



SPECIFICATION FOR
COOLING WATER TREATMENT
PLANT

SPEC.NO.ROS: 6183

REV.: 00

BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

**TECHNICAL SPECIFICATION
FOR
COOLING WATER TREATMENT PLANT**

**YADADRI TPS 5x800MW
DAMERACHERLA, NALGONDA DISTRICT**

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SECTION – 1

1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection and testing at vendor's & sub-vendor's works, painting, mandatory spares along with spares for erection and commissioning, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site , Erection & Commissioning, trial run, on FOR site basis, preparation & submission of "As Built" drawings, PG test at site and handing over of Cooling Water Treatment Plant as per the details in different sections / volumes of this specification for 5X800 MW TSGENCO YADADRI, DAMERACHERLA.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of cooling water treatment plant.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to

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the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Annexure-6 of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7** Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.8** In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.9** Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder / vendor and Customer / Purchaser / Employer will mean BHEL and / or Customer (TSGENCO: Telangana State Power Generation Corporation Ltd.) including their consultant as interpreted by BHEL in the relevant context. Bidder to refer GCC / SCC for more clarity.
- 1.10** The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL / Customer.
- 1.11** BHEL's / Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.
- 1.12** Pre-bid meeting shall be held before bid submission. Bidder may ask all their queries in pre-bid meeting if any.

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SECTION – 2

2.0 PROJECT INFORMATION

1	Name of the Project	Yadadri Thermal Power Station
2	Station Capacity	5x800 MW (Coal Based)
3	Owner	Telangana State Power Generation Corporation Limited (TSGENCO)
4	Site Location	Site is located 7 km from the NH5. Veerlapalem Village, Dameracherla Mandal, Nalgonda District, Telangana State
5	Latitude	16° 40' 19" N
6	Longitude	79° 35' 18" E
7	Nearest Town	30km Miryalaguda and 170 KM from Hyderabad by road.
8	Nearest railway Station	12km Damercherla
9	Nearest Airport	130 km Vijayawada 170 km Hyderabad
10	Site Conditions	
	Elevation above MSL	91 m
	Temperature –Minimum	10°C during Winter
	- Maximum	47°C during Summer
	- Design Ambient	50°C
	- Ambient (performance)	38°C
	Relative Humidity for design / efficiency	48 – 84 %
	Annual Rainfall - Average	753 mm
	- Maximum	1043 mm
	- Lowest	383
	Mean Wind Speed	8 kmph
	Wind Pressure	As per the latest revision of IS 875/1987
	Siesmic Co-efficient	Zone –III, as per IS 1893 (Part-IV)
11	Source of water	Source of water is Krishna River near Madachelu area which is about 1 km ie on upstream side of confluence point of Tungapahad Vagu and Krishna River. Water will be pumped through pipe line (of length 7 km) from this point to the project site.
12	Source of Coal	The boiler is designed for pulverised coal either 100% imported or 50% imported & 50% indigenous coal.

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SECTION - 3

3.0 SCOPE OF SUPPLY

The scope of this design memorandum covers the basis of design, system philosophy, equipment selection and layout aspects and Control Philosophy for CW Treatment for **5X800 MW YADADRI - NALGONDA TPS**.

3.1 SCOPE OF SUPPLY FOR CWTP SYSTEM FOR UNIT # 1 & 2

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

The CW Chemical Treatment Plant, as specified in Technical data sheets, and shall consist of the followings:

- a) Entire CW Chemical Treatment Plant as per P&ID (1-WT-080-01064) and Data Sheet-A.
- b) Complete Supply of following chemicals for a period of 6 months (this 6 months period includes one initial start up/commissioning and PG test also) for normal run.
Scale Inhibitor.
Corrosion Inhibitor.
Biocide
- c) Complete supply of Passivation Chemicals to ensure smooth operation of the plant till handing over.
- d) Chemicals should have adequate shelf life from the date of supply to meet the system requirements.
- e) All tanks complete with inlet and outlet connections, all fittings etc. as specified and as required.
- f) All necessary valves and fittings.
- g) All necessary pumps, motors, actuators, etc. as required.
- h) pH transmitter Two numbers.
- i) Electrical scope shall be as per "Electrical scope between BHEL and Vendor".
- j) All necessary drains, vents, and sampling points, with valves, as specified and as required.
- k) Hangers and supports as per the requirement.
- l) Instrumentation (minimum) as per the enclosed P&ID(1-WT-080-.01064, Rev:00)
- m) Safety requirement as per Data Sheet.
- n) Start-up and commissioning spares as required.
- o) All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- p) Finish paints for touch up painting of equipment's after erection at site in sealed container.
- q) Initial charge of all lubricants and grease.
- r) Monitoring gadgets, instruments, and equipment's required for maintenance (till PG test and plant handover).

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- s) Monitoring gadgets, instruments and equipment required to show demonstration parameters.
- t) Test racks (corrosion, scaling/deposit and bio-fouling) with coupons / test kits with mounting accessories.
- u) All flanges / counter flanges to interconnect the pipes
- v) Pipe supporting material.

Note: Bidder shall study the scheme; water analyses etc. contained in the specification and offer/supply the most suitable chemical(s). The chemicals proposed shall be non-toxic type. Heavy metal based chemical such as chromate, zinc etc. are not applicable. Further the chemicals shall not have any deleterious effect on any component of the CW System. Organic polymer / organic phosphorous / organic phosphates based chemicals shall be used. Required documentation in support of the above shall be made available to customer if required.

3.2 SCOPE OF SUPPLY FOR CWTP SYSTEM FOR UNIT # 3, 4&5

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

The CW Chemical Treatment Plant, as specified in Technical data sheets, and shall consist of the followings:

- a) Entire CW Chemical Treatment Plant as per P&ID (1-WT-080-01065) and Data Sheet-A.
- b) Complete Supply of following chemicals for a period of 6 months (this 6 months period includes one initial start up/commissioning and PG test also) for normal run.
Scale Inhibitor.
Corrosion Inhibitor.
Biocide
- c) Complete supply of Passivation Chemicals to ensure smooth operation of the plant till handing over.
- d) Chemicals should have adequate shelf life from the date of supply to meet the system requirements.
- e) All tanks complete with inlet and outlet connections, all fittings etc. as specified and as required.
- f) All necessary valves and fittings.
- g) All necessary pumps, motors, actuators, etc. as required.
- h) pH transmitter Two numbers.
- i) Electrical scope shall be as per "Electrical scope between BHEL and Vendor".
- j) All necessary drains, vents, and sampling points, with valves, as specified and as required.
- k) Hangers and supports as per the requirement.
- l) Instrumentation (minimum) as per the enclosed P&ID(1-WT-080-.01065, Rev:00).
- m) Safety requirement as per Data Sheet.

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- n) Start-up and commissioning spares as required.
- o) All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- p) Finish paints for touch up painting of equipments after erection at site in sealed container.
- q) Initial charge of all lubricants and grease.
- r) Monitoring gadgets, instruments, and equipments required for maintenance (till PG test and plant handover).
- s) Monitoring gadgets, instruments and equipment required to show demonstration parameters.
- t) Test racks (corrosion, scaling/deposit and bio fouling) with coupons/test kits with mounting accessories.
- u) All flanges/counter flanges to interconnect the pipes
- v) Pipe supporting material.

Note: Bidder shall study the scheme; water analyses etc. contained in the specification and offer/supply the most suitable chemical(s). The chemicals proposed shall be non-toxic type. Heavy metal based chemical such as chromate, zinc etc. are not applicable. Further, the chemicals shall not have any deleterious effect on any component of the CW System. Organic polymer / organic phosphorous / organic phosphates based chemicals shall be used. Required documentation in support of the above shall be made available to customer if required.

3.3 SCOPE OF SERVICE

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

- 1) Erection and commissioning, unloading, storage and handling at site.
- 2) Supervision of the treatment program for a period of 6 months at site.
- 3) Arrangement of all instruments and lab facilities to carry out trial run/commissioning and PG test.
- 4) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- 5) All personnel required during commissioning and PG Test.
- 6) Performance testing.
- 7) Determination of corrosion rates & scale deposition at regular intervals & review on regular basis & submit fortnightly reports to the BHEL
- 8) Painting as per enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by

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the bidder without any commercial and delivery implication. Color-coding scheme shall be intimated to vendor during detailed engineering.

- 9) All statutory clearance as per CCE Nagpur as applicable.

3.4 CIVIL SCOPE

Nil (including acid alkali resistant lining).

3.5 TERMINAL POINTS

For Unit # 1 &2

- a. Inlet water line (service water/ potable water/ Sample water from CW Pump): At 10 meters from CW Chemical Treatment Plant Area.
- b. Outlet Chemical Line from CW Chemical Treatment Plant upto the dosing point at CW Forebay (consider 200m piping distance). Check the tender plot plan also.
- c. All drains: Common drain shall be connected to a lime pit.
- d. Acid unloading: Necessary manifold including the flexible unloading hose pipe (20 meter) shall be supplied by vendor.
- e. Lime pit neutralized effluent from N-Pit Dewatering pump to CW Forebay (consider 200 meter piping distance). The distance is tentative, bidder may suitably consider as per the requirement.

For Unit # 3, 4 & 5

- a) Inlet water line (service water/ potable water/ Sample water from CW Pump): At 10 meters from CW Chemical Treatment Plant Area.
- b) Outlet Chemical Line from CW Chemical Treatment Plant upto the dosing point at CW Forebay (consider 200m piping distance) . Check the tender plot plan also
- c. All drains: Common drain shall be connected to a lime pit.
- d. Acid unloading: vendor shall supply necessary manifold including the flexible unloading hosepipe (20 meter).
- f. Lime pit neutralized effluent from N-Pit Dewatering pump to CW Forebay (consider 200 meter piping distance). The distance is tentative, bidder may suitably consider as per the requirement.

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3.6 EXCLUSIONS

- a) Service air, up to the terminal point.
- b) Air-conditioning and fire fighting facilities. However, bidder to furnish the requirement of it after award of contract.
- c) All Civil works at site including Acid/Alkali resistant tiling.
- d) M.C.C./ Switch fuse feeder panels for the power plant and control cabling up to & beyond the battery limit (Refer electrical section for scope).
- e) 98% Sulphuric Acid.

3.7 QP AND SUBVENDOR APPROVAL

- a) QAP shall be submitted by vendor for BHEL/Customer approval during detailed engineering. Any additional comments as given by BHEL/Customer shall be adhered by the bidder without any implication to BHEL.
- b) Approved sub vendor list is enclosed elsewhere of this specification. However, any additional sub-vendor shall be subject to BHEL and Customer approval.

3.8 DESIGN/CONSTRUCTION

In addition to the requirements of Section-3, the following shall also be complied under scope of this specification:

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

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

3.9 DRAWING DOCUMENTS REQUIREMENT (FOR MECHANICAL / ELECTRICAL / C&I / ETC)

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.

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- a) Detailed piping and instrument or engineering P&ID for process and utility, showing all equipment's, 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 drgs, 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 control system, electrical wiring and schematic drgs for the development of logic diagrams, GA and layout drgs of control panels, junction boxes, bill of material for panel drgs and terminal, chart for all the panel drgs, inter connection diagram for cabling, cable schedule, earthing layout and cable tray layout drawings..
- e) Design calculation of process and mechanical design, equipment and systems. The bidder shall show, explain and prove the validity of the basis/procedures and methods used in these calculations.
- f) Details civil scope drawing for all civil works.
- g) Detailed piping layout drawings, pipe support drawings, complete bill of materials of the piping, valve schedule etc.
- h) Submission of O&M manual.
- i) P.G Test procedure shall be submitted by bidder during detail engineering and shall be subject to approval by BHEL/Customer.
- j) Against customer / BHEL comments bidder has to give replies point wise during detailed engineering after award of contract.
- k) Spec. for acid/alkali resistant lining and areas requiring such lining.
- l) Cable schedule in BHEL format (shall be handed over after award of contract)

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

- Technical Offer (including List of chemicals, Quantity of chemicals, Dosage rate, calculation, pump capacity etc.)
- Deviation/clarification, if any, in the BHEL format only (Annexure -1).
- Unpriced Schedule duly filled.
- Electrical load data format (filled).
- Documents in support of meeting the Qualification Requirement.
- Electrical Load List.
- Valve Schedule.
- Pipe Schedule.

NOTE-1: - Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the works

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for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

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

Note-3: The above Note-1 and 2 shall be applicable for Electrical and C&I also.

Note-4: Chlorine is being dosed @ 5 ppm shock for half an hour once in 8 hrs. in each pump CW Pump pit and continuous dosing 1 ppm in CW Forebay by BHEL (Chlorination plant supplier).

3.11 DESIGN CLARIFIED WATER ANALYSIS (MAKE UP WATER) for Unit (1, 2, 3, 4 & 5)

S.No.	CONSTITUENTS	As	CONTENT
1.	Calcium	CaCO ₃	76.9 ppm
2.	Magnesium	CaCO ₃	59.5 ppm
3.	Sodium	CaCO ₃	148.2 ppm
4.	Potassium	CaCO ₃	2.5 ppm
5.	Iron in Soln.	Fe	0.7 ppm
6.	Hydrogen (FMA)	CaCO ₃	0.0 ppm
7.	Strontium (Sr)	CaCO ₃	0.0 ppm
8.	Barium	CaCO ₃	4.6 ppm
9.	Ammonia (NH ₄)	NH ₄	0.0 ppm
	TOTAL CATIONS (Except Fe)	CaCO₃	291.7 ppm
10.	Bicarbonate	CaCO ₃	116 ppm
11.	Sulphate	CaCO ₃	82.9 ppm
12.	Chloride	CaCO ₃	82.6 ppm
13.	Nitrate	CaCO ₃	7 ppm
14.	Phosphate	CaCO ₃	0.6 ppm
15.	Fluoride	CaCO ₃	2.6 ppm
	TOTAL ANIONS	CaCO₃	291.7 ppm
16.	Boron	B	0.52 ppm
17.	Reactive Silica	SiO ₂	14 ppm
18.	Colloidal Silica	SiO ₂	2.9 ppm
19.	Total Silica	SiO ₂	16.9 ppm
20.	Nitrites	NO ₂	1.8 ppm
21.	Total Hardness	CaCO ₃	109.7 ppm

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22.	Total Suspended Solid		15 ppm
23.	Total Dissolved Solids		411 ppm
24.	Conductivity at 25°C		610 μS/cm
25.	pH value at 25°C	-	8.3
26.	Turbidity		15 NTU
27.	TOC		8.9 ppm
28.	BOD ₃ at 27°C		12 ppm
29.	COD		40 ppm
30.	Dissolved Oxygen		6.3 ppm
31.	Oil & Grease		<1 ppm

NOTE:

1. THE CYCLE OF CONCENTRATION (COC) SHALL BE CONSIDERED AS 6.5 for sets of cooling water systems.

2. DATA FOR COOLING TOWER :

For Unit 1&2

- i. Recirculation Volume of Cooling Tower is 174214 cum/hr (approx.).
- ii. Storage/Holdup volume of cooling tower basin=48000 Cu.m
- iii. Temperature difference across cooling tower is 9.4 Deg.C
- iv. MOC of Condenser tube is Welded SS as per ASTM-A-249-TP304.
- v. Blow down=464 Cu.m/Hr.
- vi. Make up water=3000 Cu.m/Hr.

For Unit 3,4&5

- i. Recirculation Volume of Cooling Tower is 261321 cum/hr (approx.).
- ii. Storage/Holdup volume of cooling tower basin=72000 Cu.m
- iii. Temperature difference across cooling tower is 9.4 Deg.C.
- iv. MOC of Condenser tube is Welded SS as per ASTM-A-249-TP304.
- v. Blow down=696 Cu.m/Hr.
- vi. Make up water=4500 Cu.m/Hr.

SECTION – 4

4.1 SUB VENDOR LIST

Vendor to refer sub vendor list as per attached Annexure – B

SECTION – 5

5.1 PAINTING SCHEDULE

Vendor to strictly adhere to the attached painting schedule Annexure – C

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SECTION – 6

6.1 LIST OF MANDATORY SPARES FOR UNIT 1 & 2

Vendor to provide the following mandatory spares along with the main supply.

