considered as 500 meters. However bidder to please note that DM regeneration pumps shall be located near DM water storage tanks in DM water Pump house. The piping distance between DM water pump house (where the CPU regeneration pumps are located) and CPU regeneration area shall be around 100 m. Also bidder to note that piping from DM regeneration pumps to service vessels of both the units and back to regeneration vessels for transfer of resin is also in bidder's scope. The piping distance between DM water pump house and service vessel area (one way) shall be considered as 500 meters. The regeneration

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waste of Condensate polishing unit and RO-DM plant shall be led to the neutralization pit of Condensate polishing unit regeneration area. For further disposal of effluents from CPU Regeneration area N pit up to the Central monitoring basin bidder to provide two nos (2X100%) Effluent disposal pumps, along with recirculation line of the pumps. The piping distance between CPU Regeneration area N pit and Central monitoring basin shall be 550 meter. Bidder to consider these pipings in his scope and accordingly design the system. Any addition / deletion in the length of piping shall be adjusted based on unit prices. However system will be designed to take care any addition/deletion of piping.

- Complete instrumentation, control etc for automatic operation.
- Operating platforms, ladders, supports and other structural works for each vessel to facilitate accessibility for operation and maintenance for all the condensate polisher mixed beds, regeneration vessels, storage tanks, alkali and acid measuring tanks & preparation tanks and other equipments.

5.7.2 Vessel Freeboard Requirements

The pressure vessels shall be provided with adequate freeboards over the top of the settled resins, to minimize resin loss during their use. Minimum permissible freeboards are as follows:

- Mixed resin Storage vessel - 100%
- Resin separation vessel- 100%
- Cation regeneration vessel- 100%
- Anion regeneration vessel- 100%
- Resin Make up hopper – 80 %
- Activated carbon filter- 75%

However if a vessel is used for more than one service, then the vessel design shall be based on the service which gives maximum free board.

6.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

6.1 RESIN TRAPS

Outlet of each condensate polisher vessel and waste effluent header of the common regeneration shall be provided with a resin trap. Pressure drop at design flow through a clean resin trap shall not exceed 0.35 kg/sq.cm. Trap shall be of rubber lined steel constructions (Rubber lining of 4.5 mm in three layers) and internals (cord & screen) shall be of JOHNSON SCREENS (Australia) SS-316 construction only. Resin traps of process effluent line shall have screen opening not exceeding 120% of associated process vessel under drain screen opening. Other resin traps shall have screen opening of 60 mesh. In place back flushing shall be provided for all the resin traps.


The resin trap shall be flanges at one end and will be connected at the end of respective pipeline. The other end shall be open to drain so that the flow can be seen to check the choking of the trap.

6.2 CARBON TRAP (FOR ACF)

At the outlet of each Activated carbon filter a carbon trap (media trap) shall be provided by the bidder.

6.3 HOT WATER TANK FOR HEATING ALKALI DILUENT WATER

6.3.1 For heating of alkali diluent water 2x50% electrical heating coil in a tank of mild steel rubber lined construction shall be provided. The tank shall be vertical cylindrical type with dished ends. The capacity of tank shall be minimum 25% higher than the maximum water demand. This tank shall be provided with burn out protection, pressure relief valve, level transmitter, temperature indicator .temperature transmitter and other required instruments and accessories. The heater shall be

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controlled by the temperature transmitter provided on the tank. The heaters shall be sized for heating the water from a temperature of 15 deg.C to 50 deg.C at the outlet of ejector. The duration of heating the water shall not be more than five hours. Accessories such as operating platforms, ladders, vent, overflow & drain connections with valves, etc. shall be provided.

6.4 ACTIVATED CARBON FILTER FOR ALKALI

The alkali preparation facility shall be provided with an activated carbon filter to remove iron and other harmful impurities from the alkali solution. The filter shall be designed for a capacity equivalent to the discharge flow of one Alkali transfer cum recirculation pump. Maximum velocity through the filter for this flow shall not exceed 12 meters/hours. Depth of the filter material shall not be less than 1.2 meter and supporting gravel not less than 0.3 m. The filtering medium shall be granulated activated carbon, meeting following requirements.

- | | | | |
|----|----------------------------------|---|---------------------------|
| a) | Total Surface Area | : | Not less than 850 sq.m/gm |
| b) | Bulk Density | : | Not less than 400kg/cum |
| c) | Iodine number | : | 850 minimum |
| d) | Uniformity coeff | : | 1.5 to 1.6 |
| e) | Effective Size | : | 0.8-0.9 mm |
| f) | Ash | : | 8% (maximum) |
| g) | Moisture | : | 5% (maximum) |
| h) | Carbon Content | : | Not less than 90% |
| i) | Mean Particle dia | : | 1.2 – 1.4 mm |
| j) | Particle Density wetted in water | : | 1.3 – 1.4 gm/cc |

The filter shall be provided with necessary valves and connections for manual backwashing and rinsing with DM water. Rate set valves shall be provided with adjustable limit stops for setting backwash and rinse rates. Accessories such as Manholes, hand holes, Vent, & drain connection with required valves shall be provided for the AC filter. Accessories such as operating platforms, ladders, vent, overflow & drain connections with valves, etc. shall be provided.

6.5 RESIN INJECTION HOPPER


The supplier shall provide a hopper type tank for resin make up, using water slurry, to the condensate polishing system. This make – up system will constitute a portion of the condensate polishing external regeneration system. The resin hoper shall have a conical bottom and a flat top. The top shall have piano type hinged port, having a lifting handle, of sufficient size for easy resin loading. The resin shall have discharge through a bottom connection to a water ejector for transport. Water shall be added to hopper to assist in the resin transfer. The ejector discharge shall be to the resin separation-cation regeneration vessel. Demineralized water shall be used throughout for the resin transfer.

- | | | |
|----|-----------|--|
| a) | Capacity: | The resin make-up hopper tank shall be sized to handle up to minimum 150 litres of as received new resin per single injection. |
| b) | Material: | The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6 mm and rubber lined (4.5 mm in three layers). |

6.6 RESIN TRANSFER PIPELINE LINE

The resin transfer line shall be of stainless steel type SS 304 to ASTM A 312 Gr. TP 304 schedule 10S minimum. The pipeline shall be sized for a flow velocity between 2.3 and 3.0 m/sec however the minimum pipe size shall be 80 NB. The isolation valve on the resin transfer line shall be eccentric plug type / ball valve of stainless steel (SS 316) construction.

Resin Transfer Line – Piping from Service vessel area to regeneration area and back from regeneration area to service vessel area shall be in bidder's scope. The piping distance from service vessel area to regeneration area shall be considered as 500 m (one way). Any addition / deletion in the length of piping shall be adjusted based on unit prices.


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6.7 ACID DOSING FACILITY

- 6.7.1 Two Nos (2) no. bulk acid storage tanks complete with fume absorber and overflow seal. The tank shall be of horizontal cylindrical with dished ends. The tank shall have adequate capacity to hold acid required for 15 days of operation of both CPU & RO-DM Plant. However the minimum capacity of each acid storage tanks shall be 15 M3. The acid required per day of RO-DM Plant is **1372 kg as 30% HCl**.
- 6.7.2 Two nos. (2X100%) horizontal centrifugal type acid unloading cum transfer pumps of 10 M3/hr each capacity and head to meet the system requirements with 20% margin shall be provided by the bidder.
- 6.7.3 One (1) no. acid measuring tank complete with fume absorber and overflow seal. The tank shall be of vertical cylindrical (atmospheric) type with dished bottom and cover on top. The tank shall have adequate capacity to hold 120% acid required for one regeneration.
- 6.7.4 Two nos. (2X100%) positive displacement type metering pumps for dosing acid of adequate capacity and head to meet the system requirements with 20% margin shall be provided by the bidder. These pumps shall take suction from the acid measuring tank.
- 6.7.5 All necessary suction and discharge piping for these pumps including all strainers, valves and fittings as required, upto the mixing tee with the diluent water.
- 6.7.6 Diluent water supply for acid with an automatic on off valve, throttling valve for setting of flow, a local flow indicator and a mixing tee where the chemicals get injected into the system.
- 6.7.7 All interconnecting piping, valves and fittings as required for the system.
- 6.7.8 Accessories such as operating platforms, ladders, vent, overflow & drain connections with valves, Fume absorbers (for acid application) etc. shall be provided for each tank.

6.8 ALKALI DOSING FACILITY

- 6.8.1 Two Nos (2) no. bulk alkali storage tanks complete with fume absorber and overflow seal. The tank shall be of horizontal cylindrical with dished ends. The tank shall have adequate capacity to hold acid required for 15 days of operation of both CPU & RO-DM Plant. However the minimum capacity of each alkali storage tanks shall be 15 M3. The alkali required per day of RO-DM Plant is **695 kg NaOH as 48% NaOH**.
- 6.8.2 Two nos. (2X100%) horizontal centrifugal type alkali solution transfer cum unloading pumps of 10 M3/hr each capacity and head to meet the system requirements with 20% margin shall be provided by the bidder.
- 6.8.3 Two nos. (2X100%) horizontal centrifugal type alkali solution transfer cum recirculation pumps of 10 M3/hr each capacity and head to meet the system requirements with 20% margin shall be provided by the bidder.
- 6.8.4 One (1) no. alkali measuring tank complete with carbon dioxide absorber and overflow seal. The tanks shall be of vertical cylindrical (atmospheric) type with dished bottom and cover on top. The tank shall have adequate capacity to hold 120% alkali required for one regeneration.
- 6.8.5 One (1) no. alkali preparation tank complete with carbon dioxide absorber and overflow seal. The tanks shall be of vertical cylindrical (atmospheric) type with dished bottom and cover on top. The tank shall have adequate capacity to hold 120% alkali required for one regeneration.
- 6.8.6 Two nos. (2X100%) positive displacement type metering pumps for dosing alkali of adequate capacity and head to meet the system requirements with 20% margin shall be provided by the bidder.
- 6.8.7 All interconnecting piping, valves and fittings as required for the system.
- 6.8.8 The alkali measuring tank & alkali preparation tank shall be provided with a slow speed agitator (speed 200 RPM max.) driven by motor drive & reduction gear unit as well as one dissolving basket. The material of shaft & impeller/blade of each agitator and each dissolving basket shall be SS 316 construction only.

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6.8.9 Diluent water supply separately for alkali, provided with an automatic on-off valve, throttling valve for settling of flow, a local flow indicator, and a mixing tee where the chemicals are injected into the water stream.

6.8.10 Accessories such as operating platforms, ladders, vent, overflow & drain connections with valves, CO₂ absorbers etc. shall be provided for each tank.

6.9 BLOWERS

6.9.1 Two (2X100%) capacity blowers shall be provided in each of the service vessel area and two (2X100%) capacity blowers shall be provided in regeneration unit.

6.9.2 Blowers shall be centrifugal/ twin lobe types.

6.9.3 Capacity (Flow) & Head of the blowers shall be selected as per system requirement with 20% margin.

6.9.4 Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided by the bidder as required. Acoustic hood for each air blower shall also be provided by the bidder.

6.10 DM WATER PUMPS (FOR REGENERATION & RESIN TRANSFER)


Two (2X100%) DM Water pumps with electric motor drives for water supply for transfer of resin from service vessel to regenerating vessels and vice versa & for water supply for chemical preparation and for dilution water supply during dosing. These pumps shall be horizontal centrifugal type and conform to IS:1520 or equivalent.

6.11 EFFLUENT NEUTRALIZATION SYSTEM

Neutralization pit of RCC construction with acid/alkali resistant tiles shall be provided. Bidder shall design the system so that the pit shall be provided in two compartments and each compartment shall have a holding capacity of 1.5 times the waste effluent generated from regeneration of each vessel plus regeneration waste generated from RO DM Plant. The regeneration waste generated by RO-DM plant per regeneration is 180 M3. However minimum capacity of each section shall be 500 CuM. The regeneration waste shall be led to the N- pit through drain. For further disposal of effluents from CPU Regeneration area N pit up to the Central monitoring basin bidder to provide two nos (2X100%) Effluent disposal pumps, along with recirculation line of the pumps. The piping distance between CPU Regeneration area N pit and Central monitoring basin shall be 550 meters. Bidder to consider these piping in his scope and accordingly design the system. Any addition / deletion in the length of piping shall be adjusted based on unit prices. However system will be designed to take care any addition/deletion of piping. Material of construction of effluent disposal piping shall be HDPE (sch. Minimum PN10).

Necessary air grid arrangement of polypropylene construction shall be provided in each compartment for effective neutralization of the waste effluent, in addition to recirculation of the pumps. For this 2X100 % capacity air blowers with diffusers shall be provided. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter/silencer, flexible couplings and discharge snubber, all mounted on a single base. Relief valve(s) shall be provided by the bidder as required. Acoustic hood for each air blower shall also be provided by the bidder.

Dosing of acid and alkali shall also be provided to neutralize effluents of both CPU regeneration waste and RO-DM plant regeneration waste before disposal along with piping, valves etc for neutralization. The quality of regeneration waste generated per regeneration of RO-DM plant is 20000 ppm. One no of acid and alkali tank shall be provided by the bidder with dissolving basket, agitator (slow speed), platform / ladder, manhole, overflow drains etc. Effective volume of each Alkali Measuring Tank & Acid Measuring Tank for NPit shall be quantity required for neutralization of excess acid / alkali in waste effluent generated due to single regeneration of a condensate polisher mixed bed and RO-DM plant regeneration waste with 20% overall margin or 2 cum whichever is higher.


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6.12 PIPING


- 6.12.1 Bidder shall design, supply and erect the piping between service vessel area of both units and the common external regeneration facility for transferring the exhausted and regenerated resin, piping between DM water regeneration pumps and DM water storage tanks, piping between DM water regeneration pumps and service vessel area of both units, piping between DM water regeneration pumps and regeneration area, piping between N- Pit located in CPU regeneration area & Central monitoring basin etc. as required.
- 6.12.2 All piping shall be laid above ground and generally laid in pipe trestles including crossing of road/pipe/cable trenches if any. Piping of between chemical tanks area and regeneration area etc may be laid on pedestals if layout permits.
- 6.12.3 The arrangement shall avoid sharp bends which cause segregation of the mixed resins and pockets where the resins can get trapped. Suitable observation ports shall be provided by the bidder in all critical areas to enable the operator to monitor completeness of the resin transfer operations. All necessary arrangements for venting and draining of the pipeline shall also be provided by the bidder.
- 6.12.4 Complete supporting system for the pipeline shall be designed, fabricated and supplied by the bidder. Inside the power house, the overhead portion of the pipeline may be supported from the building structures. Outdoor the pipeline may run on steel posts. Crossing of the roads shall be on a pipe bridge with a clear height of at least 12 meters over the road surface. All the steel structures of the pipe bridge and the supporting posts along with all necessary hanger, clamps, connecting steel, fixing bolts, nuts, etc. shall be supplied and clamps, connecting steel, fixing bolts, nuts, etc. shall be supplied and erected including the civil works.
- 6.12.5 Routing of the pipe line shall be developed by bidder and shall be finalized in coordination with the employer, based on the space available and layout.
- 6.12.6 The resin transfer line shall be sized for a flow velocity between 2.3 to 3 m/sec.
- 6.12.7 Remotely operated valves suitably interlocked with the plant operation, shall ensure that the resins get transferred to and from only the particular service vessel which has been selected by the operator.
- 6.12.8 Material of constructions of various piping shall be as per attached Datasheet – A.
- The carbon steel pipe shall conform to IS 1239 Part I (Heavy) / IS 3589 Part II or equivalent. Inside surface of fittings to be rubber lined (4.5 mm thick rubber lining in three layers). The dimensions of the fittings shall be ANSI B 16.9. Flange ends to be ANSI B 16.5.
 - The resin transfer pipe line shall be of stainless steel to ASTM A 312 Gr. TP 304 schedule 40. The minimum pipe size shall be 80 NB with minimum schedule 40.
 - The fittings shall be of forged stainless steel to ASME SA 182 F 304 with SW ends to ANSI B 16.11
 - Piping for air service shall be of hot dip galvanized (heavy grade) steel to IS 1239.
- 6.12.9 All the lined vessel connections and connections in the unlined vessels (25 NB and larger) shall be flanged to ANSI 300 lb class. Flat face flange shall be used throughout. Nozzle material shall be ASTM-106 Gr. B. Sch 80 pipe for all the vessels. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full face gaskets. The entire pipeline in the service vessel shall be designed for 300 lb class (min).

6.13 VALVES

- 6.13.1 All valves shall be designed as per applicable AWWA/BIS/BS or equivalent international standards/codes.
- 6.13.2 Emergency bypass control valve shall be double flanged butterfly type. Isolation valves of wafer (lugged) type butterfly valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and downstream sides of the control valve.
- 6.13.3 The isolation valve of the resin transfer line shall be eccentric plug type/ball valve (full bore type) of stainless steel construction.

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- 6.13.4 Isolation valve handling Acid and Alkali shall be diaphragm type in MSRL (mild steel rubber lined) construction with 4.5 mm thick rubber lining inside in three layers.
- 6.13.5 Isolation valve handling DM water shall be diaphragm or gate or globe type and shall be in SS 316 construction.
- 6.13.6 Non-return valves for DM water & alkali shall be SS 316 construction and for acid/alkali non return valve shall be Cast Iron rubber lined + SS 316.
- 6.13.7 All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class rating (min).
- 6.14 PRESSURE VESSELS, ATMOSPHERIC TANKS & MISCELLANEOUS ITEMS**
- 6.14.1 Design of all pressure vessels shall conform to ASME section VIII ed 2010/IS 2825 or acceptable equivalent international standard.
- 6.14.2 Design pressure of the condensate Polisher Service Vessels shall be as indicated in the data sheet. For all other pressure vessels, unless otherwise mentioned design pressure shall be at least 8 kg/cm²(g)
- 6.14.3 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.
- 6.14.4 Design of all horizontal cylindrical storage tanks containing water, acid, alkali and other chemicals shall conform to BS EN12285-2:2005.
- 6.14.5 Unless otherwise mentioned design temperature of all pressure vessels and storage tanks shall be 10 deg.C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.
- 6.14.6 In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.
- 6.14.7 The design of Demineralized water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
- 6.14.8 All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end of torospherical type.
- 6.14.9 Vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Conical ends shall not be accepted. All dished ends shall be stress relieved suitable mill tolerance shall be considered for determining the thickness of the shells ends and dished ends. Wall thickness of atmospheric tanks shall not be less than 6 mm.
- 6.14.10 Vessel coming under preview of IBR shall be designed accordingly.
- 6.14.11 All the atmospheric tanks shall have sufficient free board above the "Level High /Normal Level" as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the "Level High /Normal Level" for all the tank except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of tank.
- 6.14.12 Operating platforms, ladders, supports and other structural works for each vessel to facilitate accessibility for operation and maintenance for all the condensate polisher mixed beds, regeneration vessels, storage tanks, alkali and acid measuring tanks & preparation tanks and other equipments etc shall be provided by the bidder.