S.No.	Mandatory Spares	
1	Spares for Horizontal Centrifugal Pumps (for each service)	
1.1	Shaft	1 No.
1.2	Shaft Sleeve	2 Nos.
1.3	Impeller	1 No.
1.4	Impeller locking nut and bolt	4 Nos.
1.5	Impeller wear ring	4 Nos.
1.6	Casing wear ring	4 Nos.
1.7	Oil Seal	4 Nos.
1.8	Oil Deflector	3 Nos.
1.9	Oil Ring	3 Nos.
1.1	Gland Packing	400%
1.11	Lantern Ring	3 Nos.
1.12	Mech Seal Assembly	1 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal"	3 Sets
1.14	Oil Level Gauge	3 Nos.
1.15	Coupling	2 Nos.
1.16	Rubber Bush for Coupling	2 Nos.
1.17	O" Rings "	2 Sets
1.18	Suction Strainers Element	3 Nos.
1.19	Bearing for Pump Motor	2 Sets
2	Spares for Valves	
2.1.i	Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.1.ii	Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.1.iii	Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.2.i	Non return valves (NRV)	2 nos. of each size & type
2.2.ii	ii) Flaps for above NRV	2 nos. of each size
2.3	Gate/Globe/Ball valves/plug valve/needle valve.	
2.3.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two

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		(2) for each type and size.
2.4	415 Volt Motor (Upto 30KW Rating)	
2.4.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
2.4.2	Cooling Fan	2No. for each type and rating of Motor
2.4.3	Motor Terminal Block	5No. for each type and rating of Motor
2.4.4	Complete Set of Coupling	1Set for each Application
2.5	Field Instruments	
2.5.1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for each type along with accessories.
2.5.2	Temperature Element (RTD/Thermocouple) with thermowell	10% of each type, range and immersion length. Minimum 5 nos.
2.5.3	Furnace Temperature Probe.	10% of each type, range and immersion length, Minimum 5 nos.

Note-1: Only applicable items shall be considered. Applicable items are those, which are installed in the system.

6.2 LIST OF MANDATORY SPARES FOR UNIT 3, 4 & 5

Vendor to provide the following mandatory spares along with the main supply.

S.No.	Mandatory Spares	
1	Spares for Horizontal Centrifugal Pumps (for each service)	
1.1	Shaft	1 No.
1.2	Shaft Sleeve	2 Nos.
1.3	Impeller	1 No.
1.4	Impeller locking nut and bolt	4 Nos.
1.5	Impeller wear ring	4 Nos.
1.6	Casing wear ring	4 Nos.
1.7	Oil Seal	4 Nos.
1.8	Oil Deflector	3 Nos.
1.9	Oil Ring	3 Nos.
1.1	Gland Packing	400%
1.11	Lantern Ring	3 Nos.
1.12	Mech Seal Assembly	1 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal"	3 Sets
1.14	Oil Level Gauge	3 Nos.
1.15	Coupling	2 Nos.
1.16	Rubber Bush for Coupling	2 Nos.
1.17	O" Rings "	2 Sets
1.18	Suction Strainers Element	3 Nos.

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1.19	Bearing for Pump Motor	2 Sets
2	Spares for Valves	
2.1.i	Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.1.ii	Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.1.iii	Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.2.i	Non return valves (NRV)	2 nos. of each size & type
2.2.ii	ii) Flaps for above NRV	2 nos. of each size
2.3	Gate/Globe/Ball valves/plug valve/needle valve.	
2.3.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
2.4	415 Volt Motor (Upto 30KW Rating)	
2.4.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
2.4.2	Cooling Fan	2No. for each type and rating of Motor
2.4.3	Motor Terminal Block	5No. for each type and rating of Motor
2.4.4	Complete Set of Coupling	1Set for each Application
2.5	Field Instruments	
2.5.1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for each type along with accessories.
2.5.2	Temperature Element (RTD/Thermocouple) with thermowell	10% of each type, range and immersion length. Minimum 5 nos.
2.5.3	Furnace Temperature Probe.	10% of each type, range and immersion length, Minimum 5 nos.

Note-1: Only applicable items shall be considered. Applicable items are those, which are installed in the system.

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SECTION – 7

DATA SHEETS COOLING WATER TREATMENT SYSTEM

7.1 DATA SHEET FOR COOLING WATER TREATMENT SYSTEM FOR UNIT 1&2

Sl no.	Description	Parameters
1.0	SULPHURIC ACID STORAGE TANK	
1.1	Numbers	Two (2)
1.2	Type	Horizontal cylindrical with dished ends.
1.3	Type of fluid to be handled	98 % Sulphuric Acid.
1.4	Effective capacity, in m3	35 m3 (each)
1.5	Minimum Free Board	300 mm
1.6	Material of Construction	
1.6.1	Shell	Mild steel as per IS 2062 or ASTM A 516 Gr.70.
1.6.2	Dished Ends	Mild steel as per IS 2002 or ASTM A 516 Gr.70.
1.7	Design Temperature	80 Deg.C
1.8	Dimensions (diameter, length & thickness)	ASME SEC VIII DIV I /IS 2825. Thickness of each acid storage tank will be 10 mm.
1.9	Instruments	As per P& ID and system requirement.
1.10	Accessories for each tank	Fume absorbers, breather, manhole (2 nos), vent, drain, sample connection, level transmitter, operating platform, ladders etc.
1.11	Manhole	2 Nos in each tank each of 600 mm dia.
2.0	SULPHURIC ACID UNLOADING PUMPS	
2.1	Number	Two (2) [1W+1S].
2.2	Location	Outdoor.
2.3	Fluid to be handled	98% w/w Commercial Sulphuric Acid.
2.4	Service	To unload Concentrated Sulphuric Acid from Tanker to Sulphuric Acid Storage Tank.
2.5	Type of Pump	Horizontal Centrifugal Non Clog type
2.6	Design standard	As per IS-5659 /IS-5120/ or equivalent.
2.7	Rated Capacity, in m3/hr	10 m3/hr
2.8	Range of operation	20 % - 120 %.
2.9	Head to be developed at rated capacity	10 mlc min or as per system requirement.
2.10	Accessories	As per tender specification, P&ID and system requirement.
2.11	Design standard and design temp	As per IS-5659 & IS-5120 and 80 Deg C.
2.12	Material of construction	
2.12.1	Casing	Alloy-20.
2.12.2	Impeller	Alloy-20.

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2.12.3	Shaft	EN-8 to BS-970.
2.12.4	Mechanical Seal	Alloy-20.
2.12.5	Common Base plate	Fabricated Steel as per IS 2062.
2.12.6	Nuts and bolts	Alloy-20.
2.13	Type of drive	Electrical Motor
2.14	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher kW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
2.15	Rated speed (RPM)	1500 (Sync.) max
2.16	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to – 10%).
2.17	Type of coupling between Pump & Motor	Flexible Spacer.
2.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
2.19	HDPE Hose	Two (2) numbers, each min 80 NB and 20 m long type-2 HDPE hose as per IS-7654/1989 with isolation hose.
2.20	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener.
2.21	Suction strainer	PVDF (2X100 %, 50 BS).
2.22	Tests and Inspection	
2.23	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
2.24	b) Hydro-test	Shall be provided Tender Specification
2.25	c) Dynamic Balancing Test	Shall be provided
2.26	Performance Test	Shall be provided Tender Specification
3.0	SULPHURIC ACID DOSING PUMPS	
3.1	Number	Two (2) [1W+1S].
3.2	Fluid to be handled	98% w/w sulphuric acid.
3.3	Service	To inject concentrated sulphuric acid into CW Fore bay.
3.4	Duty	Continuous and to be suitable for parallel Operation.
3.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
3.6	Rated Capacity of Pump, in LPH	300 LPH.
3.7	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
3.8	Range of Capacity	0 % - 100 %.

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	Adjustment	
3.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 mlc
3.10	Y- type strainers for each pump	PVDF (2X100 %, 50 BS).
3.11	Accessories	As per tender specification, P&ID and system requirement.
3.12	Material of construction	
3.12.1	Housing	Alloy-20.
3.12.2	Pump head	Alloy-20.
3.12.3	Plunger	Alloy-20.
3.12.4	Worm	Manganese Bronze / Cast Iron.
3.12.5	Worm Wheel	Manganese Bronze / Cast Iron.
3.12.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
3.12.7	Base plate	MS.
3.12.8	Foundation bolts	Alloy-20.
3.13	Type of drive	Electrical Motor
3.14	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
3.15	Rated speed (RPM)	1500 (Sync.) max.
3.16	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to – 10%).
3.17	Type of coupling between Pump & Motor	Flexible Spacer.
3.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
3.19	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.

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3.20	Design Temperature	80 Deg.C.
3.21	Accessories	As per tender specification, P&ID and system requirement.
4.0	SULPHURIC ACID DAY TANK	
4.1	Numbers To be provided	One (1W) number
4.2	Type	Vertical cylindrical with dished ends.
4.4	Effective capacity, in m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 2 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 5.0 cum.
4.5	Type of fluid to be handled	98 % Sulphuric Acid.
4.6	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
4.7	Thickness, in mm	Not less than 6.0
5.0	SCALE INHIBITOR TANK	
5.1	Numbers To be provided	Two (1W+1S) numbers, each having total capacity of 24 hours storage, complete with feed funnel, Overflow, drain, vent, level indicators & other necessary accessories as required.
5.2	Type for each Tank	Vertical cylindrical with dished bottom.
5.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
5.4	Effective capacity of each tank, m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 2 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 500 litres.
5.5	Minimum Free Board, in mm	300
5.6	Material of Construction	SS-316
5.7	Thickness, in mm	Not less than 5
5.8	Accessories	Chemical charging platform with steps.
5.9	Manhole	One (1) on shell of minimum 600 mm NB.
6.0	SCALE INHIBITOR DOSING PUMPS	
6.1	Number	Two (2) [1W+1S]
6.2	Location	Indoor
6.3	Capacity of Pump	50 LPH (each).
6.4	Service	To inject Scale Inhibitor Solution into CW forebay.
6.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
6.6	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).

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6.7	Range of Capacity Adjustment	0 % - 100 %.
6.8	Suction Condition	Flooded.
6.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 m
6.10	Material of construction	
6.10.1	Housing	SS-316.
6.10.2	Pump head	SS-316.
6.10.3	Plunger	SS-316.
6.10.4	Worm	Manganese Bronze / Cast Iron.
6.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
6.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
6.10.7	Base plate	MS.
6.11	Foundation bolts and nuts	SS 316
6.12	Type of drive	Electrical Motor
6.13	Criteria of selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
6.14	Rated speed (RPM)	1500 (Sync.) maximum.
6.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to – 10%).
6.16	Type of coupling between Pump & Motor	Flexible Spacer.
6.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
6.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
6.19	Design Temperature	80 Deg.C.
6.20	Accessories	As per tender specification, P&ID and

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		system requirement.
7.0	CORROSION INHIBITOR TANKS	
7.1	Numbers To be provided	Two (1W+1S) numbers, each having total capacity of 24 hours storage, complete with feed funnel, Overflow, drain, vent, level indicators & other necessary accessories as required.
7.2	Type for each Tank	Vertical cylindrical with dished bottom.
7.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
7.4	Effective capacity of each tank, m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 2 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 500 litres.
7.5	Minimum Free Board, in mm	300
7.6	Material of Construction	SS-316
7.7	Thickness, in mm	Not less than 5
7.8	Accessories	Chemical charging platform with steps.
7.9	Manhole	One (1) on shell of minimum 600 mm NB.
8.0	CORROSION INHIBITOR DOSING PUMPS	
8.1	Number	Two (2) [1W+1S]
8.2	Location	Indoor
8.3	Capacity	50 LPH (each).
8.4	Service	To inject Scale Inhibitor Solution into CW forebay.
8.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
8.6	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
8.7	Range of Capacity Adjustment	0 % - 100 %.
8.8	Suction Condition	Flooded.
8.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 mlc
8.10	Material of construction	
8.10.1	Housing	SS-316.
8.10.2	Pump head	SS-316.
8.10.3	Plunger	SS-316.
8.10.4	Worm	Manganese Bronze / Cast Iron.
8.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
8.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
8.10.7	Base plate	MS.

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8.11	Foundation bolts and nuts	SS 316
8.12	Type of drive	Electrical Motor
8.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher kW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
8.14	Rated speed (RPM)	1500 (Sync.) maximum.
8.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to - 10%).
8.16	Type of coupling between Pump & Motor	Flexible Spacer.
8.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
8.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
8.20	Design Temperature	80 Deg.C
8.21	Accessories	As per tender specification, P&ID and system requirement.
9.0	BIOCIDE TANKS	
9.1	Numbers To be provided	Two (2W) numbers, both having combined total capacity of 24 hours storage, complete with feed funnel, Overflow, drain, vent, level indicators & other necessary accessories as required.
9.2	Type for each Tank	Vertical cylindrical with dished bottom.
9.2	Type of fluid to be handled	Commercial Biocide Solution.
9.3	Effective capacity of each tank, m ³	Cumulative capacity of the tanks shall be adequate to hold the quantity required for one-day operation of 2 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 7.0 cum.

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9.4	Minimum Free Board, in mm	300
9.5	Material of Construction	SS-316
9.6	Thickness, in mm	Not less than 5
9.7	Manhole	One (1) on shell of minimum 600 mm NB.
10.0	BIOCIDE INJECTION PUMPS	
10.1	Number	Two (2) [1W+1S]
10.2	Location	Indoor
10.3	Capacity	600 LPH (each).
10.4	Service	Commercial Biocide Solution.
10.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
10.6	Facility for Capacity adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
10.7	Range of Capacity adjustment	0 % - 100 %.
10.8	Suction Condition	Flooded.
10.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 mlc
10.10	Material of construction	
10.10.1	Housing	SS-316.
10.10.2	Pump head	SS-316.
10.10.3	Plunger	SS-316.
10.10.4	Worm	Manganese Bronze / Cast Iron.
10.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
10.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
10.10.7	Base plate	MS.
10.11	Foundation bolts and nuts	SS 316
10.12	Type of drive	Electrical Motor
10.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
10.14	Rated speed (RPM)	1500 (Sync.) maximum.
10.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to - 10%).
10.16	Type of coupling between Pump & Motor	Flexible Spacer.
10.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
10.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating

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		pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
10.19	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
10.20	Design Temperature	80 Deg.C
10.21	Accessories	As per tender specification, P&ID and system requirement.
11.0	NEUTRALIZATION PIT (CIVIL WORK BY BHEL CIVIL)	
11.1	Quantity	One number.
11.2	Capacity	70 Cu.m
11.3	MOC	RCC with acid alkali protection.
11.4	Accessories	As per tender specification, P&ID and system requirement.
12.0	NEUTRALIZATION PIT DEWATERING PUMP	
12.1	Quantity	Two (2) nos. (1W+1S).
12.2	Capacity & Head	10 Cum/Hr & 2 Kg/cm ² (g).
12.3	Type	Horizontal Centrifugal.
12.4	Motor rating	Vendor Design specific.
12.5	Material of Construction	Casing/Cover – PP. Pump shaft– EN8. Impeller – PP. Base Plate-MS-FRP. Fastener- SS 316L.
12.6	Accessories	As per tender specification, P&ID and system requirement.
13.0	PIPE, VALVES, STRAINER AND DIFFUSER	
13.1	Pipe MOC	For 98% H ₂ SO ₄ application-Seamless Carbon Steel pipe to ASTM A53 Gr. B /IS: 1239 Part- I, Heavy grade. For Scale & Corrosion Inhibitor and Biocide application-Stainless Steel to ASTM 312 Type 316 welded, schedule-40.
13.2	Valves	For 98% H ₂ SO ₄ application-PVDF, PN10. For Scale & Corrosion Inhibitor and Biocide application-SS 316 PN10.
13.3	Strainer	For 98% H ₂ SO ₄ application-PVDF (50 BS). For Scale & Corrosion Inhibitor and Biocide

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		application- Stainless Steel to ASTM 312 Type 316 (50 BS).
13.4	Diffuser	SS-316 (except sulfuric acid, for sulfuric acid the MOC is PVDF).
13.5	Safety Equipment	Four sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. A personnel water drench shower and eye bath shall be provided.
13.6	Supply of chemical	Shall be as per contractual requirement.

NOTES:

1. All accessories for each equipment shall be as per tender specification.
2. All instrument and interlocks as addressed in tender specification along with it shall be provided for each equipment/items.
3. Noise level of all equipment shall be within 85 dbA and vibration level shall be within 30 μ .

7.2 DATA SHEETS FOR CW TREATMENT PLANT FOR UNIT 3,4 & 5

Sl no.	Description	Parameters
1.0	SULPHURIC ACID STORAGE TANK	
1.1	Numbers	Three (3)
1.2	Type	Horizontal cylindrical with dished ends.
1.3	Type of fluid to be handled	98 % Sulphuric Acid.
1.4	Effective capacity, in m3	35 m3 (each)
1.5	Minimum Free Board	300 mm
1.6.	Material of Construction	
1.6.1	Shell	Mild steel as per IS 2062 or ASTM A 516 Gr.70.
1.6.2	Dished Ends	Mild steel as per IS 2002 or ASTM A 516 Gr.70.
1.7	Design Temperature	80 Deg.C
1.8	Dimensions (diameter, length & thickness)	ASME SEC VIII DIV I /IS 2825. Thickness of each acid storage tank will be 10 mm.
1.9	Instruments	As per P& ID and system requirement.
1.10	Accessories for each tank	Fume absorbers, breather, manhole (2 nos), vent, drain, sample connection, level transmitter, operating platform, ladders etc.
1.11	Manhole	2 Nos in each tank each of 600 mm dia.
2.0	SULPHURIC ACID UNLOADING PUMPS	
2.1	Number	Two (2) [1W+1S].
2.2	Location	Outdoor.
2.3	Fluid to be handled	98% w/w Commercial Sulphuric Acid.

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2.4	Service	To unload Concentrated Sulphuric Acid from Tanker to Sulphuric Acid Storage Tank.
2.5	Type of Pump	Horizontal Centrifugal Non Clog type
2.6	Design standard	As per IS-5659 /IS-5120/ or equivalent.
2.7	Rated Capacity, in m3/hr	10 m3/hr
2.8	Range of operation	20 % - 120 %.
2.9	Head to be developed at rated capacity	10 mlc min or as per system requirement.
2.10	Accessories	As per tender specification, P&ID and system requirement.
2.11	Design standard and design temp	As per IS-5659 & IS-5120 and 80 Deg C.
2.12	Material of construction	
2.12.1	Casing	Alloy-20.
2.12.2	Impeller	Alloy-20.
2.12.3	Shaft	EN-8 to BS-970.
2.12.4	Mechanical Seal	Alloy-20.
2.12.5	Common Base plate	Fabricated Steel as per IS 2062.
2.12.6	Nuts and bolts	Alloy-20.
2.13	Type of drive	Electrical Motor
2.14	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
2.15	Rated speed (RPM)	1500 (Sync.) max
2.16	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to –10%).
2.17	Type of coupling between Pump & Motor	Flexible Spacer.
2.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
2.19	HDPE Hose	Two (2) numbers, each min 80 NB and 20 m long type-2 HDPE hose as per IS-7654/1989 with isolation hose.
2.20	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, Y- type strainers, pressure gauges, pulsation dampener.
2.21	Suction strainer	PVDF (2X100 %, 50 BS).
2.22	Tests and Inspection	
2.22.1	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
2.22.2	b) Hydro-test	Shall be provided Tender Specification
2.22.3	c) Dynamic Balancing Test	Shall be provided
2.23	Performance Test	Shall be provided Tender Specification
3.0	SULPHURIC ACID DOSING PUMPS	

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3.1	Number	Two (2) [1W+1S].
3.2	Fluid to be handled	98% w/w sulphuric acid.
3.3	Service	To inject concentrated sulphuric acid into CW Fore bay.
3.4	Duty	Continuous and to be suitable for parallel Operation.
3.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
3.6	Rated Capacity, in LPH	500 LPH each.
3.7	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
3.8	Range of Capacity Adjustment	0 % - 100 %.
3.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 mlc
3.10	Y- type strainers for each pump	PVDF (2X100 %, 50 BS).
3.11	Accessories	As per tender specification, P&ID and system requirement.
3.12	Material of construction	
3.12.1	Housing	Alloy-20.
3.12.2	Pump head	Alloy-20.
3.12.3	Plunger	Alloy-20.
3.12.4	Worm	Manganese Bronze / Cast Iron.
3.12.5	Worm Wheel	Manganese Bronze / Cast Iron.
3.12.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
3.12.7	Base plate	MS.
3.12.8	Foundation bolts	Alloy-20.
3.13	Type of drive	Electrical Motor
3.14	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
3.15	Rated speed (RPM)	1500 (Sync.) max.
3.16	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
3.17	Type of coupling between Pump & Motor	Flexible Spacer.
3.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
3.19	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure

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		or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
3.20	Design Temperature	80 Deg C.
3.21	Accessories	As per tender specification, P&ID and system requirement.
4.0	SULFURIC ACID DAY TANK	
4.1	Numbers To be provided	One (1W) number
4.2	Type	Vertical cylindrical with dished ends.
4.4	Effective capacity, in m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 3 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 7.0 cum.
4.5	Type of fluid to be handled	98 % Sulphuric Acid.
4.6	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
4.7	Thickness, in mm	Not less than 6.0
5.0	SCALE INHIBITOR TANK	
5.1	Numbers To be provided	Two (1W+1S) numbers
5.2	Type for each Tank	Vertical cylindrical with dished bottom.
5.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
5.4	Effective capacity of each tank, m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 3x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 500 Litres.
5.5	Minimum Free Board, in mm	300
5.6	Material of Construction	SS-316
5.7	Thickness, in mm	Not less than 5
5.8	Accessories	Chemical charging platform with steps.
5.9	Manhole	One (1) on shell of minimum 600 mm NB.
6.0	SCALE INHIBITOR DOSING PUMPS	
6.1	Number	Two (2) [1W+1S]
6.2	Location	Indoor

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6.3	Capacity	50 LPH (each).
6.4	Service	To inject Scale Inhibitor Solution into CW forebay.
6.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
6.6	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
6.7	Range of Capacity Adjustment	0 % - 100 %.
6.8	Suction Condition	Flooded.
6.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 m
6.10	Material of construction	
6.10.1	Housing	SS-316.
6.10.2	Pump head	SS-316.
6.10.3	Plunger	SS-316.
6.10.4	Worm	Manganese Bronze / Cast Iron.
6.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
6.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
6.10.7	Base plate	MS.
6.11	Foundation bolts and nuts	SS 316
6.12	Type of drive	Electrical Motor
6.13	Criteria of selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
6.14	Rated speed (RPM)	1500 (Sync.) maximum.
6.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
6.16	Type of coupling between Pump & Motor	Flexible Spacer.
6.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
6.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric

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		Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
6.19	Design Temperature	80 Deg C.
6.20	Accessories	As per tender specification, P&ID and system requirement.
7.0	CORROSION INHIBITOR TANKS	
7.1	Numbers To be provided	Two (1W+1S) numbers
7.2	Type for each Tank	Vertical cylindrical with dished bottom.
7.3	Type of fluid to be handled	Commercial Scale Inhibitor Solution.
7.4	Effective capacity of each tank, m ³	Total effective capacity of each tank shall be adequate to hold the quantity required for one-day operation of 3 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 500 Litres
7.5	Minimum Free Board, in mm	300
7.6	Material of Construction	SS-316
7.7	Thickness, in mm	Not less than 5
7.8	Accessories	Chemical charging platform with steps.
7.9	Manhole	One (1) on shell of minimum 600 mm NB.
8.0	CORROSION INHIBITOR DOSING PUMPS	
8.1	Number	Two (2) [1W+1S]
8.2	Location	Indoor
8.3	Capacity	50 LPH (each).
8.4	Service	To inject Scale Inhibitor Solution into CW forebay.
8.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
8.6	Facility for Capacity Adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
8.7	Range of Capacity Adjustment	0 % - 100 %.
8.8	Suction Condition	Flooded.
8.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 mlc
8.10	Material of construction	
8.10.1	Housing	SS-316.
8.10.2	Pump head	SS-316.
8.10.3	Plunger	SS-316.
8.10.4	Worm	Manganese Bronze / Cast Iron.
8.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
8.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
8.10.7	Base plate	MS.
8.11	Foundation bolts and nuts	SS 316

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8.12	Type of drive	Electrical Motor
8.13	Criteria of selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
8.14	Rated speed (RPM)	1500 (Sync.) maximum.
8.15	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to -10%).
8.16	Type of coupling between Pump & Motor	Flexible Spacer.
8.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
8.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps required.
	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
8.20	Design Temperature	80 Deg C.
8.21	Accessories	As per tender specification, P&ID and system requirement.
9.0	BIOCIDE TANKS	
9.1	Numbers To be provided	Two (2W)
9.2	Type for each Tank	Vertical cylindrical with dished bottom.
9.2	Type of fluid to be handled	Commercial Biocide Solution.
9.3	Effective capacity of each tank, m ³	Cumulative capacity of the tanks shall be adequate to hold the quantity required for one-day operation of 3 x 800 MW Unit at full load but effective capacity of each of the tank shall not be less than 10.0 cum.
9.4	Minimum Free Board, in mm	300
9.5	Material of Construction	SS-316
9.6	Thickness, in mm	Not less than 5

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9.7	Accessories	Chemical charging platform with steps.
9.8	Manhole	One (1) on shell of minimum 600 mm NB.
10.0	BIOCIDE INJECTION PUMPS	
10.1	Number	Two (2) [1W+1S]
10.2	Location	Indoor
10.3	Capacity	900 LPH (each).
10.4	Service	Commercial Biocide Solution.
10.5	Type of Pump	Positive displacement, constant speed, variable stroke and plunger operated reciprocating type.
10.6	Facility for Capacity adjustment	Local manual through Micrometer Dial and remote manual from Control Room (DDCMIS).
10.7	Range of Capacity adjustment	0 % - 100 %.
10.8	Suction Condition	Flooded.
10.9	Head to be developed at rated capacity	As per system requirement. However it shall not be less than 15 m
10.10	Material of construction	
10.10.1	Housing	SS-316.
10.10.2	Pump head	SS-316.
10.10.3	Plunger	SS-316.
10.10.4	Worm	Manganese Bronze / Cast Iron.
10.10.5	Worm Wheel	Manganese Bronze / Cast Iron.
10.10.6	Shafts (worm)	Hardened Steel (EN 19 / ASTM A 276 Gr.410).
10.10.7	Base plate	MS.
10.11	Foundation bolts and nuts	SS 316
10.12	Type of drive	Electrical Motor
10.13	Criteria of selection of drive motor	Minimum 15 % margin over BHP at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
10.14	Rated speed (RPM)	1500 (Sync.) maximum.
10.15	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+10 to –10%).
10.16	Type of coupling between Pump & Motor	Flexible Spacer.
10.17	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
10.18	Tests and Inspection	
	a) Material Test	Required for Pump Head and Plunger.
	b) Hydro-Test	Test Pressure - 200% of pump operating pressure or 15 kg/cm ² (g) whichever is higher. Test Duration - Half an hour (minimum).
	c) Dynamic Balancing Test	Static Balancing for all rotating parts of pumps

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		required.
10.19	Performance Test	
	a) Test Code	Hydraulic Institute Standard and API-675.
	b) Tests to be done for determination of	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	c) Test to be carried out	Capacity, Volumetric Accuracy, Volumetric Efficiency and Power Consumption.
	d) Test for satisfactory operation of pump at site	Shall be provided.
10.20	Design Temperature	80 Deg.C
10.21	Accessories	As per tender specification, P&ID and system requirement.
11.0	NEUTRALIZATION PIT (CIVIL WORK BY BHEL CIVIL)	
11.1	Quantity	One number.
11.2	Capacity	110 Cu.m
11.3	MOC	RCC with acid alkali protection.
11.4	Accessories	As per tender specification, P&ID and system requirement.
12.0	NEUTRALIZATION PIT DEWATERING PUMP	
12.1	Quantity	Two (2) nos. (1W+1S).
11.2	Capacity & Head	10 Cum/Hr & 2 Kg/cm ² (g).
11.3	Type	Horizontal Centrifugal.
11.4	Motor rating	Vendor Design specific.
11.5	Material of Construction	Casing/Cover – PP. Pump shaft– EN8. Impeller – PP. Base Plate-MS-FRP. Fastener- SS 316L.
11.6	Accessories	As per tender specification, P&ID and system requirement.
12.0	PIPE, VALVES, STRAINER AND DIFFUSER	
12.1	Pipe MOC	For 98% H ₂ SO ₄ application-Seamless Carbon Steel pipe to ASTM A53 Gr. B /IS: 1239 Part- I, Heavy grade. For Scale & Corrosion Inhibitor and Biocide application-Stainless Steel to ASTM 312 Type 316 welded, schedule-40.
12.2	Valves	For 98% H ₂ SO ₄ application-PVDF, PN10. For Scale & Corrosion Inhibitor and Biocide application-SS 316 PN10.
12.3	Strainer	For 98% H ₂ SO ₄ application-PVDF (50 BS). For Scale & Corrosion Inhibitor and Biocide application- Stainless Steel to ASTM 312 Type 316 (50 BS).
12.4	Diffuser	SS-316 (except sulfuric acid, for sulfuric acid the MOC is PVDF).

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12.5	Safety Equipment	Four sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. A personnel water drench shower and eye bath shall be provided.
12.6	Supply of chemical	Shall be as per contractual requirement.

NOTES:

1. All accessories for each equipment shall be as per tender specification.
2. All instrument and interlocks as addressed in tender specification along with it shall be provided for each equipment/items.
3. Noise level of all equipment shall be within 85 dbA and vibration level shall be within 30 μ .

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SECTION - 8

DESIGN CRITERIA FOR COOLING WATER TREATMENT SYSTEM

8.0 DESIGN CRITERIA FOR COOLING WATER TREATMENT PLANT

The treatment shall be designed to minimize the formation of scale and build-up of micro – organisms, and prevent fouling, and corrosion of the turbine condenser and other heat exchanger.

To inhibit scale formation in the CW system it is proposed to dose Sulphuric acid to convert calcium and magnesium bicarbonates into Sulphate, which have higher solubility in water. synthetic polymer based Scale Inhibitor along with Corrosion inhibitor, Biocide and H₂SO₄ dosing Systems have been designed to dose required quantity of chemical to maintain CW quality at CW fore bay.

8.1 CAPACITY SELECTION FOR CW TREATMENT PLANT (UNIT-1&2)

ACID DOSING (98% SULPHURIC ACID)

Acid Dosage Rate	=	$\frac{[\text{Make-up M-Alkalinity} - (\text{Desired M-Alkalinity in Make-up water/COC})] \times \text{Make-up water} \times 24}{1000}$
	=	$[130-150/6.5] \times 3000 \times \frac{24}{1000}$
	=	7698.4 Kg./day
	=	320.76 Kg/hr
98 % Sulphuric Acid	=	$\frac{320.76}{0.98}$ 327.3 Kg/hr
Specific Gravity	=	1.84
Acid Dosage Rate	=	$\frac{327.3}{1.84}$ LPH 177.88 LPH
Acid Dosing Pumps Selected	=	300LPH(Selected)
Capacity of Sulphuric Acid Day Tank	=	177.88×24 4269.2 Liters
Day Tank Selected	=	5000 Liters
Capacity of Sulphuric Acid Bulk Storage Tank	=	$178.26 \times 24 \times 15$ Liters
	=	64038.1 Liters
Bulk Storage Tank Selected	=	2Nos each of 35 M³

SCALE INHIBITOR/CORROSION INHIBITOR/BIOCIDE

Scale inhibitor and corrosion inhibitor are a proprietary chemicals and level of its dosage in CW & ACW depends upon the recommendations of chemical

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manufacturer and based upon plant operation. However, the Plant will be designed for 10-ppm dosage of either scale inhibitor or corrosion inhibitor, & for biocide, dosing rate is maximum 3 ppm.

Scale Inhibitor/ Corrosion Inhibitor Dosing Rate	=	[CW Blowdown water(m ³ /hr) X Dosage (ppm)] /1000
Dosing rate	=	(464 X 10)/1000 4.64 Kg/hr of 100 % Solution
Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate	=	4.64/1 LPH (Approx.) 4.6 LPH
Chemical Dosing Pump Considered	=	50 LPH (Selected)
Biocide Dosing Rate	=	[Total CW + ACW flow (m ³ /hr) X Dosage (ppm)] /1000
Dosing rate	=	(174214 X 3)/1000 522.64 Kg/hr of 100 % Solution
Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate	=	522.64/1 LPH (Approx.) 522.64 LPH
Chemical Dosing Pump Considered	=	600 LPH (Selected)

8.2CAPACITY SELECTION FOR CW TREATMENT PLANT (UNIT-3,4& 5)

ACID DOSING (98% SULPHURIC ACID)

Acid Dosage Rate	=	[Make-up M-Alkalinity- (Desired M-Alkalinity in Make-up water/COC)] X Make-up water X 24/1000
	=	[130-150/6.5] X 4500 X 24/1000
	=	11547.69 Kg./day
	=	481.15 Kg/hr
98 % Sulphuric Acid	=	(481.15/0.98) 490.97 Kg/hr
Specific Gravity	=	1.84
Acid Dosage Rate	=	(490.97 /1.84)LPH 266.83 LPH
Acid Dosing Pumps Selected	=	500 LPH(Selected)
Capacity of Sulphuric Acid Day Tank	=	(266.83 X 24) 6403.99Liters
Day Tank Selected	=	7000 Liters

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Capacity of Sulphuric Acid Bulk Storage Tank	=	274.51 X 24 X 15 Liters
	=	96059.99 Liters
Bulk Storage Tank Selected	=	3Nos each of 35 M³

SCALE INHIBITOR/CORROSION INHIBITOR/BIOCIDE

Scale inhibitor and corrosion inhibitor are a proprietary chemicals and level of its dosage in CW & ACW depends upon the recommendations of chemical manufacturer and based upon plant operation. However, the Plant will be designed for 10-ppm dosage of either scale inhibitor or corrosion inhibitor, & for biocide, dosing rate is maximum 3 ppm.