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6.14.13 Material:

- i) The pressure vessels shall be fabricated from carbon steel plates conform to SA 516 Gr. 70. The design code of each pressure vessels shall be ASME section VIII Div 1 ed. 2010.
- ii) All atmospheric tanks shall be fabricated from steel conforming to IS: 2062 Gr A/B. The material of construction for various connections, for the lined or unlined vessels/tanks shall be same as that of interconnecting piping material suitably lined wherever required. The pipe flanges, manhole/manhole covers reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel/tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 NB and less shall be of stainless steel construction (SS: 316)
- iii) The lining shall be rubber having a hardness of 65 +/- 5 shore-D meeting the requirements of IS: 4682 Part-1. The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

6.14.14 All pressure vessels and storage tank shall be fabricated complete and tested at manufacture's work to ensure better workmanship.

6.14.15 Vessels internals shall meet the following requirements

- i) Inlet water and regenerant distributor -Hub and internals diffuser splash plate or header or perforated laterals. Material of construction shall be SS-316 except for acid service which will be of Haste alloy-B.
- ii) Under drains: Same as above with screened laterals with internal perforate pipes and rubber lined flat bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA clog type with pore septanurese, fully supported by subway grid on equal)) All internal fastener shall be of SS-316 and heavy duty locknuts shall be used throughout.

7.0 CONTROL & OPERATION OF THE PLANT

The regeneration system shall be external and common to the polisher of all the units. Under normal condition, it shall hold a complete charge of freshly regenerated mixed resin, ready for use in its storage tank. For regeneration, resin from the exhausted exchanger vessel shall be transferred hydraulically / hydro pneumatically to this facility. The empty exchange vessel shall be filled up with the already regenerated resin which was stored in the regeneration facility. This exchange vessel shall come into service soon after requisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin charge shall be cleaned, separated, regenerated, mixed and rinsed before being stored for next use.

The common influent headers of each polisher service vessel shall be connected to the automatic bypass line. This bypass line shall include a differential pressure device which on high signal shall cause an automatic valve to open, bypassing the service vessels.


The control & operation of condensate polishing units shall be from the respective OWS in all the TG units with interlocks to the remote PLC based Operator working cum engineering station (OWES) located in the regeneration area.

Time synchronization of service vessel area controller shall be done with the controllers in the regeneration area. Further the controllers in the regeneration area shall be time synchronized with the Master clock system located in the DCS control system

8.0 CONTROL & OPERATION OF CONDENSATE POLISHING PLANT

8.1 GENERAL

It is not the intent to specify herein the complete details of the control system. Basic type of controls required has been specified below. The bidder shall submit with the proposal the complete detail of the system offered by him like the extent of automation offered, operation of the complete system, logic/flow

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diagrams, type and details of the presentation of the information, the type of mimic, hardware details etc along with detailed circuit descriptions.

- 8.1.1 It shall be possible to operate the regeneration 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.
- 8.1.2 Control for chemical dosing system and alkali preparation facility shall also be provided in it.
- 8.1.3 'Close-Auto-Open' control facility shall be provided from the OWES for solenoid valves. In 'Auto' position, the valve shall receive close/open command from the control system.
- 8.1.4 'Stop-Auto-Start' control facility shall be provided from the OWES for solenoid valves. In 'Auto' position, the valve shall receive start/stop command from the control system.
- 8.1.5 On control system failure, it shall be possible to operate the valves by means of manual operator of solenoid valves too.
- 8.1.6 The control system shall ink the various steps such as closing/ opening of different valves, starting / stopping of various pumps etc which form a sequence. The logic system shall adhere to the correct sequence of operation and predetermined time intervals. The system shall have interlocks so that, criteria necessary for each step are complete prior to proceeding to the next step.
- 8.1.7 It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.
- 8.1.8 For steps, which require frequent time adjustment and all other steps, it shall be possible to change the time setting from the OWES.
- 8.1.9 For all sequences, the current step number, time of the step, elapsed time of the step and the total elapsed time of the sequences shall be indicated in the OWES.
- 8.1.10 A mimic diagram for the CPP scheme and Regeneration system scheme shall be provided in all the OWS and OWES.
- 8.1.11 The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criterion is not fulfilled or missing for a pre determined time interval, the steps shall not proceed further, and alarm shall be provided. Missing criteria, sequence, which is under hold up etc, shall be displayed.
- 8.1.12 The safety system for any sequence/step shall check the opening of the required valves and closure of the remaining valves of the plants to avoid mal operation.
- 8.1.13 Wherever standby drives / equipments are provided, it shall be possible to select each of the drive / equipment on standby duty.
- 8.1.14 The detailed control logic in the form of step list shall be submitted for customer's Information during post award stage based on supplier's recommendation.
- 8.1.15 Start, progress and stop of each of the sequence shall be annunciated in both service vessel area control room and regeneration control room.
- 8.1.16 The status of vessels of condensate polishing plant shall be available in all the OWS of all the TG units and as well as in the regeneration plant OWES. Similarly the status of regeneration plant shall be available in the OWS of Condensate Polishing Plant of all the TG units.

8.2 CONDENSATE POLISHER CONTROL SYSTEM

Operation of the complete Condensate Polishing System shall be through Programmable Logic Controller (PLC). The control and monitoring of condensate polishing plant is done at two places:

- **Service vessel:** The operation of the service vessels shall be done from the local panels (OWS)

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located near the polishing vessels. These panels have certain remote I/O modules for interlock and data transfer to PLC based regeneration control panel.

- **Regeneration system:** The operation of regeneration system shall be by means of PLC based control system located in regeneration area.

Further please refer the system configuration for CPU enclosed in the specification also.

The respective OWS shall indicate various operating mode of condensate polishing mixed beds (in service, standby, resin transfer, rinsing step etc) and position of all automatic valves, operating parameters (such as flow, conductivity, differential pressure etc) and alarm conditions. Mimic diagram shall be provided in the all the OWS and OWES. Status of various valves shall be indicated on the mimic diagram

Facility to monitor the Condensate Polishing System from the Main control room is not envisaged. However the status of all measured parameter shall be sent to the control room for indication.

8.2.1 The control system for both service vessel area and regeneration area shall be linked to the main plant Control system for any data transfer through a bidirectional dual redundant modbus RTU serial link. It shall be possible to select each of the CPU vessel for any of the following operations or mode:


- Standby (Applicable for where spares service vessel (s) are provided)
- Service
- Isolation from service.
- Exhausted Resin transfer from CPU vessel to Regeneration plant.
- Regenerated Resin transfer from Regeneration plant to Service vessel.
- Rinse mode

8.2.2 STANDBY MODE

- Among all the vessels, any one of the vessel maybe selected in this mode.
- Under this mode, the vessel, which was regenerated in the previous cycle and filled with regenerated resin, shall be kept ready for next service cycle.
- The selection of any vessel for standby mode shall be initiated by operator and there shall be indication about details such as "Condition of the resin; whether it is filled with regenerated resin or exhausted resin, whether the standby vessel has undergone rinse cycle or not, data and time of receipt of regenerated resin and completion of rinse cycle.

8.2.3 SERVICE MODE

- Flow indicator shall monitor service flow rate for each polishing vessel. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence.
- A differential pressure transmitter installed between the influent and effluent headers on a high pressure drop signal will cause an alarm and bypass system shall be initiated as described elsewhere in this section.
- By observing the flow out from each individual vessel or conductivity at vessel outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of regeneration.
- Panel mounted cation conductivity indicators, silica analyzers (online) & sodium analyzers (online) shall monitor the polishing system influent and effluent streams as well as the discharge of each service vessel. A High influent conductivity alarm will alert the plant operator that a problem condition such as air or condenser cooling water leakage has occurred. This conductivity analyzer shall also provide contacts for an alarm at the power station main control room. A High effluent header or service vessel conductivity alarm will alert the operator to the need for regeneration of a polishing vessel.
- When the vessel under Service mode is ready for regeneration, the operator shall change the same into "Isolation mode" in the respective OWS. Subsequently the "Standby vessel" shall be selected for "Service

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mode” from the respective OWS. The selection shall follow, required sequence such as pressurization of the vessel, checking of the effluent quality and putting the vessel in service on satisfactory effluent quality

8.2.4 Isolation from Service

Normally “Service vessel” once exhausted shall be isolated from service till the “Resin Transfer” operation is complete. In addition, provision shall be kept for isolation of one or all the vessels from service if required by operator from the respective OWS or OWES.

8.2.5 Exhausted Resin Transfer from CPU vessel to Regeneration Plant


- When a vessel in a “Service” mode needs regeneration as stated above the resin transfer from the particular vessel to the regeneration plant shall be initiated from the respective OWS of the condensate polishing plant.
- The transfer of resin from the service vessel shall include operations such as isolation of the service vessel, hydraulic / hydro pneumatic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel.
- The sequence of “Resin Transfer” operation shall be initiated from the condensate polishing unit OWS but shall be controlled in the regeneration OWES.
- The completion of the operation shall be exhibited in both the respective OWS and OWES.

8.2.6 Regenerated Resin Transfer from Regeneration Plant to CPU vessel

- When the regeneration is complete in the regeneration plant, the resin shall be transferred to the empty service vessel of Condensate Polishing Plant.
- This shall be initiated by the operator from the respective OWS of condensate polishing plant of the unit from which resin was transferred to the regeneration plant in previous service. Provision shall also be kept to transfer the regenerated resin to any of the empty vessel of the CPP of any of the TG unit if required.
- The transfer of resin from the regeneration plant shall include operation such as hydraulic / hydro pneumatic transfer of the resin and the complete drain down of the water.
- The sequence of “Resin Transfer” operation shall be initiated from the respective condensate polishing unit OWS but shall be controlled in the regeneration OWES.
- The completion of resin transfer operation shall be exhibited in both the respective OWS and OWES.

8.2.7 Rinse Mode

- After transfer of regenerated resin from the regeneration plant to the empty condensate polisher vessel, this rinse cycle shall be initiated from the OWS of the respective unit so that the vessel may be rinsed and kept ready for next service cycle.
- The rinse mode shall be manually initiated full automatic sequence. This sequence shall include the rinse down step using condensate at a flow rate of 0.4 to 0.6 cum / min /sq.m until the unit effluent quality is acceptable for boiler feed water. Prior to rinsing, the resin shall be given air scrub by means of air blowers provided near the CPP.
- The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is returned to condensate hot well for recycle.
- Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete.
- The completion of rinse operation shall be annunciated in the respective OWS and OWES so that the rinse vessel may be selected for “Standby mode” or “Service mode” as per requirement.

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8.3 EXTERNAL REGENERATION CONTROL SYSTEM

External regeneration system shall be provided to serve the condensate polishing for the unit. This system shall be designed for physical cleaning and chemical regeneration of the resin.


The control of external regeneration system shall be from the PLC based Operator working cum engineering station (OWES) located in the regeneration area. The PLC based OWES shall interlock to the OWS of the condensate polisher mixed beds based on supplier's recommendation. The OWES will provide a manually initiated automatic sequence for physical cleaning and chemical regeneration of the resins and show the status of all the cycles at all the times.

- 8.3.1 Physical cleaning of the resin shall include three steps, drain to level, air scrub and rinse. The air scrub and rinse steps are of short duration, approximately 1 and 2 to 3 minutes respectively. However the program will allow the operator to increase or decrease the number of times the sequence is repeated to meet the requirements existing at that time.
- 8.3.2 The chemical regeneration is a many step sequence. This will include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels. The bidder may include a layer of inert intermediate density resin to achieve a better separation of the cation and anion resins, improve resin regeneration, and reduce leakage. The separated resins are then back washed, regenerated with 4% hydrochloric acid and sodium hydroxide solutions respectively (the later being at 50 deg C) and then rinsed. Following the rinse step the resin shall be given an air scrub followed by a good backwash. The resin is then transferred back to the resin separation vessel and the resins are air mixed. The mixed resins after regeneration are given a final rinse with the discharge conductivity being monitored. The quality of this discharge will determine if the regeneration has been effective. If the quality is not satisfactory the regeneration sequence must be repeated. If satisfactory, the mixed resin is transferred to resin storage vessel.
- 8.3.3 A resin mixing and final rinse may occur in the resin storage vessel provided the system design will permit direct return of the resins to the resin separation vessel in the event of unsatisfactory regeneration.
- 8.3.4 Upon satisfactory completion of regeneration, the status shall be annunciated audio-visually in the Service vessels OWS, regeneration system OWES and as well in the DDCMIS. This repeat annunciation shall facilitate the operator to initiate regenerated resin transfer operation from the regeneration plant to the desired vessel of the unit in which the service vessel is empty.
- 8.3.5 Upon resin transfer operation from regeneration plant as described above, the regeneration plant shall be ready to receive next batch of exhausted resin from any of the CPP. The status of regeneration plant (Whether ready to receive resin for regeneration or under regeneration etc) shall be available in the main control system.
- 8.3.6 Demineralized water shall be used throughout the regeneration process for backwashing, diluting the regenerant rinsing and resin transfer.
- 8.3.7 A conical bottom hopper having a water ejector will be used for resin make-up.
- 8.3.8 At any time only one of the sequences shall be in progress.

9.0 SPECIFIC INTERLOCKS RELATED TO SERVICE & REGENERATION SYSTEM

All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement.

- 9.1.1 Service vessels can be back in service, only after they have been pressurized.
- 9.1.2 Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- 9.1.3 Resin can be transferred to and from only one service vessel at a time.
- 9.1.4 Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.

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- 9.1.5 Regeneration sequence can commence, only when the level in the waste NPit is low enough to receive the entire waste water from the regeneration operation.
- 9.1.6 Wherever possible, completion of all timed steps in the regeneration and resin transfer process shall be physically verified by effluent conductivity etc as applicable. The automatic sequence shall be prevented from advancing to next step till these required physical conditions are achieved and the same time this delay shall be annunciated to draw the attention of the operator. The automatic sequence of operations shall be interruptive at any time by the operator and he shall be able to take over the control to manual from the steps onwards. Further operator should be able to over ride sequence, if required. It shall be possible for the operator to extend the timing of a particular step by isolating the timer for the duration. The timer will restart once the operators put back the system on auto and the other steps will then follow as programmed.
- 9.1.7 The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition, which do not permit the various desired parameter of this step to be achieved. A manual over ride for this shall also be provided.
- 9.1.8 Annunciation logic shall be carefully designed so that the alarms are activated only under abnormal conditions. As for example, low flow of diluent water is only relevant when the chemical dosing is in progress. All other times, when no diluent water flow is required, this annunciation should be blocked. In general, Normal and trouble free operation of the plant shall not activate any of these alarms.
- 9.1.9 Adequate diluent water flow shall be established before starting of the ejectors/dosing pumps for acid and alkali.
- 9.1.10 The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.
- 9.1.11 CPU service vessel inlet and outlet isolation valves will be closed automatically in the event of tripping of condensate extraction pumps.


10.0 PAINTING

- 10.1.1 All the piping, valves and equipments of this system shall be protected against external corrosion by providing suitable painting.
- 10.1.2 The surfaces of stainless steel, gunmetal, brass, bonze and non-metallic components shall not be applied with any painting.
- 10.1.3 The condensate pipelines near the condensate polisher vessels shall be painted as specified under elsewhere in the technical specification.
- 10.1.4 All the condensate polisher vessels and other equipments, piping valves and equipments in the regeneration area shall be painted as per the painting schedule (annexure VI).

11.0 SCOPE OF SERVICES

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

- (i) Erection and Commissioning.
- (ii) Arrangement of all instruments, reagents for carrying out trial run /commissioning and PG test.
- (iii) Monitoring gadgets, instruments and equipments required for maintenance (till PG test and plant handover).
- (iv) All personnel required during maintenance and PG test.
- (v) Trial run for requisite period.
- (vi) Performance testing.

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- (vii) Painting as per enclosed painting schedule (Annexure – VI). However any variation in the painting schedule as finally approved by BHEL / Customer shall be taken care by the bidder without any commercial and delivery implication. Color coding scheme shall be intimated to vendor during detail engineering.

12.0 TERMINAL POINTS

A) Condensate Polishing Plant -Service Vessel Area


- (i) Service vessel inlet for Unit – 1 (OD 457 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection at 5 meter distance near service vessel area in AB bay.
- (ii) Service vessel outlet for Unit – 1 (OD 457 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection at 5 meter distance near service vessel area in AB bay.
- (iii) Service vessel inlet for Unit – 2 (OD 457 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection at 5 meter distance near service vessel area in AB bay.
- (iv) Service vessel outlet for Unit – 2 (OD 457 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection at 5 meter distance near service vessel area in AB bay.
- (v) Rinse water outlet- Rinse water outlet piping (OD 114.3 x 6.02 mm, SA 106 Gr-C) till condenser hot well for each unit is in the scope of bidder. Distance of rinse nozzle at condenser from CPU service vessel for each unit is to be considered as 70 meter.
- (vi) Instrument air supply at 3 to 7 kg/cm² (g) – At 5 meter distance from service vessel area.
- (vii) Service air supply at 3 to 7 kg/cm² (g) – At 5 meter distance from service vessel area.
- (viii) Gland sealing water supply- At 5 meter distance from service vessel area.