Scale Inhibitor/ Corrosion Inhibitor Dosing Rate	=	[CW Blowdown water(m ³ /hr) X Dosage (ppm)] /1000
Dosing rate	=	(696 X 10)/1000 6.96 Kg/hr of 100 % Solution
Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate	=	6.96/1 LPH (Approx.) 6.9 LPH
Chemical Dosing Pump Considered	=	50 LPH (Selected)
Biocide Dosing Rate	=	[Total CW + ACW flow (m ³ /hr) X Dosage (ppm)] /1000
Dosing rate	=	(261321 X 3)/1000 783.963 Kg/hr of 100 % Solution
Specific Gravity of Chemical	=	1 (approx.)
Chemical Dosage Rate	=	783.963/1 LPH (Approx.) 783.963 LPH
Chemical Dosing Pump Considered	=	900 LPH (Selected)

8.3 EQUIPMENT DESIGN CRITERIA FOR CW TREATMENT SYSTEM

One CW Treatment Plant have been provided for Unit 1& 2, similarly One (1 No.) CW Treatment plant have been provided for Unit 3, 4 & 5.

8.3.1 SCALE INHIBITOR / CORROSION INHIBITOR / BIOCIDE DOSING FOR UNIT 1 & 2

The chemical is dosed in CW forebay to control scaling and corrosion and to prevent bio growth in the system. For this purpose Scale Inhibitor /corrosion inhibitor /biocide dosing system has been provided. The dosing system shall mainly consist of the following equipment:

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- a) Two (2) numbers Scale Inhibitor Tanks, each complete with all necessary accessories.
- b) Two (2) numbers Scale Inhibitor Injection Pumps, each complete with drive motor and all other necessary accessories.
- c) One (1) number SS-316 Pipe Diffuser for Scale Inhibitor.
- d) Two (2) numbers Corrosion Inhibitor Tanks, each complete with all necessary accessories.
- e) Two (2) numbers Corrosion Inhibitor Injection Pumps, each complete with drive motor and all other necessary accessories.
- f) One (1) number SS-316 Pipe Diffuser for Corrosion Inhibitor.
- g) Two (2) numbers Biocide Tanks, each complete with all necessary accessories.
- h) Two (2) numbers Biocide Injection Pumps, each complete with drive motor and all other necessary accessories.
- i) One (1) number SS-316 Pipe Diffuser for Biocide.
- j) All necessary piping, valves, fittings, instrumentation etc.

8.3.2 SULPHURIC ACID DOSING FOR UNIT (1 &2)

H₂SO₄ is dosed to control the pH in the cooling water cycle. For this purpose one (1) no. H₂SO₄ dosing system has been provided. The H₂SO₄ dosing system shall consist of the following:

- a) One (1) number hose station for unloading 98% Sulfuric Acid. The hose station shall have two (2) numbers HDPE hose connections (80 NB each).
- b) Two (2) numbers Sulfuric Acid Unloading Pumps, each complete with drive motor and all other necessary accessories.
- c) Two (2) numbers Sulfuric Acid Storage Tanks, each complete with all necessary Accessories.
- d) One (1) number Sulfuric Acid Day Tank, each complete with all necessary accessories.
- e) Two (2) numbers Sulfuric Acid Injection Pumps, each complete with drive motor and all other necessary accessories.
- f) One (1) number PVDF Pipe Diffuser for Sulphuric Acid.
- g) All necessary piping, valves, fittings, instrumentation etc.

Flow of sulphuric acid from bulk storage tank to acid day tank shall be by gravity.

8.3.3 SCALE INHIBITOR/ CORROSION INHIBITOR/ BIOCIDES DOSING FOR UNIT (3,4 & 5)

The chemical is dosed in CW foreBay to control scaling and corrosion and to prevent bio growth in the system. For this purpose Scale Inhibitor /corrosion inhibitor /biocides dosing system has been provided. The dosing system shall mainly consist of the following equipment:

- a) Two (2) numbers Scale Inhibitor Tanks, each complete with all necessary.

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- b) Two (2) numbers Scale Inhibitor Injection Pumps, each complete with drive motor and all other necessary accessories.
- c) One (1) number SS-316 Pipe Diffuser for Scale Inhibitor.
- d) Two (2) numbers Corrosion Inhibitor Tanks, each complete with all necessary accessories.
- e) Two (2) numbers Corrosion Inhibitor Injection Pumps, each complete with drive motor and all other necessary accessories.
- f) One (1) number SS-316 Pipe Diffuser for Corrosion Inhibitor.
- g) Two (2) numbers Biocide Tanks, each complete with all necessary accessories.
- h) Two (2) numbers Biocide Injection Pumps, each complete with drive motor and all other necessary accessories.
- i) One (1) number SS-316 Pipe Diffuser for Biocide.
- j) All necessary piping, valves, fittings, instrumentation etc.

8.3.4 SULPHURIC ACID DOSING FOR UNIT(3,4 &5)

H₂SO₄ is dosed to control the pH in the cooling water cycle. For this purpose one (1) no. H₂SO₄ dosing system has been provided. The H₂SO₄ dosing system shall consist of the following:

- a) One (1) number hose station for unloading 98% Sulfuric Acid. The hose station shall have two (2) numbers HDPE hose connections (80 NB each).
 - b) Two (2) numbers Sulfuric Acid Unloading Pumps, each complete with drive motor and all other necessary accessories.
 - c) Two (4) numbers Sulfuric Acid Storage Tanks, each complete with all necessary Accessories.
 - d) One (1) number Sulfuric Acid Day Tank, each complete with all necessary accessories.
 - e) Two (2) numbers Sulfuric Acid Injection Pumps, each complete with drive motor and all other necessary accessories.
 - f) One (1) number PVDF Pipe Diffuser for Sulphuric Acid.
- All necessary piping, valves, fittings, instrumentation etc.

Flow of sulphuric acid from bulk storage tank to acid day tank shall be by gravity.

SECTION - 9

TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION

Electrical, Controls & Instrumentation requirements for the Cooling Water Treatment system for both Unit 1 & 2 & Unit 3, 4&5 is attached separately as **ROS: 4181, Rev 00** along with this specification.

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PERFORMANCE GUARANTEE

Performance Guarantee parameters for Circulating Water Treatment System

i) Corrosion rate:

On MS < 3.0 mpy

On Cu < 0.5 mpy

On SS (304) < 0.5 mpy

ii) Scaling < 15mg/dm²/day

iii) Ni-Cr mesh should be clean when visually inspected

iv) Pitting corrosion rate on MS/Brass < 20 mpy.

v) Micro/Bio fouling conditions

- Total Viable Count (TVC) < 1x10⁵ Counts/ml
- Sulfate reducing bacteria (SRB) < 1x10⁵ Counts/ 100ml

NOTE-1: - One number safety shower and eyewash shall be provided near sulphuric acid handling area.

NOTE-2: - The system shall be designed based on the dosing rate indicated in this document. However, the dosing rate shall be done on the actual water analysis

NOTE-3:- Dyke shall be provided around the acid storage tank. The dyke shall be capable to hold one Bulk acid storage tank spillage.

NOTE-4: Painting shall be as per Nit/Tender Specification.

Minimum 72 hrs. Performance test run shall be conducted for the guaranteed values of treated water quality, quantity and other performance parameters.

SECTION 11

PUMPS & PIPE SELECTION CRITERIA

Sl. No.	Pipe Size	Velocity in m/sec		
		Below 50mm	50mm-150mm	200mm & above
1	Pump Suction for Water		1.2-1.5	1.2-1.8
2	Pump Discharge for Water	1.2-1.8	1.8-2.4	2.1-2.5

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3	Header		1.5-2.4	2.1-2.4
4	Compressed Air Below 2Kg/cm2(g)	15-20	20-30	25-35
5	Compressed Air Above 2Kg/cm2(g)	20-30	25-40	35-45
6	Suction to compressor/Blowers		7-8	
7	Pump Suction for Chemical Solution	1.0-1.2	1.1-1.3	
8	Pump Discharge for chemical solution	1.2-1.4	1.3-1.5	
GRP PIPES				
9	For GRP Pipe with negative suction		1.2 (Max)	2 (Max)
10	For GRP Pipe with pressurized suction		1.5 (Max)	
11	For GRP Pipe Delivery		2.0 (Max)	2.0 (Max)

SECTION – 12

12.0 ATTACHMENTS

The following drawing is enclosed with this specification as a part of the specification:

- 11.1 Tender P& ID for CWTP System (Unit# 1&2): 1-WT-080-01064, Rev: 00
- 11.2 Tender P&ID for CWTP System (Unit# 3, 4 &5):1-WT-080-01065, Rev: 00
- 11.3 Tentative Pipe Routing for CWTP (Unit# 1, 2)
- 11.4 Tentative Pipe Routing for CWTP (Unit#3, 4&5)
- 11.5 Plot Plan : PE-DG-417-100-M001

12.1 IMPORTANT POINTS TO BIDDERS

1. If the vendor has suggestions/requirements of any additional instruments/equipment over & above as shown in the P & ID drawing , the same has to be clearly indicated and suitably covered in the commercial bid also separately.
2. The specification for the instruments/equipment available in the main specification has to be taken for such additional requirements (or) Customer should be contacted.



SPECIFICATION FOR
COOLING WATER TREATMENT
PLANT

SPEC.NO.ROS: 6183

REV.: 00

Annexure 1

TECHNICAL DEVIATIONS

<i>Sl. No</i>	<i>Section no.</i>	<i>Clause No.</i>	<i>Page / No.</i>	<i>Specification</i>	<i>Statement of Deviations/variatio</i>	<i>Reason for Deviation</i>	<i>cost of withdrawal</i>



TECHNICAL SPECIFICATION FOR
CW TREATMENT PLANT
5 X 800MW TSGENCO YADADRI TPS
CWTP(1,2) & (3,4,5)

SPEC NO: ROS 4181

REV NO: 00

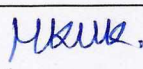
PART OF ROS 6183

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BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION FOR
ELECTRICAL
CONTROL & INSTRUMENTATION
5 X 800MW TSGENCO YADADRI TPS
CW TREATMENT PLANT UNIT(1,2) & (3,4,5)

01.08.17	AJV 	MKV 	VNS 	Fresh issue
Date	Prepared	Checked	Approved	Remarks

	TECHNICAL SPECIFICATION FOR CW TREATMENT PLANT 5 X 800MW TSGENCO YADADRI TPS CWTP(1,2) & (3,4,5)	SPEC NO: ROS 4181
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Specific Technical Requirements (ELECTRICAL):

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

- a) Services and Equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment.
- d) Electrical load requirement for CW Treatment Plant.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
- h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
- i) Motors shall meet minimum requirement of Electric motor specification.
- j) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- l) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

THREE PHASE A.C. MOTORS

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power

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station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 **CODES & STANDARDS**

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

- i) IS-325
- ii) IS-12615
- iii) IEC-60034

3.00.00 **SERVICE CONDITIONS**

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose,

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

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4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-

Motors up to 1500kW - 600% subject to IS tolerance of plus 20%.

Motors above 1500kW - 450% not subject to any positive tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor.

5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.

b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80%

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rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

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6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

LT motors 15kW and above shall be provided with external greasing arrangement.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault

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current for a duration of 0.25 sec.

6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor Minimum Ph-Ph & Ph-Earth clearance

0.415 kV : 25 mm

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating Conductor Size

Above Up to

----- 5.5 kW : 8 SWG GI Wires.

5.5 kW 22 kW : 25mm X 4mm GS Flat.

23 kW 55 kW : 40mm X 6mm GS Flat.

56kW 174kW : 50mm X 8mm GS Flat.

175kW ABOVE : 75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows**

a) For 415V, 3-Ph, LT Motors- Rating : Cable Size Above Up to----- 5.5 kW : 1R X 3C X 6 Sq.mm

5.5 kW 11 kW : 1R X 3C X 10 Sq.mm

11 kW 22 kW : 1R X 3C X 35 Sq.mm

22 kW 37.5 kW : 1R X 3C X 70 Sq.mm.

37.5kW 55 kW : 1R X 3C X 150 Sq.mm

55 kW 75 kW : 1R X 3C X 300 Sq.mm

75 kW 110kW : 2R X 3C X 150 Sq.mm

110 kW 175kW : 2R X 3C X 300 Sq.mm

7.00.00 **ACCESSORIES**

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7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listedi)

For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS- 1554(Part-1).

Specific Technical Requirements (C&I):

- 1.0 Operation & Control of CW TREATMENT System shall be from plant DCS (BHEL Scope) as well as through Local Control Panel.
- 2.0 Local control panel will act as interface between the DCS and the field devices for commands & feedbacks. LCP shall have the provision of command (start/stop, load/unload) & feedback interface with plant DCS.
- 3.0 Bidder to include all the instruments (PG, PS, PT, LS, RTD etc.) required for the package along with necessary fittings, accessories and valve manifold etc.
- 4.0 The solenoid operated valves/ damper/gates shall have limit switches for open/ close feedback. Solenoid valve shall be rated for 24 V DC only.
- 5.0 The junction boxes/LIEs for termination of instruments /solenoid valve limit switches etc are in bidder's scope.
- 6.0 BHEL shall provide 230 VAC UPS supply feeder at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder and all necessary hardware/software for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.
- 7.0 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 8.0 Vendor representative shall be available for 3 -4 days at BHEL Electronic Division (EDN) Bangalore during testing of DCS.

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- 9.0 Vendor representative shall be available at site at the time of commissioning of the system and Vendor to delegate/depute their person/experts as per owner/consultant requirements.
- 10.0 Mandatory spare to be supplied by bidder.
- 11.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.
- 12.0 For instrument & control cable scope of supply refer 'Electrical scope sheet between BHEL & vendor'.
- 13.0 Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.
- 14.0 Every panel- mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 15.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
- 16.0 The make of all the items shall be from approved sub-vendor list.
- 17.0 Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, cable interconnections details for complete system shall be in Bidders' scope.
- 18.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract:
- Control & operational write-up for the system
Recommended control scheme/ logic diagram
Process manuscript for implementation in DCS
List of Drives (Solenoid valves etc)
 - I/O list (DCS)
 - GA & wiring diagram of local panel. Power requirement.
 - Local control panel and field instruments quality plan. Local control panel & instruments data sheet.
 - JB grouping document.
 - Cable schedule and cable interconnection drawing.
Instrument schedule
 - Alarm Schedule
SOE schedule
 - Instrument hook-up diagram.
 - Mandatory spare BOQ
 - UPS load list
- Any other document decided during detailed engineering.

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9.00.00 WATER SYSTEM RELATED SPECIAL INSTRUMENTS

9.02.00 PARSHALL FLUME

9.02.01 Bidder shall include in his scope complete equipment for flow measurement through Parshall flumes. Measurement shall be carried

out by Ultrasonic Level measurement principle. Bidder shall provide primary sensors, transmitters, flow indicator & totalizer & shall include all required accessories. System shall be of reputed make and acceptable to Owner / Engineer.

The general components of this system are as follows.

9.02.02 Level Transmitter shall have 2 wire along output of 4 – 20 mA DC

(600Ω load impedance) in direct proportion to level with an accuracy of + / - 0.16 % or better. The transmitter shall be SMART type with interface with HART management system. The flow compensation is to be implemented in the transmitter itself.

9.02.03 Flow signal from the system shall be in the form of analog output of 4 – 20 mA DC with an accuracy of + / - 1 % or better.

9.02.04 Field mounted local flow indication facility shall also be provided.

9.02.05 All necessary liberalization circuits must be integral to the field transmitter and the enclosure should conform to IP-65 and corrosion resistant.

9.03.00 CHLORINE LEAK DETECTOR

1. Type : Electrochemical
2. Resolution : 0.1 ppm
3. Response Time : Less than 1 second
4. Operating Temperature : 0 - 45 ° C
5. Display Type : Digital Indicating meter
6. Alarm Contacts : Dual Alarm setpoints (240V AC, 5A)
7. Protection : IP 65
8. Mounting : Wall Mounting
9. Power Supply : 240 V AC
10. Output : 4~20 mA DC
11. Load : 600Ω

9.04.00 RESIDUAL CHLORINE ANALYZER

1. Type : Amperometric
2. Electrode : Platinum / Gold and copper electrode shall be provide with cell cleaning system
3. Indication : LCD in analyzer panel
4. Range : 0 to 20.0 mg / L (ppm)
5. Accuracy : 2% or better
6. Sensitivity : 0.01 mg / L

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7. Output signal : 4-20 mA DC (isolated) into 600 ohms
8. Alarm annunciation : Dual Alarm setpoints (240V AC, 5A) (Field adjustable)
9. Calibration : Zero and span adjustment Final calibration / adjustment of analyzer to be done at site and duly verified by titration.
10. Temp. Compensation : 0-50 °C
11. Sample drain : Yes
12. Enclosure : Stainless Steel (IP-65)
13. Power supply : 240 V AC, 50 Hz, 1 Phase (through UPS)
14. Accessories : Chemical Reagents

9.05.00 DENSITY INDICATOR

1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part Stainless Steel
2. Enclosure Stainless Steel (IP-65)
3. Power Supply 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy ± 0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories Mounting hardware, integral amplifier (if required), cable glands, tag plate etc.

pH ANALYSER

A. Sensor

1. Type of Cell : Flow thru
2. Range : 0-14 pH
3. Type of measurement : Combination electrode
4. Temp. Compensation : Manual and Automatic (Integral) 0- 100°C
5. Process Connection : Screwed
6. Measuring Electrode : Glass, high independence, thin electrode in one housing
7. Pressure Rating : 10 kg/cm²
8. Accessories : Vessel (SS 316) with ½" NPT connection

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9. Cable : Upto transmitter in flexible conduct
10. Preamplifier : Integral or separate
11. Liquid Junction : Ceramic / Kyner or equivalent

B. Transmitter

1. Type : Microprocessor based, Single stream
2. Mounting : 2" pipe
3. Protection Class : IP-65 or better
4. Output : 4-20 mA DC (isolated)
5. Display : Digital Display in Engineering Unit,
Alarm Status.
6. Accuracy : $\pm 0.2\%$ of FSD or better
7. Response time : Less than 5 sec
8. Stability : ± 0.001 pH /week
9. Repeatability : $\pm 1\%$ or better
10. Temp. Compensation : Automatic (Pt-100 sensor)
11. Diagnostic : Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc.
12. Alarm : Dual set point, hysteresis and time delay adjustable
13. Enclosure : Die cast aluminum, epoxy coated
14. Cable Termination : Internal (cable entry through conduit)
15. Accessories : 2" pipe mounting bracket, Sensor cable with flexible conduit (as required),
½" NPT Cable Gland, SS Tag plate, , Ultrasonic Electrode Cleaner, Buffer
solution tablets

SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed
digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero
elevation and suppression by 100% of span

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9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 10. Output Indicator : LCD (Integral indicator of 5 digit display)
 11. Nameplate : Tag number, service engraved in SS tag plate
 12. Body : SS
 13. Operating Voltage : 24V DC
 14. Load : 600 Ohms (min.) at 24 Volts D.C.
 15. Ambient Temperature : 0 - 50 OC
 16. Performance:
 - i. Accuracy $\pm 0.075\%$ of Span or better
 - ii. Repeatability $\pm 0.05\%$ of Span or better
 17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
 18. Accessories : a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel Ubolts
 - c. Siphon for steam and hot water services
 - d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. ½" NPT cable gland
 - g. Handheld calibrator
 19. Adjustment/Calibration/Maintenance: From handheld calibrator/ HART management system
- 1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER**
1. Working Principle : Smart (HART Compatible)
 2. Type : Microprocessor based, 2 – Wire
 3. Output Signal : 4-20 mA DC along with superimposed digital signal
 4. Measuring Element : Capsule / Diaphragm
 5. Element material : SS-316 (Stainless Steel) or better
 6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
 7. Turn-down ratio : 100: 1
 8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
 9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 10. Output Indicator : LCD (Integral indicator of 5 digit display)
 11. Nameplate : Tag number, service engraved in SS tag plate
 12. Body : SS

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13. Operating Voltage : 24V DC
 14. Load : 600 Ohms (min.) at 24 Volts D.C.
 15. Ambient Temperature : 0 - 50 OC
 16. Performance:
 - i. Accuracy : $\pm 0.075\%$ of Span or better
 - ii. Repeatability : $\pm 0.05\%$ of Span or better
 17. Sealing/Isolation : Extended diaphragm (Silicon oil/Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
 18. Accessories : a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel Ubolts
 - c. Siphon for steam and hot water services
 - d. $\frac{1}{2}$ " NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. $\frac{1}{2}$ " NPT cable gland
 - g. Handheld calibrator
 19. Adjustment/Calibration/Maintenance: From handheld calibrator/ HARTmanagement system
- 1.03.00 Displacer Type Level Transmitters
1. Type : Smart (HART Compatible)
 2. Stages of operation : Continuous
 3. Material :
 4. i. Displacer SS-316
 5. ii. Suspension wire SS-316
 6. iii. Torque tube housing SS
 7. iv. Torque tube Inconel
 8. v. Displacer chamber SS
 9. vi. Transmitter Housing SS
 10. Operating Voltage : 24 V DC
 11. Transmission : Microprocessor based, 2-wire
 12. Output Signal : 4-20 mA DC along with superimposed digital signal
 13. Static / overload : Maximum static pressure without pressure permanent deformation or loss of accuracy
 14. Turn-down ratio : 10 : 1 or better
 15. Zero & Span : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span

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16. Enclosure Class : IP-65
 17. Output Indicator : LCD type (Integral indicator of 5 digit display)
 18. Nameplate : Tag number and Service engraved in stainless steel tag plate
 19. Ambient Temperature : 0 - 50 OC
 20. Load Impedance : 600 Ohms at 24 Volts (minimum)
 21. Process Connection : 2" Flanged
 22. Performance – Accuracy : + 0.075 % of span or better
 23. Accessories : a) Counter Flange, nuts, bolts, gaskets etc
b) Weights for 5 point calibration of instruments
c) Vent and drain plugs
d) ½" NPT Glands
e) Handheld calibrator
 24. Preferred Features : a) Test plug connection and cutout terminals physically separated from other electronics
b) Electronic Damping facility (adjustable)
 25. Adjustment/Calibration/ Maintenance: From handheld calibrator/ HART management system
- 1.04.00 MASS FLOW METER
- 1.04.01 SENSOR
1. Measuring Principle : Coriolis Mass flow
 2. Primary Element : Flow Tube of 316SS or better
 3. Heating Arrangement : Integral
 4. Temperature Control : For heavy fuel oil application
 5. Process Connection : Flanged of rating as per process requirement
 6. Drain : Self-draining facility
 7. Enclosure : Stainless steel
 8. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 TRANSMITTER
1. Measured quantities : Mass Flow rate, Total Mass Flow, Density
 2. Input Signal Processing : Smart (HART compatible)
 3. Display : LCD
 4. Output : 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
 5. Load : < 750 ohms

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6. Power supply : 240V AC, 50 Hz
 7. Turn Down : 100:1
 8. Accuracy : + 0.2 % of measured value
 9. Housing : IP 65 (Explosion proof)
 10. Nameplate : Tag number, service engraved in stainless steel tag plate
 11. Accessories : a) Handheld calibrator
 - b) Mounting U-bolts, nuts, bolts, prefab cable etc
 - c) ½"NPT cable gland
 12. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
 13. Applications : Fuel Oil service
- 1.05.00 RADAR TYPE LEVEL MEASUREMENT**
1. Type : Smart (HART Compatible)
 2. Antenna : Co axial / guided wave radar / Overspill protection
 3. Principle : TDR (Time Domain Reflectometry)
 4. Communication : Two wire 4-20mA DC with HART
 5. Environmental temperature : 0 – 50 °C
 6. Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 7. Calibration : a) Self calibration with internal reference
 - : b) Zero & Span calibration
 8. Process Connection : External cage mounting Flanged /screwed
 9. Electronic Housing : Epoxy painted Die-Cast aluminium alloy
 10. Antenna / Flange assembly : 316 SS or Hest alloy (as required)
 11. Power supply : 24 V DC
 12. Output Indicator : LCD
 13. Accuracy : 5 mm or 0.1% of probe length
 14. Accessories : a) Handheld calibrator
 - : b) Counter Flange, nuts, bolts, gaskets etc
 - : c) ½"NPT cable gland
 - : d) SS Nameplate
 15. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
 16. Applications : Vessels under vacuum or low pressure applications, solid levels
- 1.06.00 ULTRASONIC LEVEL TRANSMITTER**
1. Type : Microprocessor based, 2-wire, Smart (HART Compatible)
 2. Operating Principle : Detection of reflected ultrasonic pulse

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3. Output Signal : 4-20 mA DC along with superimposed digital signal
 4. Operating frequency : 10 KHz to 50 KHz (typical)
 5. Display : LCD
 6. Temperature Compensation : Built in –Programmable
 7. Power supply : 24 V DC
 8. Enclosure : SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 9. Zero & Span : Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
 10. Accuracy & Repeatability : 0.15 % of span or better
 11. Resolution : 0.1 % of span
 12. Operating temp. : Transmitter- 500 C and Sensor - 800 C
 13. MOC Sensor : SS-316/Body- PVC and Face – Polyurethane
 14. Mounting : 4" Flanged/ 2" NPT for sensor and Transmitter on panel
 15. Accessories : a) Handheld calibrator
b) Weather canopy for protection from direct sunlight and direct rain
c) ½"NPT cable gland
d) All mounting hardware (SS- 316), Prefab cable
e) SS Nameplate
 16. Diagnosis : On-line
 17. Status Indication : Power On, HI, HI-HI, Lo, LO-LO, Fault
 18. Output Contacts : 2 SPDT, 230V, 5A
 19. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
 20. Applications : Coal Bunker, Water Service etc.
- 1.07.00 ULTRASONIC FLOW TRANSMITTER**
1. Type : Ultrasonic – Clamp On
 2. Accuracy : +/- 1 % of reading
 3. Repeatability : +/- 0.3 % of reading
 4. Rangeability : 400 : 1
 5. Output Signal : 4-20 mA DC with HART
 6. Measured Parameter : Volumetric flow, Totalized flow and flow Velocity
 7. Display : LCD with internal Key Pad
(Flow rate & Totalization)
 8. Power Supply : 24 V DC (2 Wire)
 9. Enclosure : SS (IP- 68 – Submersible)

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10. Mounting : SS Chain or Strap
11. Accessories
 1. Handheld calibrator
 2. ½"NPT cable gland
 3. Transducer cable
 4. All mounting hardware (SS- 316)
 5. SS Nameplate
12. Adjustment/Calibration/ /Maintenance : From handheld calibrator/ HART management system
13. Applications : Plant water service

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element material : SS-316.
All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments : a) Internal Set Point
: b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance : a) Repeat accuracy $\pm 1.0\%$
: b) Accuracy of Setting Indication of $+ 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C
14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications

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- c) Siphons for steam and hot water services
- d) Retention ring and screws for surface mounting
- e) 1/2" NPT 2 Valve SS-316 barstock manifold
- f) 1/2" NPT cable gland

16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
 2. Sensing element material : SS-316. All other wetted part SS316
 3. Case Material : SS
 4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
 5. Over range : 150 % of maximum pressure
 6. Adjustments : a) Internal Set Point
: b) Differential adjustment
 7. End Connection : 1/2" NPT bottom/ back connected
 8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
 9. Switch Type : Snap acting, shock & vibration proof
 10. Terminal Block : Suitable for full ring lugs
 11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 12. Performance : a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $+ 1.5\%$
 13. Ambient temperature : 0 – 50 Deg.C
 14. Nameplate : Tag number, service engraved in SS tag plate
 15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 5 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
 16. Applications : During Detail Engineering on Owner's approval
- ### 3.03.00 LEVEL SWITCH
- #### 3.03.01 FLOAT OPERATED

	TECHNICAL SPECIFICATION FOR CW TREATMENT PLANT 5 X 800MW TSGENCO YADADRI TPS CWTP(1,2) & (3,4,5)	SPEC NO: ROS 4181
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1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel, construction welded
4. Float chamber mounting : Side mounted
5. Fluid connection : Side – Side
6. Fluid connection size : 1” ANSI RF Flange (rubber line, if required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories : a) Counter flange, nuts & bolts, suitable gasket etc.
- b) Steel globe type drain valve
- c) ½”NPT cable gland
- d) Stainless steel nameplate with alpha-numeric engraved for service and tag
15. Application : During Detail Engineering on Owner’s approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection : a) Threaded upto 1” line size with integral Tee
- : b) Flanged for line size > 1 ½”
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½”NPTF
9. Accessories : a) Tee, Counter flange, nuts & bolts, suitable gasket etc
- b) ½”NPT cable gland
- c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

1. Type : RADIO FREQUENCY Sensing probe
2. Material : SS-316
3. Mounting : Threaded

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4. Application Temperature : 250°C (Max.)
5. Input Supply Voltage : 240V AC $\pm 10\%$, 50 Hz.
6. Relay Output : 2 SPDT (240V AC, 5A)
7. Ambient Temperature : 50 °C
8. Enclosure Protection : IP-66
9. Enclosure Housing : SS
10. Local LED Indication :

Normal Level

Power On

Alarm Level

Probe Healthy

11. Switching Repeatability : $\pm 0.5\%$
12. Accessories :
Co-axial cable for probe connection to controller
SS Tag plate
 $\frac{1}{2}$ " NPT Cable Glands

13. Application : Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1. Type : Conductivity discrimination
2. Probe MOC : SS-316
3. Mounting : Flanged on external cage
4. Application Temperature : 250°C (Max.)
5. Test Pressure : Two times rated pressure
6. Input Supply Voltage : 240V AC $\pm 10\%$, 50 Hz.
7. Input :

Four independent channel with selectable switching threshold for water conductivity

8. Relay Output : 2 SPDT (240V AC, 5A)
9. Ambient Temperature : 50 °C
10. Enclosure Protection : IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing : SS
12. Local LED Indication : HI,LO, HIGH-HIGH, LOW-LOW Power Fault
13. Accessories :
a) Interconnecting cable from probe to electronics
b) Mounting accessories
c) External cage

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d) Washer & Gasket

e) ½" NPT Cable Glands

f) SS Tag Plate

14. Application : During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1. Type : Bimetallic or gas filled

2. Sensing Element Material : SS-316

3. Bulb Material : SS-316

4. Capillary : Stainless Steel armored

5. Movement Material : Stainless Steel

6. Case material : Stainless Steel with neoprene gasket and clear glass where applicable cover

conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).

7.. Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points

8. Over range Protection : 120 %

9. Instrument connection : Bottom

10. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)

11. Switch type : Snap acting, shock and vibration-proof

12. Adjustability : Internal Set point adjustable over span range

13. Compensation : a) Capillary compensation with invar wire throughout the capillary length

b) Case compensation

14. Performance

a) Scale Accuracy : ±1.0 % of full scale

b) Repeatability : < 0.5 % of full range

c) Response time : Less than 40 seconds with thermowell

15. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting

16. Nameplate : Tag number, service engraved in stainless steel tag plate

17. Accessories : Mounting accessories, ½" NPT cable gland

18. Applications : During Detail Engineering on Owner's approval

4.00.00 LOCAL INSTRUMENTS

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type : Bourdon/Bellows/Diaphragm

2. Sensing & Socket : SS-316

3. Movement Material : SS-316

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4. Case Material : Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size : Generally 150 mm
6. Scale : Black lettering on white in 270 O arc.
7. Window : Shatterproof glass
8. Range Selection : Normal process pressure: 50~70 % of range
9. Over-range Protection : 125% of maximum range by internal stop. External stop at zero
10. Adjustment : For Zero adjustment (Micrometer screw external)
For Range adjustment (Micrometer screw internal).
11. Element Connection : Argon welding
12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance : Accuracy of ± 1.0 % of span or better
14. Operating ambient : 0 - 50 OC
15. Safety Feature : Blow out disc /diaphragm at the back
16. Accessories :

- a) Snubbers for pulsating fluid application.discharge
- b) Stainless steel Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- d) 5-valve SS316 manifold from barstock for differential pressure gauge
- e) Siphons for steam and hot water services

17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
7. Scale Board : Anodized Aluminium with engraved marking (Minimum graduation 10mm), mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : + 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable gasket etc. as applicable, SS Tag plate

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4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent

2. Material Glass :Toughened borosilicate resistant to thermal shock

Body Material : Carbon Steel Stainless Steel Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)

3.Integral cocks & valves/Fittings: i. SS 316

ii. Rubber lined corrosion resistant stainless steel (for DM/RO service)

5. Vessel Connection : ANSI Flanged SS316

6. Accessories : i. Integral cocks ii. Drain Valves iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate iv. Illuminating lamps, Mica shield as required v. Calibrated scale

7. Pressure rating : Twice the maximum working pressure

8. Temperature : 300 O C

9. Other details : For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.

4.04.00 SLIGHT GLASS

1. Type : Flap-type.

2. End connection : Screwed / Flanged

3. Material

a) Body : SS- 304

b) Cover plate : SS- 304

c) Indicator : SS- 316

4. Sight Glass : Toughened Borosilicate

5. Gasket : Neoprene

6. Bolts & Nuts : High tensile steel.

7. Hydraulic Test Pressure : 1.5 times maximum working pressure

8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.