B) External Regeneration Area

- (i) DM Water Supply –The DM water regeneration pumps shall be located in the DM water pump house. The number of DM water storage tanks (BHEL scope) shall be 3 Nos. Piping from each DM Water storage tank outlet nozzle to the pump suctions shall be in the scope of bidder (Distance of each DM water storage tank and pump suction to be considered as 150 meter).
- (ii) DM Pumps Recirculation Line – Piping from DM Pump recirculation line to each DM water storage tank nozzle shall be in the scope of bidder (Distance of DM Pump recirculation and each DM water storage tank to be considered as 200 meter)
- (iii) Instrument air supply at 3 to 7 kg/cm² (g) – At 5 meter distance from the regeneration building
- (iv) Service air supply at 3 to 7 kg/cm² (g) – At 5 meter distance from the regeneration building
- (v) Drinking water and service water- At 5 meter distance from the regeneration building
- (vi) N Pit Disposal Waste– CPU Regeneration waste from N pit located in CPU regeneration area will be led up to the Central monitoring basin. The piping distance between CPU Regeneration area N pit and Central monitoring basin shall be 650 meters.
Any addition / deletion in the length of piping shall be adjusted based on unit prices.

13.0 EXCLUSIONS

- (i) All civil works including foundation of equipment. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder.
- (ii) Main pipe trestles interconnecting CPU regeneration building and Service vessel Pipe trestle. However, auxiliary structure, anger/support components for piping within CPU regeneration area, in acid/alkali handling area, interconnecting acid/alkali storage area and near CPU service vessels are in bidder's scope.
- (iii) Service air, Instrument air, up to terminal points.
- (iv) All chemicals.

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- (v) Air conditioning, ventilation & fire fighting facilities.
- (vi) Other exclusions are mentioned in the electrical & C&I parts of this specification.
- (vii) Drinking water and service water.

14.0 QP AND SUB VENDOR APPROVAL

- (i) QP requirements are specified under Annexure-IIA & IIB of this section. For imported items quality plan / inspection shall be as per manufacturer's standard. BHEL reserves the right for inspection of certain imported critical items by BHEL officials (if felt necessary).
- (ii) However any additional comments as given by BHEL/Customer shall be adhered by the bidder without any commercial & delivery implication to BHEL.
- (iii) Approved sub vendor list is enclosed as Annexure-III. However any additional sub vendor shall be subject to BHEL and Customer approval.

15.0 FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

Functional Guarantees and liquidated damages shall be as per enclosed Annexure-IV.

16.0 DESIGN/ CONSTRUCTION

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


The typical P&I diagram is enclosed herein in this section for bidders 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 subject to BHEL / Customer approval during detail engineering.

17.0 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, following 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 implication. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-V.

- (a) Detailed P&ID (piping and instrument diagram) or engineering flow diagram for process and utility, showing all equipment, machinery, piping and instruments. All pipes should be indicated with diameter, pipe class, pipe number, fluid flowing through it as per the Employer's legend to be furnished later.
- (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 supplied by the Bidder.
 - (c) Detailed installation drawings for all instruments and instrumentation schedule.
 - (d) Preparation and finalization of functional write-up and detailed logic diagram, for all the control system, electrical wiring and schematic drawings for the development of logic diagrams, GA and layout drawings junction boxes, inter-connection diagram for cabling, cable schedules etc.
 - (e) Design Calculation
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.

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- (f) Detailed civil scope drawings 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 performance and guarantee tests.
- (j) Submission of O&M manuals.

18.0 MINIMUM IMPORTED ITEMS

- i) High pressure ball valve.
- ii) Resins.
- iii) Resin trap element.

19.0 BIDDER TO FURNISH FOLLOWING DOCUMENTS/INFORMATION ALONG WITH THE BID (FOR ELECTRICAL AND C&I PLEASE REFER THE RESPECTIVE SECTION OF THE SPECIFICATION).

- Detailed process write up of the system offered for information (meeting the specification requirement).
- Deviation if any in the enclosed deviation schedule with mention of specification clause for which deviation is being asked.
- Equipment layout of service and regeneration area.
- Electrical Load List

20.0 Following guaranteed chemical consumption required for regeneration (in kg) to be furnished.

- i) Acid (30% HCL) consumption per vessel per regeneration
- ii) Alkali (48% NaOH) consumption per vessel per regeneration.



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DATA SHEET-A



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1.0	DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of units	Two (2)
(ii)	Capacity of each unit	800 MW
(iii)	Total flow in all the service vessels (per unit)	1700 Tones per hour
2.0	CONDENSATE POLISHER SERVICE VESSELS PER UNIT :	
(i)	No. of condensate polisher service vessel	Three (3X33.33%)
(ii)	Capacity of each condensate polisher service vessel	33.33 % of total condensate flow per unit
(iii)	Flow through each condensate polisher service vessel per unit	570 Tones per hour
(iv)	Operating pressure of each condensate polisher service vessel	38 kg/cm ² (a)
(v)	Design pressure of each condensate polisher service vessel	47 kg./sq.cm (g)
(vi)	Design code of each condensate polisher service vessel	ASME Sec VIII Div I Ed 2010.
(vii)	Design Temp.	55 °C
(viii)	Type of vessels	Vertical (Cylindrical or spherical)
(ix)	Emergency by-pass system	Provided.
(x)	Material of construction (shell & dished ends) of each condensate polisher service vessel	Carbon steel plates to SA 516 Gr. 70 with minimum 4.5 mm thick rubber lining inside in three layers.
(xi)	Resin traps at the outlet of each condensate polisher service vessel	CSRL with SS 316 Internals
2.1	AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER UNIT	
(i)	Number per unit	Two (2x100%)
(ii)	Type	Centrifugal/Twin lobe type, oil free, positive displacement
(iii)	Duty	Intermittent
(iv)	Capacity and head/Noise Level	As required/80 dB (A) Max. at one meter
(v)	Pressure gauge	One per blower
(vi)	Location	Indoor
(vii)	Material of construction	Cast Iron



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(viii)	Dive motor	The drive motor of each air blower will be Energy Efficient-1 as per IS 12615.	
3.0	EXTERNAL REGENERATION FACILITIES		
3.1	REGENERATION VESSELS		
a.	Resin Separation & Cation Regeneration Vessel	One (1)	
b.	Anion Regeneration Unit	One (1)	
c.	Mixed Resin Storage unit	One (1)	
d.	Type	Vertical (Spherical/Cylindrical)	
e.	Material of construction (shell & dished ends)	SA 516 Gr. 70 / IS 2062 Gr A / B with minimum 4.5 mm thick rubber lining inside in three layers.	
f.	Design code	ASME sec VIII div 1 ed. 2010 / IS 2825 as applicable	
g.	Minimum Design Pressure for Pressure Vessels	8 Kg/cm ² (g) minimum	
h.	Resin traps at the common outlet header of regeneration vessels	CSRL with SS 316 Internals	
i.	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos) and other structural works for each regeneration vessel to facilitate accessibility for operation and other equipments etc.	
3.2	BULK ACID AND ALKALI STORAGE TANK		
(i)	CHEMICAL TANKS	ACID STORAGE TANK	ALKALI STORAGE TANK
(ii)	Number required	Two (2)	Two (2)
(iii)	Dimensions (diameter, length & thickness)	-----As per BS : 2594----- However minimum thickness of each acid and alkali storage tank will be 10 mm.	
(iv)	Location	-----Outdoor-----	
(v)	Useful capacity	15 M3 each	15 M3 each
(vi)	Type and Pressure class	--Horizontal with dished ends, atmospheric, above ground-----	
(vii)	Material of construction	-----IS 2062 Gr A/B-----	
(viii)	Internal painting / lining	Inside lined with Natural rubber (minimum 4.5 mm thick in three layers)	
(ix)	Concentration	30 -33 % HCl	5-48 % NaOH
(x)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders , lifting lugs (4 nos) etc.	



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3.3	ACID AND ALKALI UNLOADING / TRANSFER PUMPS		
(i)	PUMPS	ACID UNLOADING/TRANSFER PUMPS	ALKALI UNLOADING/TRANSFER PUMPS
(ii)	Number required	Two (2x100%)	Two (2x100%)
(iii)	Type	-----Horizontal Centrifugal-----	
(iv)	Pump speed	-----Maximum 1500 rpm-----	
(v)	Location	-----Outdoor-----	
(vi)	Capacity and head of each pump	-----10 cum / hr and 10 mlc minimum-----	
(vii)	Liquid to be handled	30 -33 % HCL	5-48% NaOH
(viii)	Type of shaft sealing	-----Mechanical Seal-----	
(ix)	Material of construction	Polypropylene	Stainless Steel (SS) – 316
(x)	Reinforced rubber hosed	Minimum two nos of size 80 NB of minimum 20 meters length with isolation valve	Minimum two nos of size 80 NB of minimum 20 meters length with isolation valve
(xi)	Pressure gauge	-----One per pump with teflon diaphragm seal.-----	
(xii)	Pressure Dampener	-----One per pump-----	
(xiii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc.	
(xiv)	Dive motor	The drive motor of each Pump will be Energy Efficient-1 as per IS 12615.	
3.4	CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM		
a)	ALKALI TRANSFER PUMPS		
(i)	Nos. required	Two (2x100%)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Concentration of working media.	5-48% Sodium Hydroxide (NaOH)	
(v)	Capacity & head	10 M3/hr (Minimum), 10 MWC (Minimum)	
(vi)	Suction condition	Flooded	

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(vii)	Materials of construction			
1)	Casing, impeller	Stainless Steel – 316		
2)	Shaft	Stainless Steel -410		
(viii)	Pressure gauge	One per pump with teflon diaphragm seal		
(ix)	Pressure Dampener	One per pump		
(x)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc.		
(xi)	Dive motor	The drive motor of each Pump will be Energy Efficient-1 as per IS 12615.		
b)	CHEMICAL TANKS	ALKALI PREPARATION TANK	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)	One (1)
(ii)	Type	-----Vertical Cylindrical Atmospheric with dished bottom and cover at top-----		
(iii)	Useful capacity	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	Adequate to hold quantity of acid required (30-33% HCl) for single regeneration of a condensate polisher mixed bed with 20% overall margin.
(iv)	Material (Shell, Dished end & top cover)	-----IS 2062 Gr. A/B ----- ---Inside lined with Natural rubber (minimum 4.5 mm thick in three layers)---		
(v)	External protection	----- Chlorinated rubber paint -----		
(vi)	Vent, Overflow, drain connection	-----Required -----		
(vii)	Level indicator	-----Gauge glass with overlap -----		
(viii)	Level transmitter per tank	One (1)	One (1)	One (1)
(ix)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max. Material of Construction of each stirrer and agitator = Stainless Steel – 316.		Not Applicable.
(x)	Drive motor of each stirrer	-----The drive motor of each stirrer will be Energy Efficient-1 as per IS 12615-----		Not Applicable.



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(xi)	Dissolving Basket per tank	-----Provided (50-60 mesh B.S.)----- -----Material of Construction of each Dissolving Basket = Stainless Steel – 316. -----	Not Applicable.
(xii)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 nos) etc.	
c)	DOSING PUMPS	ACID DOSING PUMPS	ALKALI DOSING PUMPS
(i)	Number	Two (2x100%)	Two (2x100%)
(ii)	Type	---Simplex positive displacement hydraulically operated diaphragm type-----	
(iii)	Accessories		
1)	Pressure Dampener	One per pump	One per pump
2)	External safety relief valve (in addition to inbuilt safety valve)	Two. Material of Construction of each External safety relief valve = Poly propylene.	Two. Material of Construction of each External safety relief valve = Stainless Steel – 316.
(iv)	Pressure gauge	-----One per pump with teflon diaphragm seal-----	
(v)	Maximum pump stroke speed per minute	----- 100 -----	
(vi)	Material of construction		
1)	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.).	Polypropylene	SS 316
2)	Diaphragm	PT.F.E.	P.T.F.E.
3)	Packing	P.T.F.E.	P.T.F.E.
4)	Shaft	----- Hardened steel EN 8 (BS:970)-----	
5)	Worm & worm wheel(if applicable)	----- Manganese Bronze-----	
6)	Connecting rod	-----Manganese Bronze -----	
7)	Cross head guide	-----Bronze-----	
(vii)	Capacity & Head	Capable of meeting regeneration of one cation/Anion and one mixed bed unit (with 20% margin); head as required (with 20% margin).	
(viii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc.	
(ix)	Drive motor of pump	The drive motor of each pump will be Energy Efficient-1 as per IS 12615	



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3.5	ACTIVATED CARBON FILTER FOR ALKALI	
(i)	Number	One (1)
(ii)	Type	Vertical cylindrical with dished end bottom and cover at top
(iii)	Effective Capacity in cum	Minimum 10 CuM/Hr
(iv)	Time period for each service cycle between two consecutive regenerations, in hours	24
(v)	Design Surface flow rate in m ³ /hr/m ²	Not more than 12
(vi)	Design temp in deg C	60
(vii)	Filter Media	
a)	Type	Activated Carbon
b)	Bed depth in mm	Activated Carbon – minimum 1500 mm and support gravel – minimum 400 mm
(viii)	Material of construction	
a)	Shell & Dish ends	ASTM A 516 Gr 70/ IS 2062 Gr A/B
(ix)	Design code	ASME sec VIII div 1 ed. 2010 / IS 2825 as applicable
(x)	Minimum Design Pressure	8 Kg/cm ² (g) minimum
(xi)	Protection	
a)	Internal	Inside lined with Natural rubber (minimum 4.5 mm thick in three layers)
(xii)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc.
3.6	ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)	
(i)	Number	One (1)
(ii)	Type/Capacity	Vertical Cylindrical with dished end with Electric heater / 120% of water required for regeneration.
(iii)	Temperature of alkali to be heated	To obtain temp of 50°C at alkali mixing feed out let.
(iv)	Temperature gauge	To be provided by the bidder
(v)	Temp. transmitters	To be provided by the bidder
(vi)	Burn out protection	To be provided by the bidder



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(vii)	Material of construction of tank:	
(viii)	Shell & Dished end	ASTM A 516 Gr 70/ IS 2062 Gr A/B Inside lined with Natural rubber (8 mm thick in six layers) suitable up to a temperature of 70 deg C.
(ix)	Design code	ASME sec VIII div 1 ed. 2010 / IS 2825 as applicable
(x)	Minimum Design Pressure	8 Kg/cm ² (g) minimum
(xi)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc.
3.7	D.M. WATER PUMPS FOR REGENERATION AND RESIN TRANSFER	
(i)	Number	Two (2x100%)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Continuous
(iv)	Capacity & head	As required (with 20% margin)
(v)	Suction condition	Flooded
(vi)	Material of construction	
	• casing, impeller	SS 316
	• Shaft	SS 410
	• shaft sleeve material	SS 410
(vii)	Packing seal	Mechanical type
(viii)	Pump Speed	Maximum 1500 rpm
(ix)	Pressure gauge	One for each pump with teflon diaphragm seal.
(x)	Recirculation line with motor actuated butterfly valve	Required
(xi)	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener.
(xii)	Dive motor	The drive motor of each Pump will be Energy Efficient-1 as per IS 12615.
3.8	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA)	
(i)	Number	Two (2x100%)
(ii)	Type	Centrifugal/Twin lobe type, oil free, positive displacement
(iii)	Duty	Intermittent



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(iv)	Capacity and head/Noise Level	As required/80 dB (A) Max. at one meter	
(v)	Pressure gauge	One per blower	
(vi)	Location	Indoor	
(vii)	Material of construction	Cast Iron	
(viii)	Dive motor	The drive motor of each air blower will be Energy Efficient-1 as per IS 12615.	
4.0	NEUTRALISING SYSTEM		
4.1	NEUTRALIZATION PIT (N PIT)		
(i)	Material of Construction	RCC with acid / Alkali Resistant tiles.	
(ii)	No. of compartments	One with two compartments	
(iii)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of a condensate polisher mixed bed and RO DM Plant+ 20% overall margin. However minimum capacity of each Compartment will be 500 M3.	
4.2	NEUTRALIZATION PIT DISPOSAL PUMPS		
(i)	Number	Two nos (1 working + 1 Standby)	
(ii)	Type	Horizontal Centrifugal	
(iii)	Suction Condition	Suction from priming Chamber/ Submerged (Suction from pit)	
(iv)	Number of priming chamber	Two	
(v)	Capacity & head	Suitable to pump the total volume of one section in 8 hours (minimum 50 m3/hr). Head as per system requirement (25 MWC minimum).	
(vi)	Material of construction		
a)	casing, impeller	SS 316L	
b)	Shaft	SS 410	
(vii)	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, 'Y' type strainer, pressure gauges, pulsation dampener etc.	
(viii)	Dive motor	The drive motor of each Pump will be Energy Efficient-1 as per IS 12615.	
4.3)	CHEMICAL TANKS FOR N PIT	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)



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(ii)	Type	----Vertical Cylindrical Atmospheric with dished bottom and cover at top----	
(iii)	Useful capacity	Adequate to hold quantity of alkali required for neutralization of excess acid in waste effluent generated due to single regeneration of a condensate polisher mixed bed + RO DM Plant regeneration waste with 20% overall margin or 2 cum whichever is higher.	Adequate to hold quantity of alkali required for neutralization of excess acid in waste effluent generated due to single regeneration of a condensate polisher mixed bed + RO DM Plant regeneration waste with 20% overall margin or 2 cum whichever is higher.
(iv)	Material (Shell, Dished end & top cover)	-----IS 2062 Gr. A/B----- ---Inside lined with Natural rubber (4.5 mm thick in three layers)---	
(v)	Drive motor of each stirrer	The drive motor of each stirrer will be Energy Efficient-1 as per IS 12615	
(vi)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders , lifting lugs (4 nos) etc.	
5)	PIPING & VALVES		
(i)	Resin Transfer piping (full Port Ball Valves)	ASTM A 312 Gr. TP 304 Minimum Pipe Size: NB80 Velocity: 2-3 m/s	
(ii)	DM water line	Carbon Steel Rubber Lined (4.5 mm Thick rubber lining in three layers)	
(iii)	Piping – Service vessel Inlet	Piping-ASTM A 106 Gr C BFV – A 216 WC B Ball Valves – SS CF8M	
(iv)	Piping – Service vessel Outlet	Piping – ASTM A 106 Gr.C BFV – SS CF8M Ball Valves – SS CF8M	
(v)	Service vessel bypass piping Butterfly Valves of flangeless water type)	Piping – ASTM A 106 Gr. C BFV – A 216 WCB	
(vi)	Service vessel rinse piping	CS to ASTM A 106 Gr. C	
(vii)	Backwash, Acid & Alkali Regeneration piping (Diaphragm Valves)	> NB65 MSRL ≤ NB 50 SS304	
(viii)	Acid / Alkali Transfer piping (Diaphragm Valves)	ASTM A 312 Gr. TP 304 / MSRL Valves – CI RL + SS 316 Compressor	
(ix)	Effluent Transfer Piping (Diaphragm Valves)	HDPE	
(x)	Instrument Air piping (Full Port Ball Valves)	IS 1239 Galvanized	