4.05.00 ROTAMETER

1. Type : ON-LINE for line upto and including 50 mm NB. Borosilicate BY-PASS for line size above 50 NB

2. Metering tube : Toughened Borosilicate

3. Float : SS-316

4. End fittings : SS-316

5. Packing material : Teflon / PTFE

6. Casing : Stainless Steel

7. Gland Rings /Followers/ Other wetted parts : Stainless Steel

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8. Orifice Plate : Stainless Steel (for bypass type)
9. Operating Temperature : 0-50 Deg. C
10. Test Pressure : 200% of maximum operating pressure
11. Scale : 250 mm nominal length
12. Graduation : Direct reading
13. Process Connection : Flanged (RF) to line size as per ANSI standards (150#)
14. Tapping : D & D/2
15. Accuracy : +/- 2% of full scale reading
16. Reproducibility : Within 0.5% of instantaneous reading
17. Accessories : SS Tag Plate, orifice plate

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00 RESISTANCE TEMPERATURE DETECTOR

1. Type : Platinum (Duplex), Ungrounded
2. Platinum (Duplex), Ungrounded : 100 ohm at 0 OC
3. Base : Wound on ceramic (anti-inductive)
4. Wiring : 3 Wire
5. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
6. Response time : a) 15 sec. (bare).
b) 30 sec. (with thermowell)
7. Calibration : DIN 43760
8. Accuracy : $\pm 0.5\%$
9. Head a) Type : IP-65 universal screwed type
b) Material : Stainless Steel
c) Terminal blocks : Nickel plated Brass-screw type / silver plated
d) Cable connection : 1/2" NPT gland and grommet
e) Others : Terminal head cover with SS chain and suitable gasket. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
10. Accessories : a) Adjustable nipple-union-nipple
[1/2" Sch 80 X 1/2" NPT] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Thermowell (As specified below)

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11. Thermowell connection : ½” NPT (M) or 150 RF Flanged

12. Nameplate : Tag number, service engraved in stainless steel tag plate

5.02.00 THERMOCOUPLES

1. Type: a) 16 SWG wire of Chromel Alumel) (Type-K) b) Duplex c) Ungrounded

2. Protecting Tube

a) O.D. : 6 mm

b) Material : SS-316, Seamless

c) Filling : Magnesium oxide (Purity above 99.4%).

3. Response time : a) < 20 seconds for measurement b) < 10 seconds for control

4. Accuracy : ± 1.10 C up to 300 0 C & 0.4% of measured temperature range above 300 0 C

5. Head a) Type : IP-65 universal screwed type b) Material : Stainless Steel c) Terminal blocks : Nickel plated Brass-screw type / silver plated d) Cable connection : ½” NPT gland and grommet

6.e) Others : Terminal head cover with SS chain and suitable gasket. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :

a) Adjustable nipple-union-nipple [1/2” Sch 80 X ½” NPT] with thermowell connection

b) Compression fittings/unions

c) Flanges etc. (for flanged connections only)

d) Thermowell (As specified below)

8. Thermowell connection : ½” NPT (M) or 150 RF Flanged

9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)

2. Sensing Element Material : Bourdon – SS-316

3. Bulb and Capillary Material: SS-316

4. Capillary Tubing : Inner sheath - solid drawn Material copper tube Outer sheath - PVC tube

5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle

6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass cover conforming to IP 65.

7. Dial size : 150 mm

8. Scale : Black lettering on white background in 270 Deg.C arc

9. Over range protection : 125 percent of FSD

10. Capillary Glanding : 1/2” NPT(M) x compression fitting (SS) to suit capillary

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11. Instrument Connection : Bottom connection for local mounting, back connection for panel mounting

12. Process Connection : ½” NPT (M) or 150 RF Flanged

13. Extension Neck Length : 50 mm

14. Compensation : a) Capillary compensation 15. : b) Case compensation

16. Performance : a) Accuracy : + /- 1.0 percent of full scale Deflection

: b) Repeatability : Less than 0.5 percent of full range

: c) Response time: 15 seconds (max.).

17. Capillary length :3.0 meters (local) / 15.0 metres (local panel)

18. Other features : Shatter proof glass

19. Nameplate :Tag number, service engraved in stainless steel tag plate

20. Accessories : SS316 Thermowell

5.04.00 THERMOWELL

1. Material : SS-316

2. Manufacture : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

3. Process connection : M33x2

4. Certification : Not applicable

5. Bore concentricity : +5% of wall thickness

6. Identification mark : Tag number punched on head

7. Surface treatment : Polish after machining

8. Element connection : ½” NPT (M) or 150 RF Flanged

9. Head : Hex

10. Length of the hex head : 31.75 mm (min.)

11. Accessories : SS Plug and chain for test thermo wells

SS Nameplate, Flange with companion flange & all required accessories for flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature

2. Type : Chromel Alumel (Type-K)

Duplex, Ungrounded

3. Insulation : Mineral Insulation Magnesium Oxide

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4. Wire gauge : 16 AWG

5. Protective sheath : SS

6. Protective sheath

Diameter 8 mm O.D.

7. Characteristics : Special limits of error as in ANSI thermocouple MC 96.01

8. Accessories : ½" BSP SS sliding end connector, weld pad, clamps of heat resistant steel.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)

2. Coil voltage rating : 240 V AC /24 V DC (as required)

3. Ways : 2/3/4 way

4. Port size : 1/4" NPT all ports

5. Body : SS bar stock

Trim : SS-316

6. Duty : Suitable for continuous energization

7. Sealing : Airtight and leak proof

8. Ambient Temperature : 0 - 50 O C

9. Fluid Temperature : 0-150 O C (approx.)

10. Coil Enclosure : Stainless Steel

11. Insulation : Class-H

12. Coil Casing : IP-65 (Explosion proof for NEC Class- 1, Division-1 area)

13. Mounting : On pipe or on panel

14. Cable Connection : ½" NPT

15. Accessories : Cable glands, SS Tag plate

1.00.00 GENERAL REQUIREMENT

1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT

1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.

1.02.00 SURFACE PREPARATION & PAINTING

1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.

1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface.

The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The

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entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.

1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
- Interior - Brilliant White.

1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.

1.03.00 WIRING

1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.

1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.

1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.

1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices

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1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.

1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.

1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.

1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.

1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation colorcoding identified on drawings or by printed wiring lists.

1.04.00 TERMINAL BLOCKS

1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage

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clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.

1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.

1.04.03 The characteristics of the terminal blocks shall be as follows.

- i) High contact force, independent of conductor cross-section and large contact surface area.
- ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
- iii) Inspection and maintenance free (resistant to thermal aging and vibration)
- iv) Low and constant voltage drop

1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.

1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.

1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.

1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.

1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multiconductor control cable.

1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.

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1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

1.04.11 Other requirements of the terminal blocks are as follows:

- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
- ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
- iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
- iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
- v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

1.05.00 GROUNDING

1.05.01 Separate Protective and Electronic system ground as required shall be provided.

1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.

1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open. The electronic ground between panels of a shipping section shall be firmly looped.

2.00.00 CONTROL DESKS & PANELS

2.01.00 GENERAL

2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.

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2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.

2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.

2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.

2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.

2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

2.01.07 Nameplate

a) Nameplate shall be provided for instrument or device mounted on the panel.

b) Nameplates for panels shall be provided both in front and rear.

2.02.00 CONTROL DESK

2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.

2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.

2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.

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2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

2.03.00 BACK UP PANEL

2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.

2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.

2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring

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cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.

2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and intercabinet/ cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in subracks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

1. Material of

Construction : Cold Rolled Coal Annealed (CRCA) steel sheet

2. Thickness of Sheet : a) 2.0 mm for faces supporting instruments / terminals
: b) 1.6 mm for other sides and top

3. Construction : Welded throughout as per approved National Standards

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4. Post welding operation : a) Grounding of all welds to smoothness
: b) Rounding of corners
: c) Cleaning of weld spatters
5. Panel height : 2300 mm (approx)
6. Corners : 7 mm inner radius
7. Dimensional Tolerances : a) In height & length - 3 mm
b) In height between adjacent sections - 2 mm
c) Total for a group - 6 mm
8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
9. Gland plates : Removable in sections 4 mm thick (bottom)
10. Cable entry : Bottom
11. Hardware : a) Anti vibration pad- 15 mm
b) Predrilled base channel ISMC – 100 or equivalent for all sides
c) Stainless steel buff- finished 2 mm thick kick plate for all sides
d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
e) Rubber strips to ensure air tightness between kick plate and finished floor
f) Lifting hook / Eye bolt
g) Drawing pocket
h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures
12. Name Plate : Both at front and back surface of the panel
13. Fixing of name plate : Stainless steel pan head screws
14. Name plate material : Laminated phenolic (3 layers)
15. Lettering : Black with white engraved
16. Mounting of terminal blocks : Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure.

4.00.00 LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)

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4.01.00 GENERAL

4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.

4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.

4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.

4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.

4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.

4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging

4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

4.01.08 Earth stud shall be furnished at rack for safety grounding.

4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)

4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.

4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.

4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.

4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior.

Key shall be of identical for all enclosures.

4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.

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4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.

4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.

4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations

4.03.00 LOCAL INSTRUMENT RACK (LIR)

4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of

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the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack.

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
2. Material : 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3. Type of Cover : Solid unhinged with retention chain / Screwed at all four corners
4. Paint :
 - i) Exterior : Opaline green shade 275 of IS: 5
 - ii) Interior - Brilliant Glossy White. Surface / Two (2) inch Pipe stanchion (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification: Label for JB and Tags for cable
11. Accessories:
 - a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
 - b) Cable gland (Brass) & raceways
 - c) Ferrules & lugs (Brass)
 - d) Aluminum back panel

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- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

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 CW Treatment Plant and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
- b) Electrical load requirement.

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- I
- 4.2 Load Data Format – Annexure- II
- 4.3 BHEL Cable listing format – Annexure- III

PROJECT: 5 x 800 MW YADADRI TPS
ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: CW TREATMENT PLANT

REV: 0 DATE:01.08.17

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 3 Wire) supply to motors, 415 V AC (3 Phase, 4 Wire) /240 V AC supply to other equipment etc. shall be provided by BHEL based on load data provided by vendor at contract stage for the equipment supplied by vendor as part of contract. 2. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Refer C & I portion of specification for philosophy of using junction boxes
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	a) Cable trays, accessories & cable trays supporting system b) 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, which shall be supplied by vendor.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type Aluminium lugs for Aluminium power cables and heavy duty tinned copper lugs for copper 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.
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. All motors shall be 3 Phase only.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	Not applicable for this project.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: CW TREATMENT PLANT

REV: 0 DATE:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
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 (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable (excluding power cables) in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
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. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

[illegible]

ANNEXURE III

THIS DOCUMENT IS PART OF PE-TS-410-156-A001

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES



BHEL : BAP : RANIPET Water Business

Qualification requirement for Cooling Water Treatment System

1. Supplier should have capabilities for design / manufacture and having in-house / out-sourced facility for testing of CW Treatment Plant.

CW treatment Plant should have used chemicals for cooling water treatment (ie. Corrosion inhibitor / scale inhibitor). The circulating water treatment should be for minimum flow of 10,000 m³/hr.

2. The supplier has to submit either of following supporting documents meeting above mentioned prequalifying requirement.
 - a. Copy of minimum one (1) performance certificate in English from end user along with copy of related Purchase order (PO) or letter of intent (LOI) or letter of award (LOA) or work order (WO) specifying that the system / package is running successfully for one (1) year from date of commissioning meeting the minimum pre-qualifying requirement.
OR
 - b. Minimum two PO / LOI / LOA / WO placed with a minimum gap of one (1) year from same purchaser meeting the minimum prequalification requirement.
OR
 - c. Minimum one PO / LOI / LOA / WO after commissioning of first order from same purchaser meeting the minimum prequalification requirement.
OR
 - d. In case vendor has executed contract (s) for BHEL-Ranipet, internal assessment by BHEL, Ranipet shall be followed for evaluation for satisfactory performance. For this vendor to submit the request along with relevant documents.
OR
 - e. Minimum three Customer's / third party's inspection reports / test certificates / commissioning certificates meeting the minimum prequalification requirement.
3. Minimum two (2) nos Purchase orders, shall be submitted which should not be more than twenty (20) years old as on date of bid submission, for establishing continuity in business.

Supplier to comply general points of PQR in case supplier is not OEM, the offer shall be evaluated as per point no 1 of general PQR.

H. S. Gaur
020817



BHEL : BAP : RANIPET Water Business

General Points of PQR

1. Offers of the JV companies/ Joint Bidders/ bidders having collaboration/ licensing agreement/ MOU / Indian subsidiaries shall be evaluated as follows:

- If bidder happens to be an Indian subsidiaries of foreign OEM, then the credentials of the foreign OEM can also be considered for meeting PQR.
- If bidder happens to be the Joint Venture Company, then the credentials of any of JV partners can be also considered for meeting PQR.
- If bidder happens to bid jointly with their partner, then credentials of both the partners will be considered for meeting PQR as per distribution of the work. In all such cases, lead bidder as specified in bid documents shall be responsible for overall execution of the contract and all guarantee/ warranty.
- If bidder happens to be the having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR.

Note: If bidder(s) qualifies on the basis of credentials of his principal/ JV partner/ Collaborator/ joint bidder etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. etc. and warranty/ guarantee shall be submitted along with the offer.

2. Bidder to note that the arrangement of bidding (joint bid partners/ collaborator/ MOU partner/ licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of the project.

3. Consideration of offer shall be subject to customer's approval of bidders, if applicable.

4. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.

5. Any other project specific requirement, bidder shall submit relevant supporting documents.

6. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder/collaborators to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

7. After satisfactory fulfillment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

A. Kumar
02/08/17
Prepared

M. Sakthigopal
02/08/17
Checked

M. Kumar
02/08/17
Approved

	TITLE: TECHNICAL SPECIFICATION FOR CW TREATMENT PLANT 5X800 MW TSGENCO YADADRI TPS	SPEC NO: ROS: 6183
		ANNEXURE : B
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ANNEXURE B : LIST OF SUB VENDORS

SR No.	Items	Approved Vendor	Place / Location	Remarks
1.0	Horzional/Vertical Centrifugal Pump	KBL	Kirolskarwadi	
		M&P	Pune	
		Flowmore	Ghaziabad	
		Sulzer pumps india ltd.	Navi mumbai	
		Worthington	Ghaziabad	
		Bharat pumps & compressors ltd	Allahabad	
		Flowserve India Controls Pvt. Ltd.	Coimbatore	
		Jyoti Ltd.	Vadodara	
2.0	Vertical Centrifugal Pump	Kishore Pump	Pune	
		Sam Turbo	Coimbatore	
		KSB	Pune	
		Best and Crompton	Chennai	
		Voltas	Mumbai	
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China	
		Kishore Pump	Pune	
3.0	Strainers (Y-Type & Basket Type)	Multitext Filtration Engg Ltd.	Noida	
		Sarojini Enterprises	Kolkata	
		Otoklin Filters	Mumbai	
		BHATIA ENGINEERING CO.	Delhi	
		JAYPEE INDUSTRIES PVT. LTD.	Delhi	
		FILTRATION ENGINEERS (I) PVT. LTD.	MUMBAI	
		OTOKLIN GLOBAL BUSINESS LIMITED	Mumbai	
		SUNGOV Engg. PVT. LTD.	Delhi	
		Grand Prix	Faridabad	
4.0	Fittings (metallic)	M.S. Fittings	Kolkata	
		Metal lloyds	Mumbai	
		True Forge	Faridabad	
		Tube Products	Baroda	
		NL Hazra	Kolkata	
		Gujrat Infra Pipes	Baroda	
		Edwards	USA	
		Pipefit Engineers	Baroda	
		Siddarth & Gautam	Faridabad	
		EBY	Mumbai	
		Reliance Forge	Mumbai	
5.0	MS/GI ERW Pipes	SAIL	Rourkela	
		Jindal	Ghazibad/ Hissar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Surya Roshni	Bahadur Garh	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589

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		TATA Tube	Jamshedpur	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Kutch/Daman	Spiral Weld SAW as per IS 3589
		Lalit Profile	Thane	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589
		Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589
		Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Mann Ind	Indore	Spiral Weld SAW as per IS 3589
		Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589
		Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589
		DADU Pipes	Sikandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589
		Good Luck Tubes	Sikandrabad	
		Advance Steel Tubes	Sahibabad	
		Bihar Tubes	Sikandrabad	
		Hi Tech Pipes	Sikandrabad	
		Ratnamani	Kutch/Ahmedabad/Chhatral	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589
		Maharashtra Seamless	Raigad	200-500 NB ERW Pipes as per IS 3589
		Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/ 3589 and SAW as per IS 3589
6.0	Seamless Pipes	ISMT	Ahmednagar/Baramati	
		Maharashtra Seamless	Raigad	
7.0	S.S. Pipes (For small Quantity 500 m)	REMI	Mumbai	
		Ratmani	Ahmedabad	
		Apex Tubes	Behror	
		Choksi	Ahmedabad	
8.0	CI Gate/ Globe/NRV/ SRV (Manual and motorized)	H.Sarkar	Howrah	SIZE UPTO 300NB
		A.V. VALVES LTD	Agra	
		Leader	Jalandhar	



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		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR GV UPTO 450NB, GLV UPTO 300NB AND CHECK VALVES UPTO 350NB.
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON IRON GATE VALVES: 65 NB TO 450 NB (UPTO PN-16.0) (2) CARBON IRON GLOBE VALVES & NON RETURN VALVES: 65 NB TO 150 NB (UPTO PN-16.0)
		FLUIDLINE VALVES COMPANY PVT.LTD.	Mumbai	1. CI Gate- CL125 & up to 900 NB, 2. CI Globe- CL125 & up to 450 NB, 3. CI SCNRV- CL125 & up to 600 NB.
		G.M. DALUI AND SONS PVT.LTD.	Howrah	
		KBL	Kondhapuri	Additionally approved for FM approved Gate valve 50-250 NB
		Bankim	Kolkata	
		VENUS PUMPS AND ENGG. WORKS	Kolkata	1) CI GATE VALVE SIZES 65NB-800NB ,2) CI GLOBE VALVE FOR SIZES 65NB-400 NB AND 3) CI SCNRV FOR SIZES 65 NB -600 NB.
9.0	GM valve	A.V. VALVES LTD	Agra	
		ATAM VALVES PVT. LTD.	Mumbai	GUN METAL GATE/GLOBE/NRV : 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		Leader	Jalandhar	
		VALTECH INDUSTRIES		GUN METAL SCREWED END TYPE , SCREWED IN BONNET , OUT SIDE SCREW & YOKE TPE , PN 16 , SIZES UPTO 50.
		SANT VALVES PVT. LTD.	Jalandhar	UP TO SIZE 100-NB ONLY.
10.0	Solenoid Valve	Rotex	Baroda	
		Avcon	Mumbai	
		Asco	Chennai	
		SMC	Noida	
		Nucon	Hyderabad	
		Rotex	Baroda	
		Avcon	Mumbai	



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11.0	PLC Based Panels	SIEMENS	Nasik	
		SCHNEIDER	Nasik	
		ROCKWELL	Sahibabad	
		GE Intelligent Platform	BANGALORE	
		Honeywell Automation India Limited	Pune	
		ABB	Bangalore	
		SIEME	Nasik	
		SCHNEIDER	Nasik	
12.0	Battery (Ni Cd for PLC)	Amco saft	Bangalore	
		HBL Power System	Hyderabad	
		SAFT	France/Sweden	
13.0	Motor	Marathon,	kolkata	For HT and LT motor
		Crompton Greaves	Ahmednagar	For HT and LT motor
		NGEF	Bangalore	Upto 15 KW
		ABB	Bangalore/Faridabad	Upto 200 KW
		Siemens	Mumbai	For HT and LT motor
		Jyoti	Baroda	For LT motor only
		LHP	Solapur	Upto 120 KW
		BHEL	Bhopal	For HT motor only
		Bharat Electric (BHEL)		For LT motor only
		Bharat Bijlee	Mumbai	Upto 160 KW(For LT motor only)
		KEC	Bangalore/Hubli	Upto 90 KW
14.0	Battery (maintenance free for PLC/ Fire Alarm Panel)	EXIDE	Kolkata	
		HBL Power System	Hyderabad	
		AMAR RAJA	Tirupati	
15.0	Steel Plate, Structural Steel and section for Fire water storage tank	SAIL		
		Essar Steel		
		TISCO		
		RINL		
		Jindal		
		Lloyd		
		Ispat		
		Indian Iron & Steel Co. Ltd		
16.0	Pressure Gauge/DP Gauge	Gluck (I) Manufacturing Co	Mumbai,	
		H Guru	Rishra/Muzaffarpur/Bangalore	
		AN Instruments	Kolkata	
		ASHCROFT INDIA PVT LTD.	GIDC Chhatral Kalol	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	Mumbai,	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		WIKA	Pune	
		Manometer India	Mumbai,	



TITLE:

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		Baumer Technologies India Pvt. Ltd.	VAPI	
		GIC(Gauges Bourdon)	Panvel	
17.0	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	
		SOR	USA	
		Dressor	USA	
		Delta control	UK	
		Trafag	Ranipet	
		GIC(Gauges Bourdon)	Panvel	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		Switzer	Chennai	
18.0	Level Switch (Float/Displacer)	DK Instruments	Kolkata	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		SBEM	Pune	
		Flow Star	Faridabad	
19.0	Level Indicator	Flow Star	Faridabad	
		Scientific Devices	Mumbai	
		Gauges Bourden	Panvel	
		SBEM	Pune	
		Pune Techtrol	Pune	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		DK Instruments	Kolkata	
20.0	OWS/PC	HP/Compaq /Dell/HCL/IBM/Lenovo		
21.0	Printer	HP/Cannon/Epson/Xeror/IBM / Lexmark		
22.0	UPS	HITACHI-HIREL	Gandhinagar	
		APC	Bangalore	
		Delta	Gurgaon	
		Emerson	Mumbai	
		DB Power	Pune	
		Aplab	Mumbai	
23.0	Control / Power Cable	Cords Cable	Bhiwadi	
		Radiant Cables	Hyderabad	
		PolyCab	Daman	
		KEI	Bhiwadi	
		Nicco	Kolkata	
		Ravin Cables	Pune	
		Incab	Pune	
		HVPL	Faridabad	
		Torrent cable	Nadiad	
		Havells	Alwar	
		Paramount	Khushkhera	
		SRI Ram Cables	Bhiwadi	
		Thermocables	Hyderabad	
		Torrent cable	Nadiad	
		Universal Cables	SATNA	
		Gemscab	Bhiwadi	
		Delton	Faridabad	
24.0	Battery Charger for PLC/Diesel Engine	Chloride Power	Kolkata	



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		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HLB Power System	Hyderabad	
		Dubas	Bangalore	
		Caldyne	Kolkata	
25.0	Fibre Optic Cable	Birla Ericsson	Rewa	
		Finolex	Pune/Goa	
		Aksh Fibre	Bhiwadi	
26.0	Pressure Transmitter and Diff. pressure Transmitter	Emerson	USA/Pawane	
		Laxons Automation	Daman	
		YIL	Bangalore	
		Siemens	Thane	
		Fuji	China	
		Yokogawa	Japan	
		Honeywell	USA/Pune	
27.0	Level Transmitter	ABB LIMITED		
		Endress + Hauser (India) Pvt. Ltd.,		
		Moore Industries International Inc.		
		NIVO CONTROLS PVT. LTD.		
		Pune Techtrol Pvt. Ltd.		
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.		
		SIEMENS LIMITED		
		SMART INSTRUMENTS LTD, BRAZIL		
		SBEM PVT. LTD.		
		Honeywell Automation India Limited		
		TOSHNIWAL INDUSTRIES PVT. LTD.,		
		V. AUTOMAT & INSTRUMENTS (P) LTD.		
		YOKOGAWA INDIA LIMITED,		
28.0	AGITATOR	REMI	MUMBAI	
		FIBRE & FIBRE PRODUTS		
		STANDARD ENGINEERS	MUMBAI	
		CROMPTON GREAVES	AHAMADNAGAR	
29.0	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDRABAD	
30.0	BUTTERFLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD-KERALA	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	



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		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
31.0	DUAL PLATE CHECK VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENAI	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
32.0	ELECTRICAL HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	NEW DELHI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	NEW DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		REVA INDUSTRIES LTD.	FARIDABAD	
		ROCKWELL HOISTO CRANES PVT. LTD.	JHAJJAR-HARYANA	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA-	
33.0	INSTRUMENT	AURA INCORPORATED	NEW DELHI	
	ING			
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	AHMEDABAD	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	



TITLE:

**TECHNICAL SPECIFICATION FOR
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		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
34.0	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	
		K.S.INSTRUMENTS PVT.LTD.	BANGLORE	
		SUCHITRA INDUSTRIES	BANGLORE	
		SHRENIK & COMPANY,	GUJARAT	
35.0	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
36.0	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
37.0	TEMPERATURE ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	MUMBAI	
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	GOA	
		TECHNO INSTRUMENTS	GUJARAT	
		TEMPSENS INSTRUMENT (I) PVT LTD	UDAIPUR	
		TM TECNOMATIC SPA	ITALY	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		THERMAL INSTRUMENT INDIA PVT. LTD.	MUMBAI	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
38.0	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	



TITLE:

**TECHNICAL SPECIFICATION FOR
CW TREATMENT PLANT
5X800 MW TSGENCO YADADRI TPS**

SPEC NO: ROS: 6183

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		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	GOA	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGLORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
39.0	BALL VALVE	BDK	HUBLI	
		LEADER	JALANDHAR	
		BANKIM	KOLKATA	
		H SARKAR	KOLKATA	
		AV VALVES	AGRA	
		HAWA VALVES	MUMBAI	
		FLOW CHEM	AHMEDABAD	
		STEEL STRON VALVES	MUMBAI	
		AKAY VALVES LTD.	MUMBAI	
		AQUA VALVES PVT.LTD.	KARNATAKA	
		CRESCENT VALVES	MUMBAI	
		FISHER SANMAR LIMITED	CHENNAI	
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		KSB PUMPS LTD.	MUMBAI	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
		PEC VALVES	MUMBAI	
40.0	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	INDORE	
		YASHWANT	MIRAJ	
		GLOBETECH	HOWRAH	
41.0	DIAPHRAGM VALVE	PROCON ENGINEERES	MUMBAI	
		HAWA VALVES	MUMBAI	
		BDK VALVES	HUBLI	
		FOURESS	BANALORE	
		INERVALVE	GUJRAT	
42.0	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	



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		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
43.0	PLUG VALVE	FISHER SANMAR LIMITED	CHENNAI	
		BDK	HUBLI	
		LARSEN & TOUBRO LTD.	MUMBAI	
		LEADER	JALANDHAR	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
44.0	FLANGES (SS/CS)	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		MS FITTINGS	KOLKATA	
45.0	POSITIVE DISPLACEMENT PUMP	MILTON ROY INIDA	CHENNAI	
		SWELLORE	AHMEDABAD	
		VK PUMP	NASIK	
		DENCIL PUMP	MUMBAI	
46.0	VALVES (GATE/GLOBE/NRV/ BALL)- CPVC/PVC/PP/ HDPE/PVDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
47.0	PIPE/FITTINGS/ FLANGES CPVC/PVC/ PP/HDPE/PVDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
48.0	RUBBER LINING FOR PIPES/TANKS	RISHI INDUSTRIES	SONEPET	
		INDUSTRIAL LINING LTD	BARODA	
		MIL	CHENNAI	
49.0	NON METALIC PUMP (CENTRIFUGAL)	Anticorrosive Pumps	Mumbai	
		Rajedia Pumps	Gujrat	
		Price Pumps	Mumbai	



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50.0	Blower	Everest	Delhi	
		Kay International	Haryana	
		Swam Pneumatics	Delhi	
		Kulkarni brothers	Mumbai	
51.0	TEMPERATURE SWITCH	INDFOSS (INDIA) LTD.	GAZIABAD	
		DRESSER INDUSTRIES INC.	USA	
		SWITZER INSTRUMENT LTD.	CHENNAI	
		SOR INC.	USA	
		TOSHNIWAL BROTHERS (P) LTD.	DELHI	
		VASU TECH LIMITED	DELHI	
52.0	HDPE TANK	SINTEX		
53.0	FRP TANK	TIANODE	CHENNAI	
		BHAVI PLAST	MUMBAI	
54.0	HYDROGEN DETECTOR	Detection Instruments	INDIA	
		HACH	USA	
		HONEYWELL	UK	
		ORBIT	INDIA	
55.0	RESIDUAL CHLORINE ANALYZER	EMERSON		
		HACH		
56.0	LOCAL CONTROL PANEL	INDSUSTRIAL SWITCHGEAR & CONTROL	MUMBAI	
		POSITRONICS	BARODA	
		ECS	NOIDA	
		SWITCHING CIRCUIT	KOLKATA	
		CONTROL & SCHEMATICS	HYDRABAD	
		GE POWER	BANGLORE	
		SIEMENS	KOLKATA	
		C&S	NOIDA	
		PYROTECH	UDAIPUR	
		DELTA CONTROL	MUMBAI	
		L&T	MUMBAI	
57.0	PAINT	BERGER		
		ASIAN PAINTS		
		SHALIMAR		
		J&N		
		HIND RECTIFIER	NASIK	
58.0	Chain pulley block	INDEF		
		BRADY		
		Lifting Equipment		
		GRIP ENGG		
		Tractel tirfor		
		REVA		

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		TECHNO INDUSTRIES		
59.0	HAND PUMP (MOTOR OPERATED BARREL PUMP)	JYOTI		
		SOLVACID		
		SLEEK		
		FLUDIYNE		
		Mach Powerpoint		
60.0	STRUCTURE STEEL	SAIL		
		TISCO		
		JINDAL		
		BHUSWAL		

Notes:-

- A) All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ CUSTOMER.
- B) This vendor list applicable for Mechanical, electrical and C&I items.

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PAINTING SPECIFICATION

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TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

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- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

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- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

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- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.
- 4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**
- 4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.
- All factory finished paints shall be touched up at site as required.
- All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.
- 4.02.00 Surface Preparation**
- 4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.
- 4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.
- 4.03.00 Painting**

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- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- Surface preparation shall be done either manually or by any other approved method.
 - Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed outdoor shall be as follows :
- Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

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External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for internal surface protection of large diameter pipes (sizes above 600 mm NB and above) if any, shall be as follows :
- All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
 - Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
 - The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of internal surfaces of DM Water Storage Tank(s) shall be as follows :
- Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
 - Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
 - Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

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4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

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- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

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- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 **Adhesion Pull off Test :**
After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

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The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- Slide the dragging indicator pin on the black column to zero by pushing it downward.
- Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

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e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

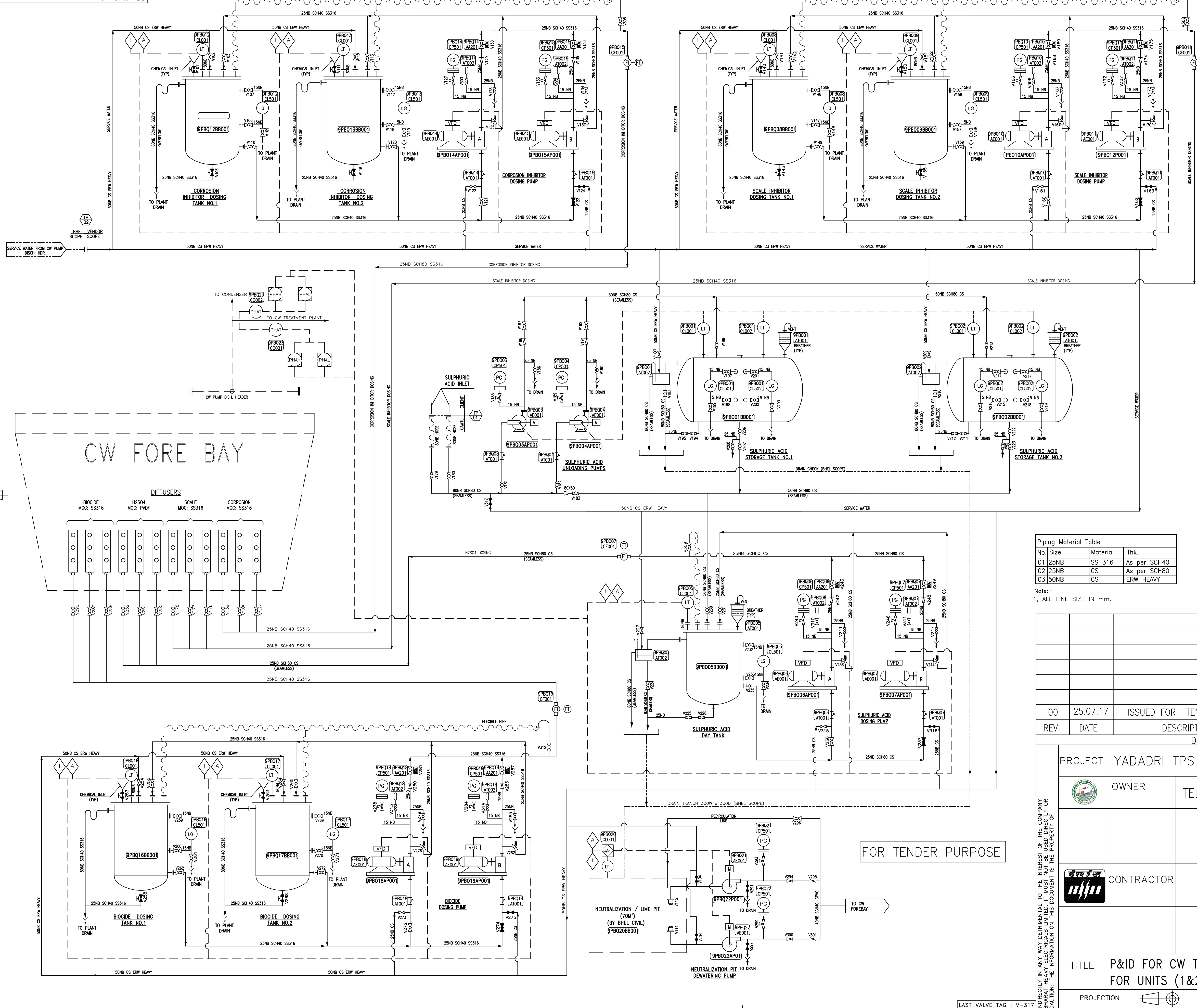
6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