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(xi)	BUTTERFLY VALVES	<p>Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or BS:5155 PN 10 (min.)</p> <p>Condensate polishing plant outlet butterfly valves shall be of stainless steel construction, SS-316 (for body, disc and shaft). Condensate polishing plant inlet butterfly valves shall be of Carbon Steel construction.</p> <p>For DM water services stainless steel body valves to ASTM A 351 Gr. 351 Gr. CF8M or CI body with suitable elastomer/rubberlining for wall internal and/or disc shall be provided. The type of valve for DM water application shall be diaphragm valve or rubber lined butterfly valves.</p> <p>All the butterfly valves shall be provided with Hand wheel or lever as per the requirements.</p> <p>For larger sizes i.e. 150 NB and above hand wheel shall be provided. For lever/wrench operated valves, means shall be provided by the bidder for positively holding the disc in not less than three intermediate positions.</p> <p>Manually operated valves shall be provided by the bidder with reduction gear unit for valves of size 250 NB and above. Valve provided with motorised or pneumatic actuator shall be provided by the bidder with a hand wheel for manual operation.</p> <p>All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Handwheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard.</p> <p>All the butterfly valves shall be provided by the bidder with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 Cl.300 (min.)</p> <p>Butter fly valves at the by pass line of service vessel shall be flangeless wafer type (A216 WCB)</p>
(xii)	DIAPHRAGM VALVE	<p>The Diaphragm shall conform to following requirement for DM water application</p> <p>i) Design standard: BS:5156 or equivalent of required rating/class. (minimum rating of valves shall be PN 10).</p> <p>ii) Type: Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type</p> <p>iii) Material of Construction</p> <ol style="list-style-type: none"> Body , Bonnet: Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB Body lining : Soft natural rubber, ebonite , Polypropelene Handwheel : Cast Iron Compressor : Stainless Steel Stem and Bush : Stainless Steel <p>For Acid and Alkali services the valve shall conform to above (as mentioned for DM water) except that the diaphragm shall be of reinforced Teflon , EPDM/Black Butyl/ approved equivalent for acid services and reinforced neoprene/Hypalon/approved equivalent for alkali services.</p>
(xiii)	ECCENTRIC PLUG VALVE/ BALL VALVE	<p>These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.</p>
(xiv)	Safety Equipments	<p>Two (2) sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. One number personnel water drench shower/safety shower and eye bath in regeneration area shall be provided by the bidder.</p>



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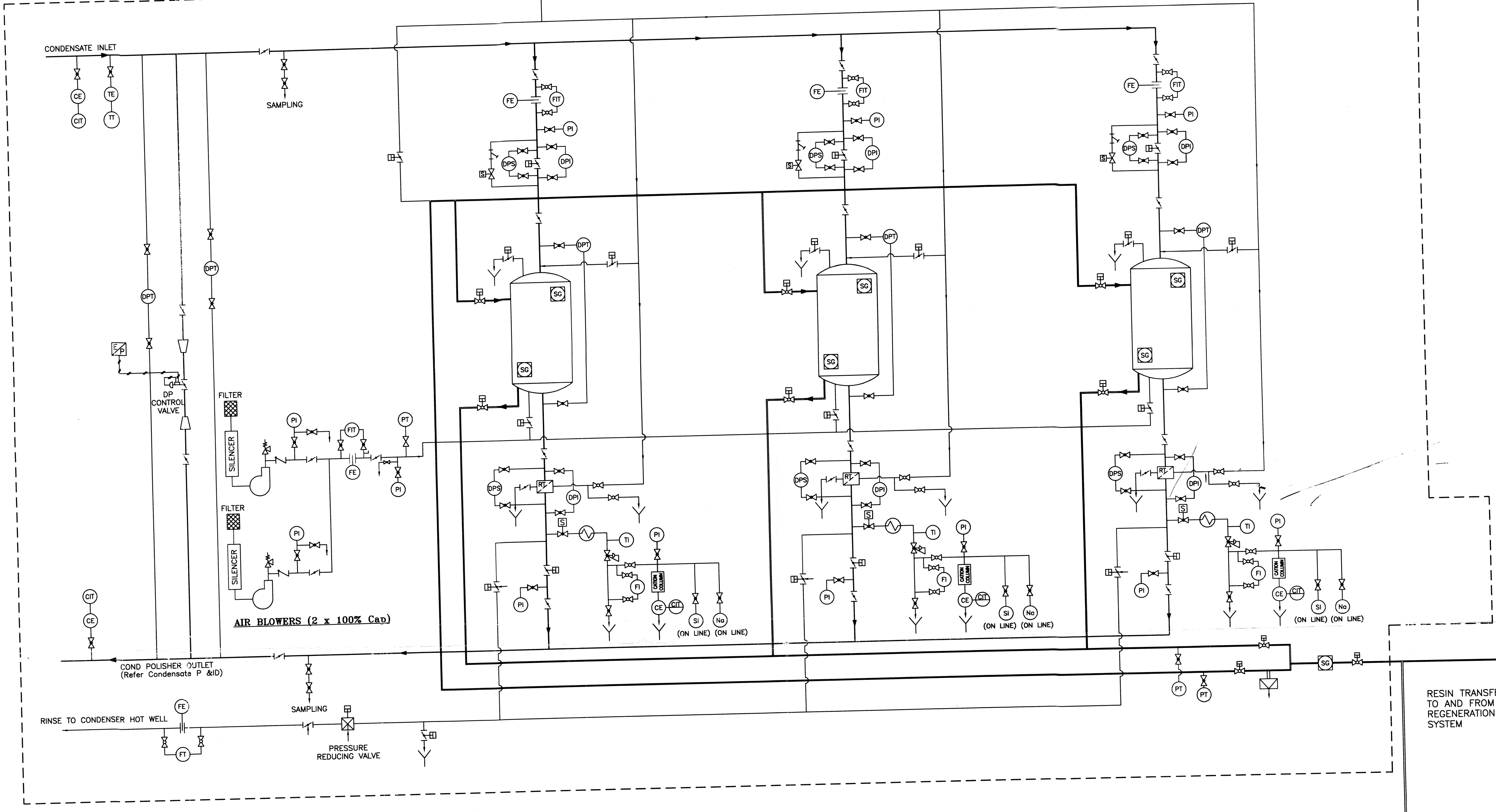
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P&ID

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ON DIMENSION

CONDENSATE POLISHING FOR UNIT # 2



FOR CONTINUATION REFER SHEET 2 OF 2 OF THIS DRAWING

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NOTES :

1. THE P&I DIAGRAM IS INDICATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT, TROUBLE FREE OPERATION OF PLANT FOR BHEL/CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
2. [Symbol] INDICATES TERMINAL POINTS BETWEEN BHEL & BIDDER:
3. SERVICE VESSELS OF SPHERICAL DESIGN IS ALSO ACCEPTABLE.
4. ALL THE INSTRUMENT ISOLATION VALVES OTHER THAN FOR ACID/ALKALI APPLICATION SHALL BE GLOBE PATTERN AND DIAPHRAGM TYPE FOR ACID/ALKALI APPLICATION TO BE PROVIDED AT SOURCE. NEAR THE INSTRUMENT 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS, 3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS, 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS, ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
5. WHERE EVER PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
6. ACID/ALKALI/DM LINE PR. INSTRUMENTS SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
7. FLOW TOTALISATION SHALL BE DONE IN SOFTWARE.
8. DP CONTROL VALVE BETWEEN INLET/OUTLET OF CPU SHALL BE MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, POS. XMTR, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
9. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
10. ALL THE TRANSMITTERS PROCESS ACTIVATED SWITCHES ARE TO BE CONNECTED TO DDCMIS.
11. BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE.
12. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.

CONDENSATE POLISHING FOR UNIT # 1 (TYPICAL)

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE		DRAIN
	BUTTERFLY VALVE		OVERFLOW SEAL POT/CO2 ABSORBER
	GLOBE VALVE		RUPTURE DISC
	DIAPHRAGM VALVE		PRESSURE REDUCING VALVE
	MOTORISED VALVE		CONDENSATE LINE
	PRESSURE RELIEF VALVE		D.M.WATER/DRAIN LINE
	NON RETURN VALVE		RINSE WATER LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ACID SOLUTION LINE
	SOLENOID VALVE		ALKALI SOLUTION LINE
	RESIN TRAP		RESIN TRANSFER LINE
	SIGHT GLASS		FIELD MOUNTED INSTRUMENT
	DOUBLE ACTING PNU.CYLINDER OPERATOR		PANEL MOUNTED INSTRUMENT
	PNEUMATICALLY OPERATED CONTROL VALVE		PULSATION DAMPER
	'Y' TYPE STRAINER		DIAPHRAGM SEAL

- CS CONTROL SYSTEM
- LS LEVEL SWITCH
- TI TEMPERATURE TRANSMITTER
- PI PRESSURE INDICATOR
- PT PRESSURE TRANSMITTER
- TI TEMPERATURE INDICATOR
- FI FLOW INDICATOR
- CE CONDUCTIVITY ELEMENT
- FT FLOW TOTALISIZER
- DPI DIFF. PRESSURE INDICATOR
- DPS DIFF. PRESSURE SWITCH
- FIT FLOW INDICATOR TRANSMITTER
- FE FLOW ELEMENT
- CT CONDUCTIVITY TRANSMITTER
- DPT DIFF. PRESSURE TRANSMITTER
- FS FLOW SWITCH
- CIT CONDUCTIVITY INDICATING TRANSMITTER
- DT DENSITY TRANSMITTER
- TE TEMPERATURE ELEMENT
- LI LEVEL INDICATOR
- PHE pH ELECTRODE
- PHAT pH ANALYSER TRANSMITTER
- ORIFICE (Pressure Breakdown)
- SI SILICA ANALYSER (ON LINE)
- Na SODIUM ANALYSER (ON LINE)

JOB NO. : 362	STATUS : CONTRACT
DISTRIBUTION :	
TO :	
VAL OF :	
REV :	
DATE :	
ALD :	
CHD :	
APPO :	

2XB00 MW YERMARUS STPP
RAICHUR POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
 POWER SECTOR
 PROJECT ENGINEERING MANAGEMENT
 NEW DELHI

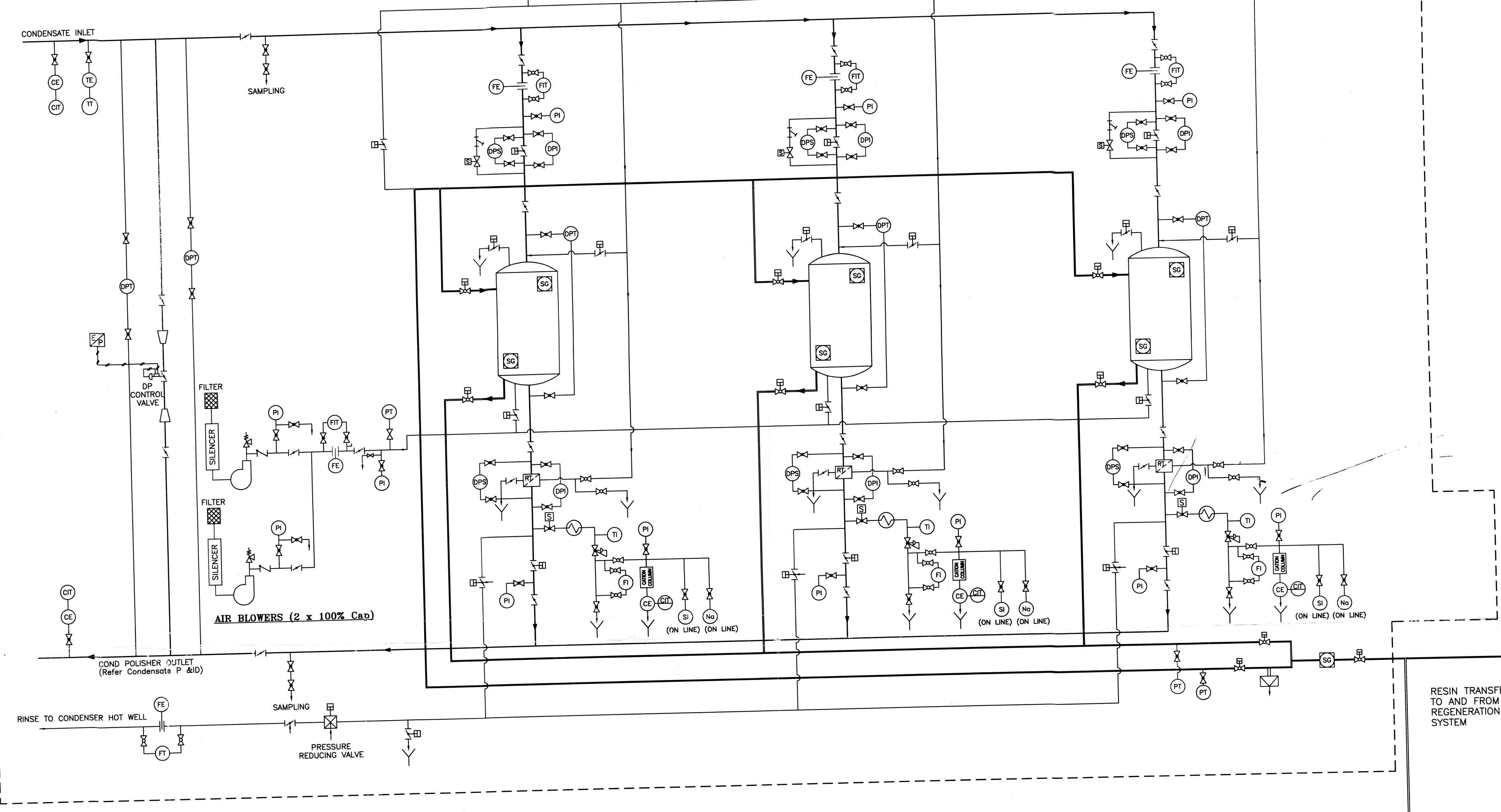
P & I DIAGRAM CONDENSATE POLISHING PLANT

DRAWING NO. **PE-DG-362-155-A001**
 SHEET 01 OF 02 REV. 0
 DEPT. SCALE NTS
 DATE

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100V-DG-362-155-A001
ON DIMENSION

CONDENSATE POLISHING FOR UNIT # 2



FOR CONTINUATION REFER SHEET 2 OF 2 OF THIS DRAWING

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5. WHERE EVER PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
6. ACID/ALKALI/DM LINE PR. INSTRUMENTS SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
7. FLOW TOTALISATION SHALL BE DONE IN SOFTWARE.
8. DP CONTROL VALVE BETWEEN INLET/OUTLET OF CPU SHALL BE MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, POS. XMTR, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
9. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
10. ALL THE TRANSMITTERS PROCESS ACTIVATED SWITCHES ARE TO BE CONNECTED TO DDCMIS.
11. BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE.
12. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.

CONDENSATE POLISHING FOR UNIT # 1 (TYPICAL)

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE		DRAIN
	BUTTERFLY VALVE		OVERFLOW SEAL POT/CO2 ABSORBER
	GLOBE VALVE		RUPTURE DISC
	DIAPHRAGM VALVE		PRESSURE REDUCING VALVE
	MOTORISED VALVE		CONDENSATE LINE
	PRESSURE RELIEF VALVE		D.M.WATER/DRAIN LINE
	NON RETURN VALVE		RINSE WATER LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ACID SOLUTION LINE
	SOLENOID VALVE		ALKALI SOLUTION LINE
	RESIN TRAP		RESIN TRANSFER LINE
	SIGHT GLASS		FIELD MOUNTED INSTRUMENT
	DOUBLE ACTING PNU.CYLINDER OPERATOR		PANEL MOUNTED INSTRUMENT
	PNEUMATICALLY OPERATED CONTROL VALVE		PULSATION DAMPER
	'Y' TYPE STRAINER		DIAPHRAGM SEAL

- CS CONTROL SYSTEM
- LS LEVEL SWITCH
- TT TEMPERATURE TRANSMITTER
- PI PRESSURE INDICATOR
- PT PRESSURE TRANSMITTER
- TI TEMPERATURE INDICATOR
- FI FLOW INDICATOR
- CE CONDUCTIVITY ELEMENT
- FT FLOW TOTALISIZER
- DPI DIFF. PRESSURE INDICATOR
- DPS DIFF. PRESSURE SWITCH
- FIT FLOW INDICATOR TRANSMITTER
- FE FLOW ELEMENT
- CT CONDUCTIVITY TRANSMITTER
- DPT DIFF. PRESSURE TRANSMITTER
- FS FLOW SWITCH
- CIT CONDUCTIVITY INDICATING TRANSMITTER
- DT DENSITY TRANSMITTER
- TE TEMPERATURE ELEMENT
- LI LEVEL INDICATOR
- PHE pH ELECTRODE
- PHAT pH ANALYSER TRANSMITTER
- ORIFICE (Pressure Breakdown)
- SI SILICA ANALYSER (ON LINE)
- Na SODIUM ANALYSER (ON LINE)

COMPUTER FILE NAME : C:\Documents And Settings\1612099\Local Settings\Temporary Internet Files\Content.Outlook\DD016A99\CPU_PID_YERMARUS.dwg


JOB NO. : 362
STATUS : CONTRACT
DISTRIBUTION :
TO :
VAL OF :
REV DATE ALD CHD APPD

2X800 MW YERMARUS STPP
RAICHUR POWER CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI


TITLE
P & I DIAGRAM CONDENSATE POLISHING PLANT

DEPT. SCALE NTS
SIGN DATE
DRAWING NO.
PE-DG-362-155-A001
SHEET 01 OF 02 REV. 0
FORMAT SIZE A4

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	VOLUME-IIB	
		SECTION - C1	
	2X800 MW YERMARUS STPP	REV. NO. 00	DATE: 14/12/11

ANNEXURE – II A

QUALITY PLANS

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	VOLUME-IIIB	
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QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within Bidder's works or at his Sub-contractor's premises or at the Customer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. A quality assurance program of Bidder shall generally cover the following:

- a) His organizational structure for the management and implementation of the proposed quality assurance program.
- b) Documentation control system.
- c) Qualification data for Contractor's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorizing release of manufactured product to the Customer / BHEL.
- l) System for handling storage and delivery.
- m) System for maintenance of records.
- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE


2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. The detailed Quality Plans for manufacturing and field activities should be drawn up by Bidder, separately and shall be submitted to BHEL / Customer authorized representative for approval.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards and quality practices and procedures followed by Contractor's Quality Control department, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by Bidder's site Quality Control department, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 Bidder shall submit quality plan for major manufacturing items. These Quality plans will be subject to BHEL and customer's approval without which manufacture shall not proceed. In these approved quality plans, BHEL / Customer's authorized representative shall identify

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customer hold points (CHP), test/checks which shall be carried out in presence of the BHEL / Customer's Engineer or his authorized representative and beyond which the work will not proceed without consent of BHEL / Customer's authorized representative in writing.

- 2.05.00 No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by BHEL / Customer's authorized representative, and duly authorized for dispatch issuance of Material Dispatch
- 2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it. Correlation of test certificate is envisaged for IBR items only. For other items material specification shall be ensured by Bidder. The modalities of QA plan submission, review, approval, inspection, issue of MDCC etc shall be discussed and finalized during detail engineering stage.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, and mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the BHEL / Customer. All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the BHEL / Customer. Bidder shall engage qualified welders only.
- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- 2.10.00 All the sub-vendors proposed by Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by Bidder and finalized with the BHEL / Customer shall be subject to BHEL / Customer's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the BHEL / Customer authorized representative.
- 2.11.00 Quality requirements for main equipment shall equally apply for spares and replacement items.
- 2.12.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the BHEL / Customer.
- 3.00.00 QUALITY ASSURANCE DOCUMENTS**
- 3.01.00 Bidder shall be required to submit two (2) copies and two (2) sets of electronic files of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment :

Certificates as required by code of construction shall be submitted.

- a) Material mill test reports of the components.

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- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Customer and BHEL and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded:
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.


4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Engineer, his duly authorized representative and/or an outside inspection agency acting on behalf of the BHEL / Customer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, Bidder shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on Bidder's own premises or works.

4.02.00 Bidder shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to Bidder's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in

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writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.


- 4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the BHEL / Customer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of Bidder or any sub-contractor, Bidder, except where otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with Bidder and shall give facilities to the Engineer/Inspector or to his authorized representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

Sr.No.		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN						PROJECT 2X800 MW YERMARUS STPP	
		COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1		2	3	4	5	6	7	8	9	10	11
1.	Welding Procedure Qualifications	Strength of parent material, weldment, Combination of Electric characteristics, Joint preparation	Major	Visual & Performance test	100%	ASME Sec. IX	ASME Sec. IX	ASME Sec. IX	QW 483 Of ASM E SEC IX	P V	Only Qualified welders & proven WPS to be used. And in case if welders are already qualified by the customer and doing similar job, re-qualification is not required.
2.	Welders performance Qualification	Welders ability to Perform as per appd. Procedure	Major	Visual & Performance test	100%	ASME Sec. IX	ASME Sec. IX	ASME Sec. IX	QW 484 of ASM E SEC IX	P V	-DO-
3.	Identification of Material - Plates	Mechanical & Chemical prop. NDT on plates	Major	Phy & Chem. UT	1/heat 100%	Matsl spec./ Appd Drg ASME SA-578	Matsl specs./ Appd Drg ASME SA-578	Mfg or Lab test report NDT report	√	P V	# Please refer note no. 5
MANUFACTURER/ SUBCONTRACTOR		CONTRACTOR		LEGEND: Records identified with "Tick" shall be essentially included by contractor in QA documentation M: manufacturer/ subcontractor C: contractor N: customer P-perform W-witness & V- verification as appropriate" CHP"							

1	MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT 2X800 MW YERMARUS STPP				
	ITEM: CONDENSATE POLISHING UNIT (SERVICE VESSEL)	QPNO. DATE	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	ANNEXURE - II B				
Sr.No.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	M C N	11	


5) FINAL INSPECTION												
a)	Final Dimensions	Dim. Conformity	Major	Visual	100%	Appd Drg.	Appd Drg.	IR	P	W	V	
b)	Hydro test	Pressure testing	Crit.	Hydro	100%	Appd Drg.	No pressure Drop/leakage	IR	✓	P	V	
c)	Rubber lining				As per separate QP							# Please refer note no 8 R/L to be done by approved Rubber liner.
d)	Review of documents	Verification	Major	Visual	100%	Appd Drg.	Appd Drg.	IR	P	V	V	
e)	Surface preparation (Sand-Blast & Wire brush) & primer At works	Cleanliness	Minor	Visual	100%	Mfg std	No defects/damage	IR	P	-	-	
f)	Preshipment checks	Completeness	Minor	Visual	100%	Mfg std	No Damage	IR	P	-	-	

MANUFACTURER/SUBCONTRACTOR	CONTRACTOR	LEGEND:	Records identified with "Tick" shall be essentially included by contractor in QA documentation M: manufacturer/ subcontractor C: contractor N: Customer P-perform W- witness & V- verification as appropriate" CHP"


	TITLE: TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT 2X800 MW YERMARUS STPP	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
		VOLUME-IIB	
		SECTION - C1	
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ANNEXURE-III


SUB-VENDOR LIST

	TITLE:	BHEL DOCUMENTS NO.: PE-TS-362-155-A001	
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SNo	ITEM	SUPPLIERS	PLACE	QP / INSPN CAT	REMARKS
1	SERVICE VESSELS	R&C	MUMBAI		
		ISGEC	YAMUNANAGAR		
		ANUP ENGG.	AHMEDABAD		WITH LLOYDS APPD'HEAT TREATMENT AGENCY
2	ACTIVATED CARBON	INDUSTRIAL CARBON	ANKLESHWAR		
		VVD & SONS	TUTICORIN		
		GLOBAL ABSORBANT	KOLKATA		
3	AIR BLOWERS	SWAN PNEUMATIC	NOIDA		
		EVEREST TRANSMISSION	NEW DELHI		
		KAY INTERNATIONAL	NEW DELHI / SONEPAT		
		EVEREST BLOWER	BAHADURGARH		UPTO 15 BHP
4	METERING PUMPS (DIAGRAPHGRAM TYPE)	VK PUMPS	NASIK		
		MILTON ROY INDIA	CHENNAI		
		SWELLORE	AHMEDABAD		
5	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI		
		FIBRE & FIBRE	MUMBAI / SILVASA		
6	HORIZONTAL CENTRIFUGAL PUMPS	KBL	WADI		
		MATHER & PLATT	PUNE		
		KSB	PUNE		
		SAM TURBO IND LTD	COIMBATORE		
		KISHOR PUMPS	PUNE		
		SULZER PUMP INDIA	PUNE		
		WPIL	GHAZIABAD		
7	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHOR PUMPS	PUNE		
		SU MOTORS	MUMBAI		
8	MISC. PUMP VERTICAL TURBINE	KBL	PUNE		
		M&P	PUNE		
		WPIL	GHAZIABAD		
		JYOTI PUMPS	VADODRA		
		VOLTAS	PUNE		
9	RESIN TRAP ELEMENT	JHONSONS SCREEN			

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	FOR SERVICE AREA			
	UNDER BED NOZZLE FOR CPU VESSEL	JONSONS SCREEN		
10	RESIN	ROHM & HASS	FRANCE.	
		BAYERS	GERMANY.	
11	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
12	CCS VALVES	LEADER ENGG WORKS	JALANDHAR	
		FOURESS ENGINEERING	AURANGABA D	
		KSB	COIMBATORE	
		BDK	HUBLI	
		AUDCO	CHENNAI	
		KBL	PUNE	
		KBL	KONDHAPU	
13	BALL VALVE (NON FIRE SAFE TYPE)	PEC	NASIK	
		FLOWCHEM	AHEMDABAD	
		BDK	HUBLI	
		AUDCO	CHENNAI / KANCHIPURA M	
		MICROFINISH VALVES	HUBLI	
		AK INDUSTRIES	HUBLI	
		LEADER	JALANDHAR	
14	ANGLE VALVE	VELAN INC	CANADA	
		IL	PALGHAT	
		REINEKE	GERMANY	
		SAMPELL AG	GERMANY	
15	HIGH PRESSURE BUTTERFLY VALVE / CONTROL VALVE	DeZURICK (Upto 400 NB)	USA	
		TYCO (UPTO 450 NB)		
16	BALL VALVE (HIGH PRESSURE)	VELAN	CANADA	
17	SS BALL VALVE 150 LBS	BDK	HUBLI	
		AUDCO	CHENNAI	UPTO 200 NB
		MICRO FINUISH	HUBLI	UPTO 40 NB
		BRAY	CHINA	
18	BUTTER-FLY VALVE (MANUAL / PNEUMATIC) UPTO 200 CLASS 150	AUDCO	CHENNAI	
		DAMBALA VALVES	THANE	
		BDK VALVES,	HUBLI	
		CRANE FLOW PROCESS	SATARA	

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19	DUAL PLATE TYPE NON-RETURN VALVE (SS & CI UPTO 100 NB, CLASS 150)	ADVANCE VALVES BDK VALVES, R& MULTIPLES	NOIDA HUBLI VALSAD	
20	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) UPTO 80 NB	BDK CRANE FLOW PROCESS	HUBLI SATARA	
21	GATE / GLOBEVALVES UP TO 300 NB PN 10	LEADER H SARKAR BANKIM & COMPANY	JALANDHAR HOWRAH HOWRAH	
22	CHECK VALVE / NRV (LINED / UNLINED), FLAP TYPE SIZE UPTO 50 NB	MAJESTIC WORKS BDK H SARKAR LEADER (FOR CHECK VALVE ONLY)	MUMBAI HUBLI HOWRAH JALANDHAR	
23	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	OTOKLIN GRAND PRIX JAYPEE GREAVES COTTON MULTITEX	MUMBAI NEW DELHI NEW DELHI MUMBAI NEW DELHI / NOIDA	
24	MS PIPES (IS: 1239 & 3589)	SAIL JINDAL TUBES SURYA ROSHINI TISCO WELSPUN MSL (FOR IS 3589)	ROURKELA. GAZIABAD BHADURGAR H JAMSHEDPUR ANJAR RAIGAD	UPTO 350 NB UPTO 300 NB UPTO 150 NB UPTO 400 NB 200 NB TO 500 NB
25	SS PIPES (ERW / SEAMLESS) UPTO 100 NB	RATNAMANI REMI APEX TUBES PVT LTD (Approved for SS welded pipes up to 150 NB & 4.78 mm thick as per ASTM A 312 & seamless pipe up to 50 NB as per ASTM A 312)	CHATTRAL TARAPUR BEHROR (ALWAR)	
26	CS PIPE (ASTM A 106 GR. B) UPTO 400 NB	INDIAN SEAMLESS METAL TUBES MAHARASHTRA SEAMLESS	AHMEDABAD RAIGAD	UPTO 150 NB UPTO 350 NB
27	VERTICAL TURBINE PUMPS	KBL WPIL LTD	KILOSARWADI KOLKOTA	



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		SAM INDUSTRIAL PUMPS	COIMBATORE		
		FAIR BANK MORSE/FLOW MORE	SAHIBABAD		
		KISHORE PUMPS	PUNE		
28	PLC	ABB	BANGLORE		
		GE FANUC	BANGLORE		
		L& T LTD	MUMBAI		
		ROCKWELL	GHAZIABAD		
		SIEMENS	NASIK		
		SCHNEIDER ELECTRIC	NEW DELHI		
29	CONTROL VALVE	CONTROL COMPONENT INC	USA		
		DRESSER	COIMBATORE		
		FISHER XOMOS	CHENNAI		
		FISHER CONTROLS	UK/ USA		
		DRESSER MESONILAN	FRANCE		
		WEIR VALVES	UK		
		IL	PALGHAT		
		MIL CONTROLS	ALWAYE		
		NIPPON FISHER	JAPAN		
		COPEVALCUN	UK		
		EMERSON	FRANCE		
30	LEVEL GAUGE	LEVCON	KOLKATA		
		SBEM	PUNE		
		SIGMA	MUMBAI		
		V. AUTOMAT	NEW DELHI		
		PUNE CONTROL	PUNE		
		CHEMTROLS	GOA		
		DK INSTRUMENTS	KOLKATA		
		SCIENTIFIC DEVICES	MUMBAI		
31	LEVEL SWITCH (FLOAT / DISPLACER TYPE / CAP TYPE)	LEVCON	KOLKATA		
		TRANSDUCERS & CONTROLS	HYDERABAD		
		SBEM	PUNE		
32	LEVEL TRANSMITTER (CAPACITANCE TYPE)	E&H	GERMANY		
		LEVCON	KOLKATA		
		PUNE TECHTROL	PUNE		
		MAGNETROL	BELGIUM		
		NIVO CONTROL	INDORE		
		SBEM	PUNE		

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		WIKA	PUNE		
33	LEVEL TRANSMITTER (GUIDED WAVE RADAR)	K TECH	USA		
		E&H	GERMANY		
		EMERSON (SAB ROSEMOUNT)	SWEDEN		
		MAGNETROL	BELGIUM		
		EMERSON	DAMAN		
		CHEMTROL	GOA		
34	LEVEL TRANSMITTER (ULTRASONIC TYPE)	KAB INSTRUMENTS	SOUTH AFRICA		
		SIEMENS MILLTRONICS	CANADA		
		K TECH	USA		
		E&H	GERMANY		
		KRISTLER MORSE	USA		
		EMERSON	USA / DAMAN		
35	SILICA ANALYSER	POLYTRON / HACH ULTRA	FRANCE		
		ABB	UK		
		HACH	USA		
36	SODIUM ANALYSER	POLYTRON / HACH ULTRA	FRANCE		
		ABB	UK		
		ORION	USA		
		SWAN	USA / EUROPE		
37	ANALYTICAL INSTRUMENTS	HACH (POLYMETRON)	FRANCE		
		ABB	UK / USA / FARIDABAD		
		EMERSON	USA / DAMAN		
38	PRESSURE AND DIFFERENTIAL PRESSURE GAUGE	A.N.INST	KOLKATTA		
		WAREE INSTRUMENTS LTD	MUMBAI		(ONLY FOR PRESSURE GAUGE)
		SWITZER INSTRUMENTS LIMITED	CHENNAI		(ONLY FOR DIFFERENTIAL PRESSURE GAUGE)
		GENERAL INST CONSORTIUM	MUMBAI / GOA		
		H.GURU (SI) PVT LTD	BANGLORE		
		BUDENBERG GAUGE CO LTD	UK		WITH IMPORTED BOURDON TUBE FOR PRESSURE GAUGE
		MANOMETER	MUMBAI		



TITLE:
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 CONDENSATE POLISHING UNIT**
2X800 MW YERMARUS STPP

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		WIKA	PUNE		
39	PRESSURE / DP TRANSMITTER	EMERSON PROCESS MANAGEMENT	USA / DAMAN		
		FUJI ELECTRIC	JAPAN		
		HONEYWELL	USA		
		YOKOGAWA	JAPAN		
		ABB	ITALY / FARIDABAD		
40	TEMPERATURE GUAGE	A.N.INST	KOLKATTA		
		WAREE INSTRUMENTS LTD	MUMBAI		
		H.GURU (SI) PVT LTD	BANGLORE		
		GIC	GOA / MUMBAI		
		PYRO ELECTRICC INSTRUMENTS PVT LTD	GOA		
41	FLOW ELEMENT	BRISTOL BABCOCK	UK		
		BALIGA LIGHTING EQUIP	CHENNAI		
		ENGINEERING SPECIALITIES	KOLKATA		
		IL	PALGHAT		
		MICRO	FARIDABAD		
		STAR-MECH	PUNE		
42	FLOW NOZZLE	IL	PALGHAT		
		MICRO PRECISION (WITHOUT ROOT VALVES)	FARIDABAD		
		ENGINEERING SPECIALITIES	KOLKATA		
		GIC	MUMBAI / GOA		
43	TEMPETAURE ELEMENT	GENERAL INST CONSORTIUM	NEW DELHI		
		DETRIVE INST & ELECTRONICS	MUMBAI		
		PYRO ELECTRIC	GOA		
		TOSHNIWAL BROS	NEW DELHI		
		WAAREE INST	MUMBAI		
44	TEMPERATURE SWITCH	INDFOSS	GHAZIABAD		
		SWITZER	CHENNAI		
		SOR INC	USA		
		DELTA CONTROLS LTD	USA		
		REGULATORS GEORGIN	FRANCE		
45	SIGHT FLOW INDICATORS	BLISS ANAND	GURGAON		
		CHEMTROLS	MUMBAI		

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		INSTRUMENTATION ENGINEERS	HYDERABAD		
		SIGMA	MUMBAI		
		TELACE E QUIP	CHENNAI		
46	INST PIPE FITTINGS	AURA INCORPORATED	NEW DELHI		
		HYD-AIR ENGG	MUMBAI		
		METPRESS ENGG	KOLKATA		
		PRECISION ENGG	MUMBAI		
		SWITZER INST	CHENNAI		
		VIKAS INDUSTRIAL	NOIDA		
47	PRESSURE / DP SWITCH	INDFOSS	GHAZIABAD		
		SWITZER	CHENNAI		
		SOR INC	USA		
		DELTA CONTROLS LTD	USA		
		REGULATORS GEORGIN	FRANCE		
48	ANUBAR	ENDRESS+HAUSER GmbH +Co.KG	SWITZERLAND		
		SWITZER	CHENNAI		
		STAR-MECH	PUNE		
49	CONTROL PANEL	SAJAS	TRICHY		
		CONTROL & SCHEMATIC	HYDERABAD		
		INDUSTRIAL CONTROLS & APPS	MUMBAI		
		PRAMMEN	PUDUKOTTAI		
		CHEMIN	PONDICHERRY		
		VEE VEE CONTROLS	BANGALORE		
50	JUNCTION BOXES	BALIGA LIGHTING EQUIP	CHENNAI		
		CREATIVE INST	BANGLORE		
		DEVI POLY	CHENNAI		
		INFO CONTROL	BANGLORE		
		K.S.INTRUMENTS	BANGLORE		
		MANISHA ENTERPRISE	PUNE		
		SUCHITRA INDUSTRIES	BANGLORE		
51	ELECTRICAL ACTUATORS (REGULATING)	AUMA INDIA (NOT FOR SMART)	BANGALORE		
		AUMA	GERMANY		
		ROTORK CONTROLS LTD (NOT FOR SMART)	CHENNAI		
		ROTORK	UK		
		NIPPON GEAR CO LTD	JAPAN		
		LIMITORQUE	USA		



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		BRISTOL BABCOCK INC	UK		
		LIMITORQUES INDIA (NOT FOR SMART)	FARIDABAD		
52	PNEUMATIC ACTUATORS (POWER CYLINDER)	INSTRUMENTATION LTD			
		KELTRON CONTROLS			
		ROTEX MANUFACTURERS & ENGINEERS PVT LTD			
		RSG ELECTRO PNEUMATIC LTD			
53	LT MOTORS	BBL	MUMBAI		
		CGL	MUMBAI / AHMEDABAD		
		ALSTOM	KOLKATTA		
		KEC	BANGALORE / HUBLI		
		NGEF	BANGALORE		
		SEIMENS	MUMBAI		
		ABB	FARIDABAD		
54	INST TUBE FITTINGS	AURA INCORPORATED	NEW DELHI		
		HYD-AIR ENGG	MUMBAI		
		METPRESS ENGG	KOLKATA		
		PRECISION ENGG	MUMBAI		
		SWITZER INST	CHENNAI		
		VIKAS INDUSTRIAL	NOIDA		
55	ROTAMETERS / ORIFICE ASSEMBLY (BYPASS / DOL)	TRAC	HYDERABAD		
		EUREKA IND	PUNE		
		IEPL	HYDERABAD		
		PLACKA	CHENNAI		
		SCIENTIFIC DEVICES	MUMBAI		
		FLOWSTAR	FARIDABAD		
56	POWER & CONTROL CABLE - LT PVC / FRLS	DELTON CABLES (EXCEPT POWER)	FARIDABAD		
		PARAMOUNT CABLES	KHUSKHERA		
		ELKAY TELELINKS	NEW DELHI		
		POLYCAB	DAMAN		
		ASSOCIATED CABLES	MUMBAI		
		CARDS CABLE INDUSTRIES PVT LTD	NEW DELHI		
		RADIANT CABLES PVT LTD (EXCEPT XLPE)	HYDERABAD		
57	SCREENED INSTRUMENT CABLE - PVC / FRLS	PARAMOUNT CABLES	KHUSKHERA		
		POLYCAB	DAMAN		




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		RELIANCE	BANGLORE		
		DELTON CABLES	FARIDABAD		
		ELKAY TELELINKS	NEW DELHI		
		ASSOCIATED CABLES	MUMBAI		
		CARDS CABLE INDUSTRIES PVT LTD	NEW DELHI		
58	BATTERY	HBL NIFE POWER SYSTEM LTD	HYDERABAD		
		HOPPECKE	GERMANY		
		AMCO SAFT	BANGLORE		
		EXCIDIE INDUSTRIES	KOLKATA		
59	BATTERY CHARGER	BHARTIA CUTLLER	-----		
		CALDYNE	KOLKATA		
		AMAR RAJA POWER SYSTEM PVT	TIRUPATI		
		DUBAS	BANGLORE		
		HBL NIFE	HYDERABAD		
		CHHABI ELECTRICALS PVT LTD	JALGAON		
60	CABLE LUGS	CHETNA	MUMBAI		
		DOWELL	MUMBAI		
		ELECTRO BILLETS (3D)	VALSAD		


NOTE: ANY OTHER SUB-VENDOR NOT LISTED IN ABOVE LIST SHALL BE SUBJECT TO BHEL / NTPC APPROVAL DURING DETAILED ENGINEERING.

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ANNEXURE-IV

SECTION – C1

FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

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FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS

The terms "Performance Guarantees" wherever appears in this ANNEXURE-IV shall have the same meaning and shall be synonymous to "Functional Guarantees" Similarly the term "Performance Tests" wherever appears in this ANNEXURE-IV shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term "BMCR" (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator at super heater outlet at rated parameters. The term " TMCR"(Turbine Maximum Continuous Rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals(power at generator terminals as per clause indicated in the sub- section) under % cycle make-up and 77 mm Hg(abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure.

1.00 PERFORMANCE GUARANTEES

General Requirements


- 1.01 The Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipment covered in these specifications.
- 1.02 The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- 1.03 The bidder shall demonstrate all the guarantees covered herein during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance tests are listed in the specification. The guarantee tests shall be conducted by the contractor at site in presence of Employer on each unit individually
- 1.04 All costs associated with the tests shall be included in the bid price.
- 1.05 In case during performance guarantee tests, it is found that the equipment/system has failed to meet the guarantees, the contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable shortfall limit specified in the specification, employer will accept the equipment/system/plant after levying liquidated damages as mention in the specification. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the employer will have the right to either of the following:

a) For Category-I Guarantees

Reject the equipment/system/plant and recover the payments already made.

OR

Accept the equipment/system/plant after levying liquidated damages as specified hereunder. The liquidated damages, for shortfall in performance shall be levied separately for each unit. The rates indicated are on station basis and per vessel basis respectively. The liquidated damages shall be prorata for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.

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b) For Category-II Guarantees

Reject the equipment/system/plant and recover the payments already made. The performance guarantees under this category shall be called 'Category-II' Guarantees. Conformance to the performance requirements under category-II is mandatory.

c) For Category-III Guarantees

Reject the equipment/system/plant and recover from the contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipments/systems replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters / capacities shall be termed as Category-III, guarantees.

2.00 GUARANTEES UNDER CATEGORY I

The performance guarantees which attract liquidated damages are as follows:

Condensate Polishing Unit

- a) Chemical consumption (acid and alkali) required for regeneration of each CPU vessel.
- b) Total throughput (in Cu. M) through each CPU vessel i.e. Design flow multiplied with 720 hours of operation.

AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES

If the performance guarantee(s) specified above are not met by the contractor even after the modifications and/or replacements mentioned but are achieved within the stipulated Acceptable Shortfall Limit as indicated in this clause, Employer will accept the equipment/system/plant after levying liquidated damages as indicated here under, however, if the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, the Employer may at his discretion reject the equipment/system and recover the payment already made or accept the equipment/system only after levying liquidated damages against the contractor, at the rates listed herein, and such liquidated damages shall be deducted from the contract price.

Condensate Polishing Plant


- a) In case each vessel of Condensate Polishing Plant (CPP) (using guaranteed chemicals for regeneration) has delivered less total throughput than guaranteed value between two successive regenerations, L.D, for shortfall in output shall be calculated as follows:

$$LD \text{ per vessel (Rs)} = 14.31 \times R \frac{[(12.167 \times Q_{mg}) - (12 \times Q_{ma})]}{Q_{ma}}$$

Where

Q_{ma} = Actual throughput per vessel between two successive regenerations (Cu.m)

Q_{mg} = Guaranteed throughput per vessel between two successive regenerations (Cu.m) which is calculated as design flow (cum/hr) per vessel multiplied by 720 (hours)

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R = R1+R2

R1 = Guaranteed acid consumption per vessel per regeneration x US\$ 93/- per ton of 30% HCL

R2 = Guaranteed alkali consumption per vessel per regeneration x US\$ 267/- per ton of 48% NaOH

Acceptable shortfall limit with LD for the above guarantee shall be (-) minus 10% of the guaranteed throughput per vessel. Liquidated damages shall be calculated considering two working vessels for each unit and for all condensate polishing plants.

NOTE:

- i. Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.
- ii. If the contract currency is other than US dollars, then the liquidated damages shall be equivalent amount of contract currency based on bill selling exchange rate of State Bank of India prevailing on the date of award of contract.
- iii. All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/Special Condition of Contract (SCC).
- iv. Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the contract price.

GUARANTEE UNDER CATEGORY –III

NIL


GUARANTEE UNDER CATEGORY –III

The parameters/capabilities to be demonstrated for various system/ equipments shall include but not be limited to the following:

CONDENSATE POLISHING PLANT

Apart from guarantees covered Under Category-I, guarantee test shall be conducted to demonstrate the following guarantee parameters for each vessel:

- i. Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations under various design conditions (as specified in technical specifications) for which CPP is designed. No shortfall in maintaining the guaranteed effluent quality will be accepted by the Employer.
- ii. Pressure drop across the polisher service vessel (as defined in specification) in clean and dirty condition of resin at rated design flow.
- iii. Vibration, parallel operation and noise level of all the pumps and blowers at the rated duty point shall be demonstrated at site.

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ANNEXURE V

DRAWING DOCUMENTS SUBMISSION SCHEDULE

Documents:	PEM-Engineering
Documents for approval	8
Documents for information	8
Schedules, diagrams, lists, tables, calculation, specifications and other documents	8
Final as-built drawings	
CD-ROMs of final as-built drawings	10
Final as-built drawings (hard copy)	14
Final O&M manuals	18
CD-ROMs of Final O&M Manuals	10
Detailed project time schedules	5

Note :

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement.
- 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 (RPCL) requirement in a short notice.

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**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

2X800 MW YERMARUS STPP

ANNEXURE-VI

1.00.00 PAINTING

1.01.00 General

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated beforehand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the BHEL and Customer.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the BHEL and Customer.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Operators trained and thoroughly experienced in the use of the equipment shall carry out spray painting. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting color and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.


Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces that will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C.

The colour scheme shall be submitted during execution of contract and shall be approved by BHEL and Customer. However, the same shall be discussed and finalized during detailed engineering.

Ladders, handrails, walkways, platform etc shall be galvanized. All gratings shall be hot dip galvanized with galvanization to 610 gm/sq.m

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1.02.00 Preparation

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

1.03.00 Damaged Paintwork

Any damaged paintwork shall be made good as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

1.04.00 Painting Systems

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification. However, the same shall be discussed and finalized during detailed engineering.

a) **Surfaces Subject To Weathering**

All surfaces shall have a minimum of four coats of paint made up as follows:

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT
Finishing coat (2 Nos.)	:	35 micron DFT per coat


The total minimum DFT shall be 140 micron.

b) **Surfaces Inside Buildings**

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT
Finishing coat (2 Nos.)	:	25 micron DFT per coat

The total minimum DFT shall be 120 micron.

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Bidder shall select the type and color of primer & finish coat after approval by the BHEL and Customer.

1.05.00 COLOUR CO-ORDINATION & FINISH

- 1.05.01 Exterior surfaces throughout the plant shall be finished in colors and textures, which will blend harmoniously together and with the surrounding landscape.
- 1.05.02 Interior surfaces throughout the plant shall be finished in colors and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be color coded for ease of identification.
- 1.05.03 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.
- 1.05.04 Final colors and finishes shall be to the Approval of BHEL.



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(ELECTRICAL)



TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
(ELECTRICAL PORTION)

SPECIFICATION NO. PE-TS-362-155-A001
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SECTION-C
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SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2 & 4.3 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 CPU 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 between BHEL & vendor (Annexure-VII).
- 4.2 Technical specification no. PE-SS-999-506-E101, Data Sheets (A & C) for 415V Electric Motors.
- 4.3 Quality Plan for motors.
- 4.4 Load data format (Annexure-VIII).

ANNEXURE – VIII TO SECTION – C : ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PROJECT: 2X800 MW YERMARUS STPP
PACKAGE: CONDENSATE POLISHING UNIT (CPU)

THIS IS A PART OF THE SPECIFICATION NO. PE-TS-362-155-A001

PROJECT: 2X800 MW YERMARUS TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	415V MCC	BHEL	BHEL	1. 415 V AC/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. 2. 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.	Power supply arrangement (battery/ battery charger) for control system/ panel	Vendor	Vendor	Only 415 V AC/ 240 V AC supply to the power supply equipment for control system shall be provided by BHEL. All downstream equipment (eg. battery, battery charger, distribution board, cables etc.) shall be in the package vendor's scope.
3.	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
4.	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope (See Remarks)	BHEL Vendor BHEL	BHEL Vendor BHEL/Vendor (See Remarks)	1. 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. 2. Laying of cables by BHEL except for cabling in vendor scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
5.	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
6.	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
7.	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
8.	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.
9.	Lighting	BHEL	BHEL	
10.	Equipment grounding & lightning protection	BHEL	BHEL	
11.	Below grade grounding	BHEL	BHEL	
12.	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.


ANNEXURE – VIII TO SECTION – C : ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
 PROJECT: 2X800 MW YERMARUS STPP
 PACKAGE: CONDENSATE POLISHING UNIT (CPU)

THIS IS A PART OF THE SPECIFICATION NO. PE-TS-362-155-A001

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
13.	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14.	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
15.	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	
16.	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.
17.	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.
18.	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/ Customer. Complete skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope only.

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DATASHEET -A FOR MOTORS

SL.NO.	PARAMETERS	UNIT	
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, \pm 10%
3	FREQUENCY WITH VARIATION	Hz	50 \pm 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	Below 175 KW
6	SYSTEM FAULT LEVEL AND ITS DURATION	KA	50 KA, 1 Sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		80%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		0.2 kW & Below
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	600% subject to IS tol. 20%
12	ACCEPTABLE NOISE LEVEL	DB	85dB at 1 m AS PER IS 12065
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP- 55
15	SPACE HEATER REQUIREMENT	<30kW	30KW & ABOVE
16	PAINT SHADE		During detailed engineering
17	SPECIAL REQUIREMENT		LT motors shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615.

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SECTION C3

CONTROL AND INSTRUMENTATION

SPECIFICATION

FOR

CONDENSATE POLISHING UNIT

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1. The requirements given below are to be read in conjunction with detailed Technical specification data sheets-A enclosed elsewhere in the specification.
2. The Bidder shall provide complete and independent control and instrumentation system with all accessories and associated equipments for Condensate polishing unit and shall be realized in hot redundant PLC based control system.
3. PLC shall be connected to DCS through dual redundant serial link with TCP/IP protocol OPC compliant for monitoring. The data communication system shall include a redundant Ethernet LAN having two identical but separate networks with redundancy for all communication controllers, network interfaces, Ethernet switches, and communication cable etc. and each network shall support full duplex communication with TCP/IP protocol having deterministic response.
4. Time synchronization of PLC with DCS is to be carried out. Necessary hardware/software for same at PLC end to be provided by vendor.
5. PLC shall be connected to DCS through dual redundant serial link with MODBUS on RS485 protocol for monitoring.
6. Fibre optic cable from PLC to DCS is excluded from bidder scope.
7. Each PLC has to be accompanied by a LIU (Light interface unit/Fibre patch chord) which has multi mode SC couplers / adapters.
8. Mounting of all interfacing hardware (information outlets, LIU/Patch Panel) and connectivity from PLC to LIU/patch panel (cabling, all interfacing etc) at PLC end, will be in PLC vendor **scope**.
9. The bidder to furnish the list of instruments and list of drives / loads along with their bid.
10. The Electric valve actuator, if applicable, shall be with integral starter.
11. Control valves shall have pneumatic actuators.
12. The UPS output Power supply shall be 110V AC with 30 min. battery back up.
13. Instrumentation Cable scope has been defined elsewhere in the specification.
14. PG/DPG/PS/PT shall have chemical/diaphragm seal.
15. LT mounted on tanks shall be DP type with chemical/diaphragm seal.
16. All transmitters & electronics items will be explosion proof / intrinsically safe as per hazardous area classification.

FORM NO. PEIM-6666-0



**SPECIFICATION FOR
CONTROL & INSTRUMENTATION FOR AUX
PACKAGES**

SPECIFICATION NO.:	
VOLUME	II B
SUB SECTION C3	
REV. NO. 00	DATE : 14/12/11
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GENERAL REQUIREMENT

- 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems

- 2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

- 3.0 Measuring instruments/equipment and subsystems 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. Further all the instruments shall be of proven reliability, accuracy, and 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 specification, ranges, makes/ numbers as approved by the employer' during detail engineering

- 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

Control Interface for Drives ;

1. Control interface for LT drives :

Following signal exchange shall take place between LCP/PLC and MCC

- i. Drive Start / Stop command to MCC
- ii. Drive ON & OFF feedback from MCC.
- iii. MCC Disturbance (Thermal Overload ,control supply fail, EPB operated, MCC isolated) feedback from MCC
- iv. Current measurement for drives $\geq 30\text{KW}$ & Critical Drives $<30\text{KW}$.

2. Control interface for Valve Actuator (with integral starter) :


Following signal exchange shall take place between LCP/PLC and Actuator:

- i. Drive Open / Close command to Actuator
- ii. Drive Opened / Closed Feedback from Actuator.
- iii. Actuator Disturbance / Fault feedback from Actuator
- iv. Position feedback from Actuator (for inching type of valve)

3. Control interface for Solenoid valves:

Following signal exchange shall take place between LCP/PLC and Solenoid valve:

- i. Drive energize / De-energize command to Solenoid valve
- ii. Open LS / Close LS feedback from Solenoid valves

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SECTION – D1

(MECHANICAL)




TITLE:
**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

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**TECHNICAL SPECIFICATION FOR
PRESSURE & STORAGE VESSEL**

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1.00.00 GENERAL

The following principal pressure and atmospheric vessels for the system has been covered in this part of specification.

1. Condensate Polisher Service vessels.
2. Condensate Polisher Resin Separation and Cation Regeneration vessel.
3. Condensate Polisher anion regeneration vessel.
4. Condensate Polisher mixed resin storage Vessel.
5. Alkali diluent Heating cum Storage Vessel.(hot water tank)
6. Activated carbon filter.
7. Alkali Preparation Tank.
8. Alkali Measuring tank.
9. Resin Injection Hopper
10. Acid Measuring Tank.
11. Acid Storage Tank
12. DM storage tank.
13. Alkali storage tank

1.01.00 Of these, the items specified from SI No. 1 to 6 shall be designed as **pressure vessels** and the rest shall be atmospheric vessels.

1.01.01 All other vessels, not specifically listed here, but required for the Bidder's system shall also meet the general requirements of this specification.


1.01.02 Process requirements of these vessels shall be governed by the requirements of the Condensate Polishing System, which will determine their design conditions. **Following** sections only indicate some of the minimum requirements which must be met, and the actual design of these vessels shall be better than these, if that is required from process considerations.

2.00.00 GENERAL DESIGN FEATURES


2.01.00 Design

2.01.01 Design of all pressure vessels shall conform to ASME Section VIII ed. 2010 or acceptable equivalent international standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 10% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction if any.

Design pressure of condensate service vessels is indicated elsewhere in this specification.

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- 2.01.02 For all other pressure vessels, design pressure shall be at least 10 Kg/cm² (g).
Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.
- 2.01.03 Design of all horizontal cylindrical atmospheric storage tank containing water, acid, alkali and other chemicals shall conform to BSEN: 12285-2:2005.
- 2.01.04 Design temperature of all pressure vessels and storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.
- 2.01.05 In case, tank is subjected to vacuum; the same shall be taken care in designing the tank.
- 2.01.06 The design of Demineralised water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
- 2.02.00 All vessels / tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end. Vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.
- 2.03.00 All the atmospheric tanks shall have sufficient free board above the "Level High"/"Normal Level" as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the "Level High"/"Normal Level" for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.
- 2.04.00 Vessels coming under preview of IBR shall be designed accordingly.
- 2.05.00 Interior surfaces of all tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
- 2.06.00 All welds on inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground flush and smooth applicable for corrosion resistant coating or lining.
- 2.07.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
- 2.08.00 Weld splatter shall be removed.
- 2.09.00 All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.
- 2.10.00 The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells be concentric and plump. Plates shall be

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cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding.

2.11.00 Vessels seam shall be so positioned that they do not pass through vessel connections.

3.00.00 MATERIAL OF CONSTRUCTION

3.01.00 All pressure vessels shall be fabricated from carbon steel plates SA- 516 Gr. 70 and lined internally (4.5 mm thick rubber lining in three layers). All atmospheric tanks shall be fabricated of steel conforming to IS 2062 Gr A/B and lined internally (4.5 mm thick rubber lining in three layers).

4.00.00 APPURTENANCES

4.01.00 Manholes

4.01.01 All the pressure vessels and horizontal type storage tanks shall be provided with manhole of 500 mm diameter minimum size, preferably at the top head, complete with cover plate, lifting handle, davit cap, nuts, bolts, gaskets etc. to ensure leak tightness at the test pressure.

4.01.02 The vertical type storage tanks shall be provided with a manhole of 500 mm dia on the top cover, if the diameter of the tank is 1200 mm or more. For the DM water storage tanks, manholes shall be provided as per IS:803.

4.01.03 All the vessels and tanks shall be normally provided with a six inch gasketed handhole located near the bottom of the straight side.

4.01.04 The required lining/coating for the inside surface of the manhole/handhole, nozzle and cover plate of the manhole/handhole shall be same as that of the respective vessel/tank.

4.01.05 Sight Glasses

All the vessels mentioned shall be provided with pad type sight glasses on their vertical sides. Locations of these sight glasses shall be as follows:

4.01.06 One with the centre line at the normal level of the bed top, and one near the bottom of the straight side, for each of these vessels.


4.01.07 In addition, item no. 1.00.00 shall be provided with sight glasses, with their center lines at each of the normal separated resin interfaces.

4.02.00 Lifting Lugs

All vessels of diameter 1200mm or greater shall be provided with a minimum of 4 lifting lugs. Smaller vessels shall be provided with at least 2 lifting lugs.

4.03.00 Vessels Supports

Adequate supporting arrangements like straps, saddles, skirt rings, or legs of steel shall be provided to transfer all loads to the respective skid structures.

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4.04.00 Vessel Internals

The internals for pressure Vessels shall be designed for a low pressure drop to promote uniform distribution and flow through the vessels and to withstand the full design pressure of the vessel in both directions.

Specification requirements for vessel internals are as follows:

4.05.00 Inlet water and Regenerant Distributors

Hub and laterals with diffuser splash plates or header and perforated laterals. Material of construction shall be type 316 stainless steel, except for acid service which shall be of Hastelloy B.

4.06.00 Underdrains

Same as above with screened laterals with internal perforated pipes, and rubber-lined false bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA – clog type with para Septanurse screen, fully supported by subway grid, or equal).

4.07.00 For lined vessels, they shall also be lined in the same manner as the internal surfaces of these vessels. For the caustic diluent heating/storage tank, they shall be of type 304 stainless steel construction.

4.08.00 Internal Fasteners

All internal fasteners shall be of type 316 stainless steel and heavy duty locknuts shall be used throughout.

4.09.00 Piping Connections

All lined vessel connections and connections in unlined vessels 25 NB and larger shall be to ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM-A-106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.


4.10.00 All vessel connections in unlined tanks smaller than 25 NB shall be screwed to ANSI 2.1 for schedule 80 pipe.

4.11.00 Resin Traps

Outlets of each of the condensate polisher service vessel and the waste effluent header of the common external regeneration facility, shall be provided with a resin trap. These resin traps shall be a minimum, conform to the following:

4.11.01 The resin trap shells shall be of steel construction and lined internally with saran or Polypropylene. The internals for all traps shall be johnson well screen type, of 316 stainless steel in both directions, resin traps located in processes effluent lines shall have a screen opening that does not exceed 120 percent of the associated process vessel under drain screen opening. Resin traps located in waste effluent headers shall have a screen opening of approximately 60 mesh.

4.11.02 Each resin trap shall be fully piped and valved for inplace manual back flushing.

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5.00.00 SPECIFIC DETAILS

5.01.00 Alkali Diluent Heating – Storage Tank (Hot water tank)

This vessel shall be sized to hold a minimum of 5000 liters of 80 deg C demineralised water required for the regeneration of condensate polisher. In sizing this vessel, preheating of the anion resins shall not be considered as a requirement. The cold water feed line shall enter the tank through or near the top head and extend downward to within 15 cm of the tank bottom. Recovery time shall not exceed 4 to 5 hours.

All tank internals, including the inlet water tail pipe, shall be fabricated of type 304 stainless steel.

5.02.00 Atmospheric Tanks

Wall thickness of these tanks shall not be less than 6mm.

5.03.00 Resin Injection Hopper

The supplier shall provide a hopper type tank for resin make-up, using water slurry, to the condensate polishing systems. This make-up system will constitute a portion of the condensate polishing external regeneration system. The resin hopper shall have a conical bottom and a flat top. The top shall have a piano type hinged port, having a lifting handle, of sufficient size for easy resin loading. The resin shall discharge through a bottom connection to a water ejector for transport. Water shall be added to the hopper to assist in the resin transfer. The ejector discharge shall be to the resin separation-regeneration vessel. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be the responsibility of the Bidder as a part of the external resin regeneration system.

a) **Capacity**

The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection.

b) **Material**


The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6 mm and rubber lined (4.5 mm thick rubber lining in three layers).

5.04.00 Chemical preparation and day tanks

These shall be vertical cylindrical tanks. They shall be of carbon steel fabrication, lined and provided with full height level gauges right up to the overflow levels.

The alkali preparation tank shall be provided with a dissolving basket of type 316 stainless steel constructions, and a motorized slow speed stirrer mounted eccentrically to the tank by a bracket fixed to the side wall. The stirrer shall have impellers of type 316 stainless steel.

The alkali day tank shall be provided with an airtight cover complete with a breather arrangement, to prevent absorption of carbon dioxide from the atmosphere by the alkali solution contained in it. The overflow connection shall also be provided with a suitable

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seal for this purpose.

The tanks for ammonia solution (if applicable) shall also be provided with similar arrangements to prevent escape of ammonia vapor to outside.

5.05.00 LINING

All internal lining of vessels provided under this specification shall be of natural rubber, meeting the following minimum requirements.

5.05.01 Hardness

Lining used may be soft rubber having a shore durometer reading or 4070 on the D scale, or semi-hard rubber having a durometer reading of 4570 on the D scale. Variations in hardness of the rubber lining between the different areas of a specific tank shall be within +/-5 durometer reading.

5.05.02 Chemical Resistance

The lining material shall be suitable for prolonged service in the chemical environment described below:

- a) Hydrochloric acid, 2 to 8% concentration, at temperature from 10 deg C to 50 deg C.
- b) Sodium hydroxide, 1 to 4% concentration, at temperature from 30 deg C to 50 deg C.
- c) 100 to 500 mg /l of sulphuric and hydrochloric acid combined. Ratio of concentration of these two acid 1 : 5 to 5 : 1 and temperatures from 10 deg C to 40 deg C.
- d) 1 to 10mg/l of sodium hydroxide at temperature from 10 deg C to 40 deg C.

The linings will be subjected to the condition (a) or (b) for intermittent periods of approximately one hour out of eight hours, and to conditions (c) or (d) remainder of the time.


5.05.03 Thickness

The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

5.05.04 Surface Preparation

Prior to rubber lining all surfaces must be prepared in the following manner.

- a) Degrease surface prior to blasting.
- b) The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.
- c) All traces of grit and dust should be removed with a vacuum cleaner or by brushing. Care must be taken to avoid contaminating the surface.
- d) Immediately after blasting and removal of grit, the first coat of primer or cement

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5.05.05 shall be applied and allowed to dry.
Protection

After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of it's transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

All lining projecting outside of the vessel, shall be protected adequately from mechanical damages during shipment, handling, storage etc.

Suitable warning, indicating the special care that must be taken with respect to these lined vessels, shall be stenciled on their outside surfaces with the letter at least 12mm high.

Example:

"Warning – Tank is lined"


"Do not weld or Burn"

"Do not Store in Direct Sunlight" etc.

6.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure and storage vessels shall conform to the latest revisions of the following standards, in addition to other standards mentioned elsewhere in the tender document subject to any modification and requirement, as specified here in after.


- | | | | |
|----|---------|---|--|
| a) | IS: 803 | - | Code of practice for design, fabrication and erection of Vertical Mild Steel cylindrical welded oil storage tanks. |
| b) | IS: 816 | - | Code of practice for use of metal arc welding for general construction in mild steel. |
| c) | IS: 817 | - | Code of practice for training and testing of metal arc welders. |
| d) | IS: 822 | - | Code of procedure for inspection of welds. |
| e) | IS:1363 | - | Black hexagonal bolts, nuts and locknuts (dia 6 to 39 mm) and black hexagon screws (dia to 24 mm). |
| f) | IS:1367 | - | Technical supply conditions for threaded fasteners. |
| g) | IS:2062 | - | Hot rolled low, medium & high tensile structural steel. |
| h) | IS:2002 | - | Steel plates for pressure vessels for intermediate and High temperature service including boilers. |
| i) | IS:2825 | - | Code of unfired pressure vessels. |

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- j) IS:3133 - Manhole and inspection opening for chemical equipment.
- k) IS:4049 - Specification for formed ends for tanks and pressure vessels.
- l) IS:4682 - Code of practice for lining of vessels and equipment for chemical processes Rubber Lining.
- m) BS:2594 - Specification for carbon steel welded horizontal cylindrical storage tanks.
- n) ASME - Boiler and pressure vessel Section VIII code.
- o) ASTM - American Society for Testing and Materials.

7.00.00 FABRICATION

- 7.01.00 The vessel ends for storage tanks of vertical type shall have flat bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Tori-spherical type designed.
- 7.02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.
- 7.03.00 All the joints (circumferential / longitudinal) shall be continuous butt welded, inside and outside. Connection shall be flush with inner surface of tanks and ~~welded continuously~~ on both sides of shell. Sharp inside edges shall be rounded to a minimum 3 mm radius.
- 7.04.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the engineers. ~~Welding shall not~~ be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
- 7.05.00 All pressure vessels and storage tanks except Demineralised water (D.M.) shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.
- 7.06.00 **Tank Connections**
- 7.06.01 Bidder shall furnish all pipe material required for tank connection for the process requirement. In addition to these, additional connections, if required by the Owner for the inter-connection of their piping, instrumentation etc. shall also be provided. Such additional requirement will be intimated to the successful Bidder later and Contractor shall provide these fittings to match with the Owner's items. Adequate pipe support attachments in the external surface of the tank/vessel shall be provided for Owners pipes for all the vessels/tanks. All lined vessels connections shall be conforms to ANSI 300 lb class. Nozzle material shall be ASTM-106 Grade B, Schedule 80.
- 7.06.02 All flanged connections should be supplied complete with matching counter flanges, nuts bolts and gasket materials. The flange design, (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 7.06.03 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS:1367. However, internal fasteners if any, shall be of IS:316 /SS-304 or

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Hastalloy-B as per the duty conditions.

- 7.06.04 Gaskets shall be of full face type.
- 7.06.05 Sight glasses shall be provided for the tanks/vessels as specified in the standard specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
- 7.07.00 **Vessels Supporting Lifting Lugs**
- 7.07.01 Adequate supporting arrangements like straps, saddles, skirt boards, pillars etc. shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 7.07.02 All vessels of internal diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs.
- 7.07.03 Material of construction for these vessel supports, saddles, lugs shall conform to IS:2062 of tested quality.
- 7.08.00 **Special Accessories Storage Tanks**
- 7.08.01 Vessel internals wherever required shall be provided as detailed out elsewhere in the specification.
- 7.08.02 All the pressure vessels and tanks shall be provided with drain connections along with drain valves of suitable size. Further all the atmospheric storage tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 7.08.03 All the pressure and tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created in the tank during maximum filling/drain-off rate. The maximum draw off rate for the DM storage tanks shall be intimated later to the successful bidder.
- 7.08.04 Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.
- 7.08.05 Water seal shall be provided for the overflow line of DM and degassed water storage tanks. The vent and overflow lines of alkali preparation /measuring / day tanks and vent line of DM storage tanks shall be provided with Carbon dioxide absorber of proven design to prevent contamination from atmospheric air. Carbon dioxide absorber shall preferably be located at ground level. The vent and overflow lines of Acid measuring tanks shall be provided with fume absorber using suitable packing material, such as pall rings/raschig rings.
- 7.08.06 Conservation vent valves shall be provided in the vent line of DM storage tanks so that, at a vacuum to the extent of 65 mm water column, the valve shall open to relieve the vacuum. Body and trim of the valve shall be Die Cast Aluminum.



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TECHNICAL SPECIFICATION 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.

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- 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.
- 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.

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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 Material of construction for pipes carrying various fluids shall be as below: -

S.No.	Service	Material
1.	Raw water	Carbon Steel
2.	Clarified water/Filtered Water	Carbon steel
3.	Acidic Water	Rubber lined Steel
4.	Demineralised Water	Stainless Steel - 304
5.	Acid (hydrochloric)	Rubber lined Steel
6.	Alkali (Sodium Hydroxide)	
	a) Strong (5% and above)	Stainless Steel - 304
	b) Dilute (below 5%)	Stainless Steel - 304
7.	Lime Solution/Suspensions	Galvanized Steel
8.	Air	Galvanized Steel to IS 1239
9.	Waste effluent from N Pit	HDPE
10.	Resin water slurry	Stainless steel Type-304

2.01.08 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.

2.01.09 Pipelines carrying water, chemicals, air etc. shall be sized generally on the following velocities. However wherever minimum pipe sizes are defined in the tender drawing /data sheets the selected size shall not be less than the specified size. The velocity in the resin transfer line is specified elsewhere in the specification.

Pipe Size	Velocity in m/sec.		
	Below 50 mm	50-150 mm	200 mm & above
a) Pump suction	-	1.2 - 1.5	1.2 - 1.8
b) Pump discharge	1.2 - 1.8	1.8 - 2.4	2.1 - 2.5
c) Header	-	1.5 - 2.4	2.1 - 2.4
d) Compressed air below 2 Kg/cm ² (g)	15 - 20	20 - 30	25 - 35

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e)	Compressed air 2 Kg/cm ² & above	20 - 30	25 - 40	35 - 45
f)	Suction to compressor/ Blowers	-	7 - 8	-

2.01.10 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.

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

i)	Carbon Steel pipe	-	100
ii)	C.I Pipe / Ductile Iron	-	100
iii)	Rubber lined steel pipe	-	120
iv)	PVC / HDPE pipes	-	140
v)	Resin Transfer Pipe	-	100

For calculating the pump head, at least 10% margin shall be taken over the pipe friction losses.


2.02.00 Material & Dimensional Standards for Piping

2.02.01 All piping system shall be capable of withstanding the maximum pressure and temperature in the corresponding line.

2.02.02 The Steel pipes (Welded type) for the services of raw water/~~clarified water~~/~~Filtered~~ water shall conform to the following standard or codes.

- i) Pipes up to 150 NB
 - a) IS:1239 Part-I (Heavy grade-Black)
 - b) ASTM-A-53 Grade B (Welded), Type-E Sch 80 up to 2 inch nominal size. Sch 40 above 2 inch nominal size.
- ii) Pipes 200 NB and above
 - a) IS:3589 - Grade 410
 - b) ASTM - A53, Type-E Grade B (Welded) - Sch. 40
- iii) Pipe 500 NB and above-In this case pipes shall be rolled and butt welded. These pipes may be fabricated by the bidder at site. The plates conforming to IS:2062 (Tested quality) or SA-285 Gr.C. or equivalent.

However, condenser polisher pipelines shall be of seamless carbon steel

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ASTM A 106 Gr.B all welded construction with minimum 300 lb flange connection.

2.02.03 Pipes for the Air Service shall conform to the above clause 2.02.02 and shall be galvanized to IS:4736.

2.02.04 Pipes to be used for the rubber-lined construction shall conform the above clause 2.02.02 and inside surface shall be completely de-beaded and made suitable for lining.

2.02.05 Other piping materials shall conform to the following standards.

- i) IS:4984 - Class-5-High density polyethylene pipes.
- ii) IS:4985 - Class-4 - PVC Pipes.
- iii) ASTM A-106, Gr. C, Schedule 80 - Seamless carbon steel pipe.
- iv) ASTM A-312 Grade TP-316 Schedule 40s - Stainless Steel pipes..
- v) ASTM A-312 - Grade TP-316 Schedule 40 - Stainless Steel pipes (ERW OR Seamless)

2.02.06 Fittings

- (a) Fittings to be used with carbon steel pipes shall conform to IS:1239 Part-II (Heavy grade) for sizes up to 150 NB.
- (b) For sizes 200 NB & above steel fittings shall conform to ASTM A 234 Gr. WPB. However for sizes above 350 NB fabricated fittings (meter bends etc) may be used. Forged elbows of long radius shall be used.
- (c) However inside surface of all the fittings used for the rubber lined application shall be de-beaded and made suitable for rubber lining.
- (d) For Galvanized pipe application all the fittings shall be galvanized as per IS:4736.
- (e) Fittings to be used in other type of piping shall conform to relevant IS/BS ANSI Standards and in conformity with the parent pipe standard.
- (f) Unless otherwise shown eccentric reducers shall be installed with straight side at the top of piping connection.


2.03.00 **Design of Piping Systems**

2.03.01 For water, air and other services where steel pipes are used, joints of this size range shall be screwed/flanged type.

2.03.02 All unlined steel pipes 65 NB and above (other than CI pipes and air service pipes) shall be joint by butt-welding.


2.03.03 All rubber lined pipes shall have flanged joints.

2.03.04 Steel pipe flanges shall be generally slip on flat face type. Weld neck flanges shall be used when flange follows immediately after a butt-welding or where it is required with

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respect to service conditions. When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to. Socket welded or threaded flanges may be used, with the appropriate piping system for connection of pipe to the flanged equipment.

- 2.03.05 All the piping flanges and counter flanges & their drilling shall conform to ANSI B 16.5 of relevant pressure & temperature class. However wherever the interferences is involved with the Owner's pipe, the flange/interconnection details shall be designed to match the piping and the details of which will be intimated later. Flanges shall conform to ANSI B.16.5 class 150 (min.) for service other than condensate polisher pipelines.
- 2.03.06 For easy handling & removal of equipments, valves etc. and for maintenance purpose, break up flanges for 65 NB and above sizes and suitable type of compression flexible coupling for flanged joints of 50 NB and below size shall be provided. The over ground piping wherever routed inside building, shall have a clear head room of minimum 2.1 meter from operating floor.
- 2.03.07 Pipes shall generally be routed above ground but where specifically indicated/specified the pipe may be laid in trenches or buried. Buried piping shall be generally installed so that the top of pipe is 1.0 metre below the ground level unless otherwise specifically mentioned. Full length of buried piping shall be provided with 100 mm thick sand bed.
- 2.03.08 Butt-welding edge preparation shall be done as per ANSI B 16.25.
- 2.03.09 Meter bends will not be accepted for steel pipes of 350 NB and below. For sizes above 350, the meter bends shall conform to BS:534. The bend radius shall be used for all pipes 1.5 times the nominal pipe diameter.
- 2.03.10 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure, trenches etc. shall be provided. Type of hangers and components for all piping shall be selected and approval obtained from the ENGINEER.
- 2.03.11 For rubber lined pipe, lining should be applied in two (2) layers, giving a total thickness not less than 3 mm. Surface hardness of rubber lining shall be $65 \pm 5^{\circ}$ Shore A
- 2.03.12 Pipe coming under purview of IBR should meet its requirements and getting the IBR approval shall be under Vendors scope.
- 3.00.00 VALVES & GATES**
- 3.01.00 Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. Sample valves will be used in sample collection lines.
- 3.02.00 (a) All valves, shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. All the valves shall be of standard pressure rating of the relevant design standard.
- (b) All the actuators of the valves shall be designed to handle the maximum expected pressure differential across the valves and to overcome friction forces and unbalance forces due to the flow through valve.

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- 3.03.00 **Valves in Raw water, Clarified & Filtered water application**
- 3.03.01 Either Butterfly type or sluice/gate valves shall be used for isolation purposes.
- 3.03.02 Sluice/gate valve shall conform to IS 14846 of rating PN 1.6 (min.). Stem, seat ring and wedge facing ring shall be of stainless steel construction. Other parts shall be as per IS:780. Flanges shall be designed as per ANSI B 16.5 Cl. 300 (min.) to meet with the piping flanges. Valves shall be of outside screw and rising stem type.
- Sluice valves for sizes below 50 NB and below shall conforms to IS:778 Class-2/ANSI B16.34 straight, rising stem; without side screw.
- 3.03.03 Sluice valves shall be provided with the following accessories in addition to the standard items.
- Hand wheel
 - Manual Gear reduction unit operator for valves 250 NB and above.
 - Bypass valve for valve of sizes 350 NB and above.
 - Draining arrangement wherever required.
 - Arrow indicating flow direction.
 - Position indicator.
- 3.03.04 Sluice Valves shall be provided with back seating bush to facilitate gland renewal during full open condition.
- 3.03.05 Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or BS:5155 PN 10 (min.)
- 3.03.06 The various components of butterfly valves shall be of the following
- Body : Cast Iron - ASTM A 48 Cl.40; BS:1452 Gr.220 SG Iron - BS:2789. Cast Iron IS:210 Gr.FG260

Cast Steel - ASTM. A 216 GR. WCB; BS:1504 Eq.Gr.

Fabricated Steel as per ASTM A515 Gr.60/80 IS:2062, Gr.B/IS:2002.
 - Disc. : Cast Iron IS:210, Gr.260; Cast Iron - ASTM A 48 Cl.40; BS:1452, Gr.220, SG Iron - BS:2789.

Cast Steel - ASTM A 216 Gr. WCB; BS:1504 Eq.Gr.

Fabricated Steel as per ASTM A515 Gr.60/80 IS:2062, Gr.B/IS:2002.
 - Shaft : ASTM. A 296 Gr. CF8M/AISI 316: AISI 420; BS 970 Gr.316; BS:970 Gr.420 S45.
 - Seat rings : Nitrile rubber, EPDM (Ethylene propylene rubber)

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3.03.07 Butterfly valves shall be fitted with sleeve type bearing such as PTFE. Valves of size 350 NB and above shall be provided with one or two thrust bearings to hold the disc securely in the centre of valve seat without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valves body shall be of self lubricated materials that do not have any effect on the fluid handled and other components of the valves.

3.03.08 All the butterfly valves shall be provided with Hand wheel or lever as per the requirements.

For larger sizes i.e. 150 NB and above hand wheel shall be provided. For lever/wrench operated valves, means shall be provided for positively holding the disc in not less than three intermediate positions.

Manually operated valves shall be provided with reduction gear unit for valves of size 250 NB and above. Valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation.


All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Hand wheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard.

3.03.09 All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 Cl.300 (min.)

3.03.10 Ball valves or Globe Valves may also be provided for the application of Raw/ Clarified / Filtered water services for sizes 40 NB and below conforming to the following specifications.

a) **Ball Valves**

- i) Design Standard : BS:5351 Class 300 (min.)
- ii) Type : Welded/Flanged ends; Full bore; Split Body & Seat supported construction.
- iii) **Material of Construction**
 - Body : Carbon Steel/Cast Iron
 - Ball : Stainless steel ANSI 420
 - Seat ring : PTFE
 - Stem : Stainless steel AISI 420
 - Seats : Nitrile rubber; PTFE.
- iv) Valves shall be designed to be directly operatable by a wrench / Hand lever.
- v) Suitable stops shall be provided for both the fully open & close condition.
- vi) All the valves shall be provided with an indicator for showing the position of the ball port.

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b) **Globe Valves 50 NB and Below**

- i) Design Standard : IS:778 Class-2
- ii) Type : Straight, rising stem, with outside screw.

iii) **Material of Construction**

- i) Body, Bonnet, stuffing Box & seat rings : Leaded Tin Bronze conforming-**IS:318 Gr.2**
- ii) Stem : Stainless Steel, AISI-316
- iii) Disc : IS:318 Gr. 2/AISI-316

For sizes above 50 NB


- i) Design Standard : IS:780/IS:2906 rating PN 1.0 min. or Equivalent/BS 5150 PN 10. (min.)

- ii) Type : Double Flanged or wafer body, outside screw and rising stem type.

iii) **Material of construction**

- Body : Cast iron : IS:210 Gr. FG 260/BS:1452 Gr.14.
- Stem : Stainless steel AISI 410/ 13% chrome steel.
- Disc : Cast iron IS:210 Gr.260/ BS:1452 Gr.14.
- Packing : PTFE
- Seat & seat rings : 13% chromium steel
- Gland & gland nut : AISI 420
- Hand wheel : Cast iron or Malleable iron.

- iv) Back seat shall be provided on the stem or on the disc.
- v) Renewable disc assembly shall consist of disc holder, disc, disc guide, check nut and disc retaining nut with washer.
- vi) Disc of globe valve may be provided with renewable rubber seating ring.
- vii) Hand wheels shall be marked with the word. OPEN or SHUT with arrow to indicate direction of opening or closing.

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3.03.11 However, valves in the flushing water lines shall be of type and material specified for the chemicals which is being flushed by the line.

3.04.00 **Valves for Demineralised water application**


3.04.01 Butterfly valves or Saunder's patented diaphragm valves shall be used for the services of demineralised water application for isolation purposes.

3.04.02 The diaphragm valves shall conform to the following requirements.

- a) Design Standard : BS:5156 or equivalent of required rating/class. (minimum rating of valves should be PN 10).
- b) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type.
- c) **Material of Construction**
 - Body/Bonnet : I) Cast Iron IS:210 Gr.FG.260 or equivalent.
II) Cast steel ASTM A-216 Gr. WCB.
 - Body lining : Soft Natural rubber, Ebonite polypropylene, PVDF.
 - Diaphragm : Reinforced rubber, hypalon/app. equal.
 - Hand wheel : Cast Iron
 - Compressor : Stainless Steel
 - Stem & Bush : Stainless Steel
- d) Flanges shall conform to ANSI B 16.5 Cl.300 and shall be cast/integral with the body.
- e) Hand wheels shall be marked with the direction of closure.
- f) Valves shall be provided with a position indicator to show the open and closed condition.
- g) Valves provided with pneumatic actuators shall be provided with a hand wheel for manual operation. The valves operators shall be designed as per relevant International Standard.

3.04.03 The butterfly valves shall conform to Cl.3.03.05 to Cl.3.03.09 above except to the following requirements.

- a) Body shall be lined (minimum 3 mm) with natural rubber, ebonite, polypropylene or PVDF.
- b) Disc shall be lined with PVDF, polypropylene, or natural rubber.
- c) Seat rings shall be of Nitrile rubber or Hypalon.

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3.05.00 Valves for Acid & Alkali Services

Valves shall be saunder's patented diaphragm type. The valves shall conform to Cl. 3.04.02 above except to the following requirements.

- a) Diaphragm shall be of reinforced teflon, EPDM/Black Butile/appd. eqv. for acid services and reinforced Neoprene/Hypalon/app eqv for alkali services.

3.06.00 Valves for Lime Slurry / Solutions

3.06.01 Plug valves shall be used for the application of lime slurry /lime solutions.


3.06.02 The plug valves shall conform to the following requirements.

- a) Design Standard : BS:5353 Class 300 or Equivalent.
- b) Type : Flanged and non lubricated, regular pattern, plug valves.
- c) Material of Construction
- i) Body : Cast Iron IS:210 Gr FG 260 or Equivalent
- ii) Plug : Stainless Steel AISI 316
- iii) Body Sleeve or Seat : PTFE
- iv) Seat : PTFE
- v) Gland : AISI 304 / AISI 316
- vi) Cover : Cast Steel ASTM A216 Gr WCB
- vii) Gland Nut : AISI :304 / AISI 316
- d) Valves shall be operated by permanently fitted wrench or Hard lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition.
- e) All valves shall be provided with an indicator for the position of the plug part.
- f) Suitable stops shall be provided for the fully open and fully closed positions of the valve.
- g) Valves of size of 250 NB and above shall be provided with a suitable reduction gear unit.

3.07.00 Resin Transfer Line

In resin transfer line in CPU two way eccentric plug valve as manufactured by De Zurik or approved equal shall be used. Ball valve may also be used for this application. The valves shall have type 316 stainless steel body and bearings, resilient faced plug and flanged ends. For service vessel area pressure rating should be in line with system requirement. All automatic valves shall be provided with double acting pneumatic cylinder actuators controlled by solenoid valves, manual over ride feature & local position indicators.

3.08.00 Butterfly valves in the condensate polisher service vessels.

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3.08.01 They shall be lugged wafer type.

3.08.02 The material of construction shall be as below:

- i) Body : Cast Steel (Please refer note written below)
- ii) Disc : SS-316
- iii) Shaft : SS-316
- iv) Seal : Teflon
- v) Seat : Teflon with Titanium back-up rings

Note: - the body material shall be SS 316 for all the butterfly valves coming at the outlet of the service vessels.

3.08.03 Flanges shall correspond to ASA 300 lb class (min).

3.08.04 All automatic valves shall be provided with double acting pneumatic cylinder actuators controlled by solenoid valves, manual over ride feature & local position indicators.

3.09.00 **Valves for Air pipe line application**

3.09.01 For Air services, globe valves or Ball valves may be used for sizes 50 NB and below.

3.09.02 For sizes higher than 50 NB, either Butterfly valve or Ball valves shall be used.

3.09.03 Globe valves shall generally conform to Cl. 3.03.10 (b) above.

3.09.04 Ball valves shall conform to the requirements stipulated in Cl.4.03.10 (a) above. However, Body material shall be leaded Tin Bronze (IS:318 Gr.2) or stainless steel (AISI:304/316).


3.09.05 Butterfly valves shall conform to the Cl.3.03.05 to 3.03.09 of this section. However, the body & Disc shall be either cast iron lined with elastomer such as PVDF or PTFE or stainless steel construction (AISI 304/316).

3.10.00 **Non-return valves (Check valves)**


3.10.01 Non return valves shall be of swing check (reflux) type or dual plate type.

3.10.02 The valves shall conform to the following specifications.

- i) Design Standard : IS:5312, BS:1868, BS:5153 API 594/ API 60 or Eqvt.
- ii) Type : Swing check Type and Flanged ends.
- iii) Material of Construction (For non corrosive application)
 - a) Body & Cover : Cast iron IS:210 Gr.FG 260/or
Hinge Disk/Door Cast Iron BS:1452 Gr.220 or Eqvt.

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- b) Hinge Pin and Door/Disc Pin : Cast steel ASTM A 216 Gr. WCB.
High tensile Brass IS:320 HT 2 or BS:2872 eqvt.
- c) Disc facing ring : Stainless steel
- d) Body Seat ring : Stainless steel
- e) Bearing bushes : Leaded Tin Bronze IS:318 Gr.2
- f) Bolts : Carbon Steel
- iv) For the application of lime, corrosive water (DM water), and air, the body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Eqvt. material. Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI 316) for the above application.
- v) For acid services, the valves shall be of lined construction as specified in (iv) above, or of Hastalloy 'B' construction and Body/Disc facing ring shall be of resilient materials such as natural rubber, PTFE or Viton.
- vi) For alkali services, the complete valve shall be stainless steel construction (AISI-316).
- 3.10.03 Flanges shall conform to ANSI B 16.5 Cl.300 to match with the piping flanges as specified elsewhere.
- 3.10.04 Body shall be permanently marked with an "arrow" inscription indicating the direction of motion of the fluid for all the check valves.
- 3.10.05 Check valves for Raw / Clarified / Filtered water may be offered in Gun metal construction & with threaded ends for sizes 50 NB and below conforming to IS:778 or Equivalent.
- 3.11.00 The safety valves / relief valves at the downstream of positive displacement type metering pumps shall be of the standard type manufactured by the pump manufacturer and the material of construction shall suit to the fluid handled.
- 3.12.00 **Gates**
- 3.12.01 Design standard for gates shall be IS:3042 or Eqv.
- 3.12.02 The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS:3042.
- 3.12.03 **Material of Construction**
- i) Frame and Door : Cast Iron IS:210 Gr. 20
- ii) Spindles, bolts & nuts : M.S. to IS:2062

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iii) Face & seat rings : Gun metal (as per IS:3042).

3.12.04 All the parts of gates shall be applied with the coats of heavy duty bitumastic paint.

3.12.05 Each of the gates shall be provided with hand wheel, and a position indicator.

3.12.06 The gates for DM plant drains shall be rubber lined to a minimum thickness of 4.5 mm.

3.13.00 STRAINERS

3.13.01 Basket Strainers

a) Basket strainers of simplex design shall have the following materials of construction for raw/clarified/filtered water application.

i) Body : Fabricated mild steel : IS:2062 (Tested quality)

ii) Strainers : Wire shall be stainless steel (AISI:316 18 BWG. 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.

iii) Drain Plug/Nuts : Gun metal

b) Inside and outside of basket body shall be protected with one coat of high build zinc phosphate primer and three coats of Chlorinated rubber paint to a total thickness of 200 microns.

c) Suitable Vent and drain valves shall be provided for the strainers.

d) Screen (strainer) flow area shall be at least four times pipe sectional area. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area.

e) Pressure drop in clean condition shall not be more than 1.0 MWC.

f) Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.

g) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness 65 ± 5°A).


3.13.02 Y-Type Strainer

a) Y-Type strainer for water application shall be constructed of following materials :

i) Body : Cast Iron IS:210 Gr. FG 260

ii) Strainers : Wires of stainless steel AISI-316, 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.


iii) Drain Plug/Nuts : Gun metal (threaded construction)

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- b) Y-Type strainers shall also conform to Cl. 3.14.01 (b), (d), (e) and (f).
- c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS:210, Gr.FG 260) and lined with soft or hard rubber to a thickness of 4.5 mm.
- d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

3.14.00 General Requirements for Valves, Gates, Strainers

- 3.14.01 All the equipments shall be of proven design for the duty conditions and the contractor or manufacturer shall have sufficient experience in using the above equipments in water treatment application in the plants supplied earlier by them.
- 3.14.02 In case owner desires, the experience list/feedback from the users shall be made available to owner for any or all the equipments during the detailed engineering phase.
- 3.14.03 Valves coming under the purview of IBR if any shall meet its requirements and the approval of the same shall be obtained by the contractor.
- 3.14.04 Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.
- 3.14.05 The various equipments shall be installed so that they are easily approachable for the operating and maintenance personnel. Generally Valves shall be located about 1.2 meter to 1.5 meter from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The position indicator for such valves shall be also provided along with the stand.
- 3.14.06 However valves which are provided (in the burried pipe line) with a valves chamber shall have manual operator/Hand wheel inside the valve chamber. The valve chamber shall be provided with built in ladders/staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.

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**TECHNICAL SPECIFICATION FOR
HORIZONTAL CENTRIFUGAL PUMPS**

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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.

2.00.0 CODES AND STANDARDS

2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps 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.

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.

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

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ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

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

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.

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