1-WT-080-01064



EQUIPMENT LIST			
KKS TAG NO.	DESCRIPTION	SIZE/CAP.NOS.	MOC
PB003-04 AP001	SULPHURIC ACID UNLOADING PUMPS	10 m ³ /hr	02(1W+1S) ALLOY 20
PB001-02 BB001	SULPHURIC ACID STORAGE TANKS	35 m ³	02NOS MS
PB005 BB001	SULPHURIC ACID DAY TANK	5 m ³	01 CS
PB006-07 AP001	SULPHURIC ACID DOSING PUMPS	300 LPH	02(1W+1S) ALLOY 20
PB012-13 BB001	CORROSION INHIBITOR Dosing PUMP	500 Litres	02 SS-316
PB014-15 AP001	CORROSION INHIBITOR Dosing TANK	50 LPH	02(1W+1S) SS-316
PB008-09 BB001	SCALE INHIBITOR Dosing TANK	500 Litres	02 SS-316
PB010-11 AP001	SCALE INHIBITOR INJECTION PUMP	50 LPH	02(1W+1S) SS-316
PB016-17 BB001	BIOCIDE Dosing TANK	7 m ³	02 SS-316
PB018-19 AP001	BIOCIDE INJECTION PUMP	600 LPH	02(1W+1S) SS-316
PB021-22 AP001	NEUTRALIZATION PIT DEWATERING PUMP	10 m ³ /hr	02(1W+1S) PP

LEGEND	
	DIAPHRAGM VALVE
	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSE
	NON RETURN VALVE
	BALL VALVE
	PRESSURE RELIEF VALVE
	VENT TO ATMOSPHERE
	GRAVITY DRAIN
	DRAIN TRENCH
	DIAPHRAGM PRESSURE GAUGE
	LEVEL GAUGE
	LEVEL TRANSMITTER (ULTRASONIC TYPE)
	Y TYPE STRAINER
	CENTRIFUGAL PUMP
	METERING PUMP
	THREE WAY VALVE
	SILICA GEL BREATHER
	FLEXIBLE PIPE
	TERMINATION POINT & BATTERY LIMIT SCOPE
	PULSATION DAMPNER
	OVER FLOW BREATHER
	FLOW INDICATOR (4-20 mA/MAGNETIC TYPE)
	SOLENOID VALVE
	FOOT VALVE

TERMINATION POINT		
MARK	DESCRIPTION	REFERENCE DOCUMENT
TP-1	HOSE PIPE (MIN. 20 METER)	
TP-2	SERVICE WATER INLET HEADER	

SCOPE OF SUPPLY	
MARK	DESCRIPTION
----	BY CAWL
----	ELECTRICAL SCOPE(BY VENDOR)
----	BY BHEL

Piping Material Table			
No.	Size	Material	Thk.
01	25NB	SS 316	As per SCH40
02	25NB	CS	As per SCH80
03	50NB	CS	ERW HEAVY

Note:-
1. ALL LINE SIZE IN mm.

REV.	DATE	DESCRIPTION	DRAWN	CHKD	APPD	REMARK
00	25.07.17	ISSUED FOR TENDERING				

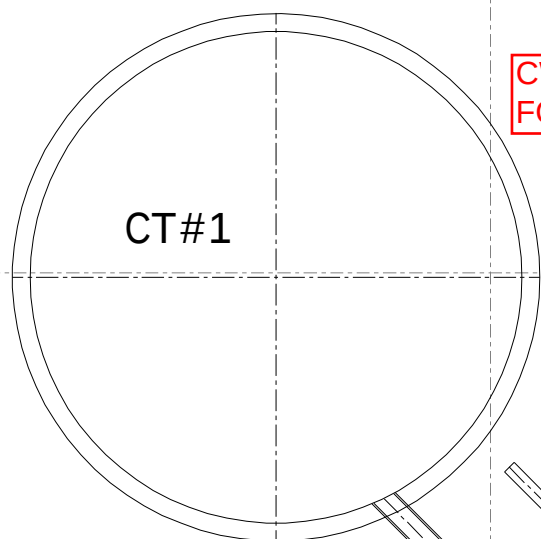
DRAWING REVISION					
PROJECT	YADADRI TPS -5x800 MW				
OWNER	TELANGANA STATE POWER GEN. CORPN. LTD.				
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD UNIT: BOILER AUXILIARIES PLANT RANIPET - 632406				
TITLE			P&ID FOR CW TREATMENT PLANT FOR UNITS (1&2)		
PROJECTION			SCALE		
			NTS		
			DRAWING NO.		
			1-WT-080-01064		
			REV		
			00		

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BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR
CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF

FOR TENDER PURPOSE

LAST VALVE TAG : V-317

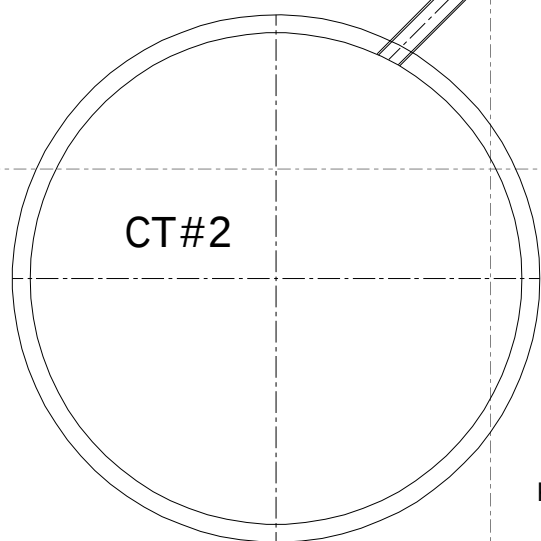
NORTH



CT#1

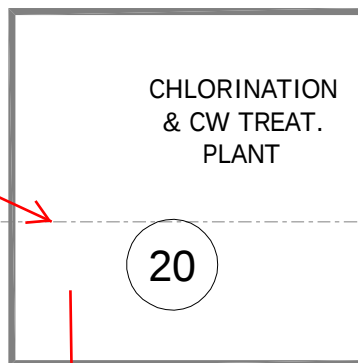
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NDCT



CT#2

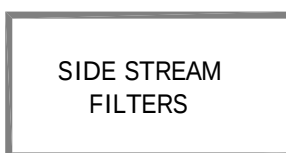
CWTP PLANT
FOR UNIT 1 & 2



CHLORINATION
& CW TREAT.
PLANT

20

19
CW P/H &
FCREBAY

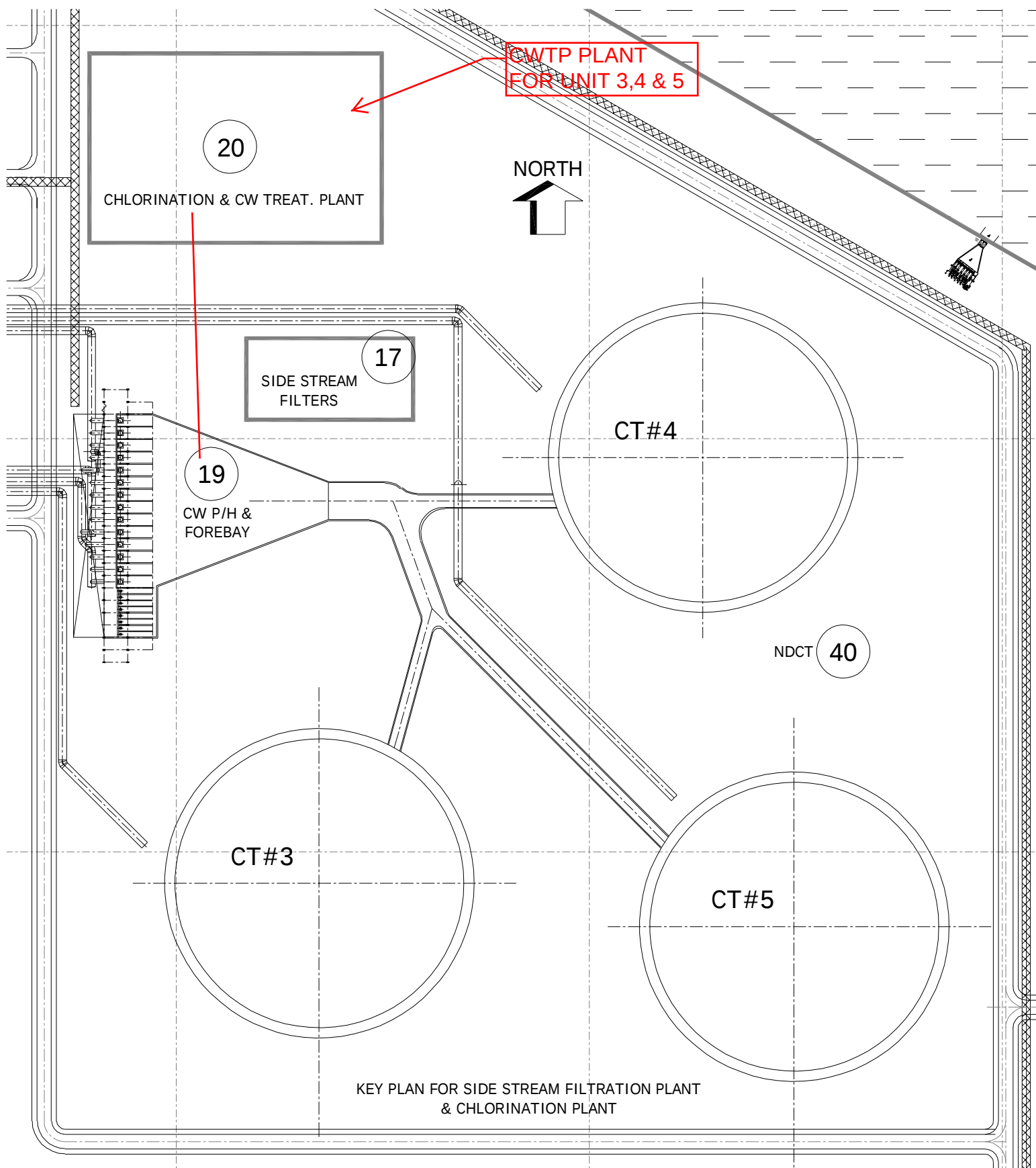


SIDE STREAM
FILTERS

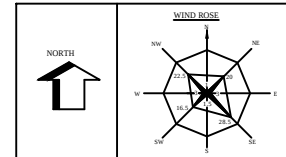
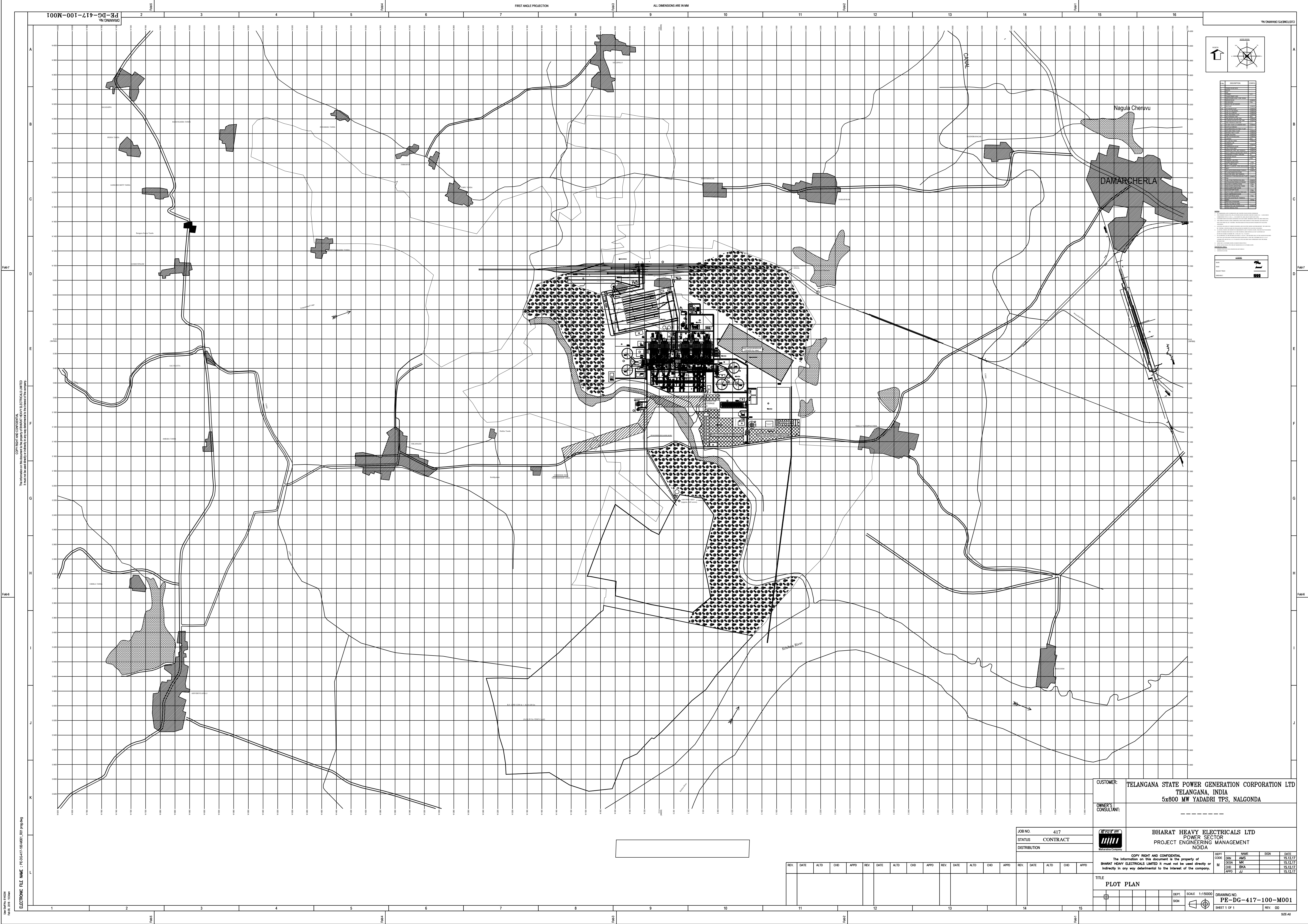
17

KEY PLAN FOR SIDE STREAM FILTRATION PLANT
& CHLORINATION PLANT

TENTATIVE PIPE ROUTING BETWEEN CWTP & FOREBAY FOR UNIT 1 & 2. EACH
GRID SQUARE SHOWN IS OF SIZE 200M X 200M.

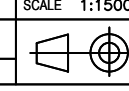


TENTATIVE PIPE ROUTING BETWEEN CWTP & FOREBAY FOR UNIT 3,4 & 5.EACH GRID SQUARE SHOWN IS OF SIZE 200M X 200M



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CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5x800 MW YADADRI TPS, NALGONDA	
OWNER'S CONSULTANT:	-----	
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	
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REV. CODE	NAME	DATE
001	AMES	15.12.17
002	MC	15.12.17
003	BKA	15.12.17
004	JJ	15.12.17
TITLE PLOT PLAN		
DEPT.	SCALE 1:15000	DRAWING NO.
SEN		PE-DG-417-100-M001
SHEET 1 OF 1		REV. 00
SIZE: A0		

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD