



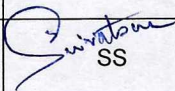
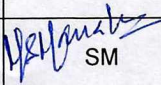
SPECIFICATION FOR
GAS CHLORINATION
SYSTEM

SPEC.NO.ROS: 6185

REV.: 00

**BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET - 632 406.**

**TECHNICAL SPECIFICATION
FOR
GAS CHLORINATION PLANT**

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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 (CW), RW WATER (RW) & POTABLE WATER (PW) CHLORINATION PLANT & ABSORPTION SYSTEM 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 chlorination 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,

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ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed 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 ROS 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 to ask all their queries in pre-bid meeting.

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SECTION – 2

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
	Seismic 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

1.0 SCOPE OF SUPPLY

The Chlorination Plant and associated accessories shall conform to the technical specification.

Broad scope of work of this package includes all equipment and accessories and shall be as per the following (please refer P&ID) and same shall be included in bidder scope. Please also refer Electrical & C&I (Section-9) for respective scopes.

1.1 SCOPE OF SUPPLY FOR CW CHLORINATION & ABSORPTION SYSTEM

- 1) Entire CW Chlorination and Absorption system as per P&ID (2-WT-040-00262 for Unit 1 & 2, 2-WT-040-00263 for Unit 3, 4&5) and Data Sheets for gas chlorination.
- 2) Two set of chlorination plant envisaged for 5 units. One set for two units (Unit #1 & 2) and second set for remaining three Units (Unit # 3, 4 & 5).
- 3) Complete Supply of 90 numbers filled chlorine ton container (each of 900 Kg capacity, approx.) for CW Chlorination plant (Unit 1 & 2) & supply of 135 numbers filled chlorine ton container (each of 900 Kg capacity approx.) for unit 3, 4&5 with accessories like isolation valves, educator tubes, two numbers Roller supports, safety accessories with automatic switch over facility, valve hood etc.
- 4) Five (4W+1S) number of chlorinators (each of not less than 225 kg/hr capacity), each vacuum operated aqueous solution feed type complete with all accessories for Unit 1 & 2), Seven (6W+1S) number of chlorinators (each of not less than 225 kg/hr capacity), each vacuum operated aqueous solution feed type complete with all accessories for Unit 3, 4 & 5). Each Chlorinator will have following accessories :
 - 4a) Remote Vacuum Regulator
 - 4b) Cabinet with:
 - 4c) Chlorine Gas Flow meter
 - 4d) Differential Pressure Regulator
 - 4e) Flow Control Valve
 - 4f) Fixed Throat Type Remote Ejector
- 5) Strainers in chlorine gas line, two (2) numbers for each of the chlorinators.
- 6) Five (4W+1S) numbers of evaporators (each of not less than 225 kg/hr capacity), each complete with all accessories for Unit 1 & 2. Seven

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(6W+1S) numbers of evaporators (each of not less than 225 kg/hr capacity), complete with all accessories for Unit 3, 4 & 5.

- 7) Five (4W+1S) numbers Water Booster Pumps each complete with electrical drive motor & all other accessories to supply water to the Evaporators & Chlorinators for Unit 1 & 2, & Seven (6W+1S) numbers Water supply booster pumps each complete with electrical drive motor & all other accessories to supply water to the Evaporators & Chlorinators for Unit 3, 4 & 5.
- 8) Each Water Supply Booster Pump shall have minimum 2 Nos. of basket strainer at the suction side with all accessories.
- 9) Adequate numbers of Chlorinated Water Diffusers required for CW Forebay & Pump Pit of Unit 1 & 2 & Unit 3,4&5 respectively. Chlorinated Water Diffusers will have optimized number of holes of appropriate size to ensure thorough mixing. The diffusers will have a Flanged Connection to provide easy dismantling for maintenance. The diffusers can be vertical/horizontal subjected to availability of space & customer requirement.
- 10) Equipment & Accessories for C.W. Chlorine Absorption system: 2 set of leak absorption system shall be provided for the CW chlorination plant. One set for (Unit 1 & 2) and second set for (Unit 3, 4, & 5). The following items shall be provided :
 - 10a) Ninety (90) numbers of FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for 2 Units (Unit 1 & 2). One Hundred Thirty Five (135) numbers of FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for 3 Units (Unit 3, 4 & 5) each with flexible hose arrangement for connection to FRP Duct Work.
 - 10b) Adequate number of Ventilation Fans with one (1) number additional ventilation fan as stand by, each complete with electrical drive motor and all other accessories for each leak absorption system.
 - 10c) FRP Duct Work to Absorption System with all accessories as required.
 - 10d) Two (2) numbers Blowers, each complete with electrical drive motor and all other accessories for each leak absorption system.
 - 10e) One (1) number Chlorine Absorption Tower complete with all accessories for each leak absorption system.
 - 10f) One (1) number Caustic Solution preparation cum Recirculation Tank, complete with agitator as well as its drive motor & all other accessories for each leak absorption system.

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- 10g) Two (2) numbers Caustic Solution Preparation cum Recirculation Pumps, each complete with electrical drive motor and all other accessories for each leak absorption system.
- 10h) Two (2) sets of Safety & Supervisory Equipment & instruments for each CW Gas Chlorination System of Unit 1&2 & Unit 3,4 & 5 respectively.
- 11) One (1) number electrically operated mono rail hoist of 3.0 Ton capacity complete with all accessories for each CW chlorination plant of Unit 1&2 & Unit 3,4 &5 respectively . Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator.
- 12) One (1) number weighing scale of 3.0 Ton capacity complete with all accessories for each CW chlorination plant of Unit 1&2 & Unit 3,4 &5 respectively. Weighing scale shall be suitable for fixing on the ground

1.2 SCOPE OF SUPPLY FOR RAW WATER CHLORINATION & ABSORPTION SYSTEM

- 13) Entire Raw Water Chlorination and Absorption system as per P&ID (3-WT-040-00843) and Data Sheets for gas chlorination.
- 14) One set of Raw Water chlorination plant envisaged for 5 units (Unit #1, 2, 3, 4 & 5).
- 15) Complete supply of 20 numbers filled chlorine ton container (each of 900 Kg capacity, approx.) for Raw Water Chlorination plant with accessories like isolation valves, educator tubes, two numbers Roller supports, safety accessories with automatic switch over facility, valve hood etc.
- 16) Two (1W+1S) number of chlorinators (each of not less than 60 kg/hr capacity), each vacuum operated aqueous solution feed type complete with all accessories. Each Chlorinator will have following accessories :
 - 16a) Remote Vacuum Regulator
 - 16b) Cabinet with:
 - 16c) Chlorine Gas Flow meter
 - 16d) Differential Pressure Regulator
 - 16e) Flow Control Valve
 - 16f) Fixed Throat Type Remote Ejector
- 17) Strainers in chlorine gas line, two (2) numbers for each of the chlorinators.
- 18) Two (1W+1S) number of evaporators (each of not less than 60 kg/hr capacity), each with one (1) expansion chamber complete with all accessories.

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- 19) Two (1W+1S) numbers Water Supply Booster Pumps each complete with electrical drive motor & all other accessories.
- 20) Two (1W+1S) Basket Strainers for Booster Pumps, each with all accessories.
- 21) Adequate numbers of Chlorinated Water Diffusers with each diffuser having optimized number of holes of appropriate size to ensure thorough mixing. The diffusers will have a Flanged Connection to provide easy dismantling for maintenance. The diffusers can be vertical/horizontal subjected to availability of space & customer requirement.
- 22) Equipment & Accessories for Raw Water Chlorine Absorption system: 1 set of leak absorption system shall be provided for the Raw Water Chlorination plant. The following items shall be provided.
 - 22a) Twenty (20) numbers of FRP hoods to enclose Chlorine Ton Containers connected to the manifolds, each with flexible hose arrangement for connection to FRP Duct Work.
 - 22b) Adequate number of Ventilation Fans with one (1) number additional ventilation fan as stand by, each complete with electrical drive motor and all other accessories.
 - 22c) FRP Duct Work to Absorption System with all accessories as required.
 - 22d) Two (2) numbers Blowers, each complete with electrical drive motor and all other accessories for leak absorption system.
 - 22e) One (1) number Chlorine Absorption Tower complete with all accessories for leak absorption system.
 - 22f) One (1) number Caustic Solution preparation cum Recirculation Tank, complete with agitator as well as its drive motor & all other accessories for leak absorption system.
 - 22g) Two (2) numbers Caustic Solution Preparation cum Recirculation Pumps, each complete with electrical drive motor and all other accessories for leak absorption system.
 - 21h) Two (2) sets of Safety & Supervisory Equipment & instruments as per requirements.
- 23) One (1) number electrically operated mono rail hoist of 3.0 Ton capacity complete with all accessories for chlorination plant. Lifting bar to grab the

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empty or full ton container during handling (1 No.) shall have suspension type load indicator.

- 24) One (1) number weighing scale of 3.0 Ton capacity complete with all accessories for RW chlorination plant. Weighing scale shall be suitable for fixing on the ground

1.3 SCOPE OF SUPPLY FOR POTABLE WATER CHLORINATION & ABSORPTION SYSTEM

- 25) Entire Potable Water Chlorination and Absorption system as per P&ID (3-WT-040-00844) and Data Sheets for gas chlorination.
- 26) Complete Supply of 2 numbers filled chlorine gas cylinder (Cylinder Mounted Chlorinator each of 100 Kg capacity, approx.) for Raw Water Chlorination plant with accessories like isolation valves, educator tubes, two numbers Roller supports, safety accessories with automatic switch over facility, valve hood etc.
- 27) Two (2) number of chlorinators (each of not less than 50 gm/hr capacity), each vacuum operated aqueous solution feed type complete with all accessories. The rate of chlorine dosing shall be set manually & shall remain constant until manually changed. The chlorinator shall be mounted directly on the chlorine cylinder & shall be equipped with necessary instrumentation for safe & reliable operation. Each Chlorinator will have following accessories :
- 27a) Remote Vacuum Regulator
 - 27b) Cabinet with:
 - 27c) Chlorine Gas Flow meter
 - 27d) Differential Pressure Regulator
 - 27e) Flow Control Valve
 - 27f) Fixed Throat Type Remote Ejector
- 28) Two (2) Chlorine Gas strainers & Accessories for each Chlorinator.
- 29) Two (2) numbers Water Supply Booster Pumps each complete with electrical drive motor & all other accessories.
- 30) Adequate numbers of Chlorinated Water Diffusers with each diffuser having optimized number of holes of appropriate size to ensure thorough mixing. The diffusers should have a Flanged Connection to provide easy dismantling. The diffusers can be vertical/horizontal subjected to availability of space & customer requirement.

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- 29) Two (2) sets of Safety & Supervisory Equipment & instruments as per requirements.
- 31) One (1) number weighing scale of 200 Kg capacity complete with all accessories for PW chlorination plant. Weighing scale shall be suitable for fixing on the ground
- 32) Adequate number of Leak Detectors (each detector with two sensors) to be provided to ensure proper safety of the system.
- 33) One (1) number of Residual Chlorine Analyzer.

1.4 GENREAL REQUIREMENTS FOR ALL THE THREE CHLORINATION SYSTEMS (RW, PW & CW)

- 34) Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, and liquid expansion chamber fitted with rupture discs, pressure indicator, Temperature indicator, pressure switch, alarms etc. will be provided. Pressure reducing & shut-off valves shall be provided in the chlorine gas line. Chlorine Manifolds each with all accessories. Flexible connector with valved ends joining chlorine ton-container to the pipe manifold shall be constructed of annealed copper tubing with silver coating of 60 microns for internal and external surfaces. Copper tubing with suitable expansion loop shall be provided with silver soldered copper nipples on each end connected by ammonia type union. Alternatively, flexible metal hose, constructed of corrugated metal with moneltire braid and monel nipples may be supplied. Tubing shall be hydraulically tested to 40 Kg /Sq.cm.
- 35) Electrically heated water bath type Chlorine Evaporators, each with all accessories will be provided for each stream wherever applicable.
- 36) All piping as required and upto the dosing point as Shown in respective Tender P&ID's.
- 37) Ejectors/Injectors as per Data Sheets of respective CW, RW & PW chlorination systems.
- 38) Electrical motor with accessories as per system requirement.
- 39) Chlorine water diffuser and Mixing system (injection quill) as mentioned in Data Sheets and as shown in P&ID.
- 40) Instrumentation as per respective system P&ID's (minimum) and system requirement.
- 41) Online Residual chlorine analyzer -4 nos (1 for Unit 1&2 of CW, 1 for Unit 3,4&5, 1 for RW and 1 for PW).

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- 42) Chlorine gas duct as per Data Sheets of respective CW, RW & PW chlorination systems.
- 43) All tanks complete with inlet and outlet connections, all fittings and appurtenances etc. as specified and as required.
- 44) All necessary valves and fittings for the installations with the actuators necessary for their remote operation.
- 45) Individual PLC based control panel for CW Chlorination Plant and absorption system for Unit 1& 2 & Unit 3, 4&5.
- 46) Exhaust fans and ventilation system as required.
- 47) Electrical scope shall be as per "Electrical scope between BHEL and Vendor".
- 48) All necessary drains, vents and sampling points, with valves, as specified and as required.
- 49) Hangers and supports as per the requirement.
- 50) Wrapping/coating for underground piping.
- 51) Start-up and commissioning spares as required.
- 52) All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
- 53) All necessary flanges and counter flanges to interconnect the pipes.
- 54) Finish paints for touch up painting of equipment's after erection at site in sealed container.
- 55) Initial charge of all lubricant & grease and first fill of chlorine and all chemical including initial fill of caustic.
- 56) Monitoring gadgets, instruments and equipment's required for maintenance (till PG test and plant handover).
- 57) Gas mask along with breathing apparatus tank complete with full mask, full vision face pieces, air flow regulating valves & all accessories shall be provided. In addition to above, canister type breathing apparatus shall be provided in which moisture content from the wearer exhaled air react with granular chemical in breathing apparatus & liberates oxygen. The released oxygen enters a breathing bag from which the wearer can inhale.

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2.0 SCOPE OF SERVICE

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

- 1) Erection and commissioning, unloading, storage and handling at site.
- 2) Arrangement of all instruments and lab facilities to carry out trial run/commissioning and PG test.
- 3) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- 4) All personnel required during commissioning and PG Test.
- 5) Performance testing.
- 6) Painting as per enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication. Color-coding scheme shall be intimated to vendor during detailed engineering.
- 7) All statutory clearance as per CCE Nagpur as applicable.

3.0 CIVIL SCOPE

Nil. However, complete civil assignment and all steel inserts, plates, bolts, nuts, sleeves and all other embedding components etc. as required to grout in bidder's scope and to hold/support the equipment's being supplied under this specification shall be done by bidders.

4.0 TERMINAL POINT

- a. Inlet motive water line: For CW Unit 1 & 2: CW Pump discharge to Booster Pump Suction consider 25m (refer enclosed Plot plan), For CW Unit 3, 4 & 5: CW Pump discharge to Booster Pump Suction consider 25m (refer enclosed Plot plan), For RW consider 800 meter piping distance from PT plant inlet line & 50m from Service Water Line. For PW consider 50 meter piping distance from potable water pump discharge DM Plant.
- b. Service water and potable water: At 15 meter from Chlorination plant building at gravity flow.
- c. Service Air: At 15 meter from Chlorination plant building.

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- d. Dosing point- For CW of Unit 1 &2 the dosing point refer Key Plan (consider 500 meter piping distance minimum), for CW of Unit 3,4 & 5 the dosing point refer Key Plan (consider 500 meter piping distance minimum), for RW consider 1000 meter piping distance minimum(dosing needs to be carried out at individual stilling chambers(5 Nos.)), for PW consider 50 meter piping distance.
- e. All drains: To be terminated at Common drain.
- f. The CW Chlorination System will be housed in the CW treatment building of Unit 1 &2.
- g. The CW Chlorination System will be housed in the CW treatment building of Unit 3, 4&5.
- h. The Raw Water Chlorination System will be housed in the Chemical House of PT Plant. The RW Chlorination System will be controlled through PT Plant PLC
- i. The Potable Water Chlorination System will be housed in the DM Plant. The PW Chlorination System will be controlled through DM Plant PLC.

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

5.0 EXCLUSIONS

- a) Service air, upto the terminal point.
- b) Air-conditioning and fire fighting facilities. However, bidder to furnish the requirement of same after award of contract.
- c) Drinking water and service water.
- d) All Civil works at site including Acid/Alkali resistant tiling.
- e) 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).
- f) Monorail for hoist/crane movement is excluded from bidder scope.
- g) The PLC for RW Chlorination is excluded from the bidder scope.
- h) The PLC for PW Chlorination is excluded from the bidder scope.

6.0 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.

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- b) Approved sub vendor list is enclosed elsewhere of this specification. However, any additional sub-vendor shall be subject to BHEL and Customer approval.

7.0 DESIGN/CONSTRUCTION

In addition to the requirements of Section-2 the following shall also be complied under scope of this specification:

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

The material of construction specified in Data 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.

8.0 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.

- 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.
- 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.
- Detailed installation drawings for all instruments and instrumentation schedule.
- 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..
- Design calculation of process and mechanical design, equipments and systems. The bidder shall show, explain and prove the validity of the basis/procedures and methods used in these calculations.
- Details civil scope drawing for all civil works.
- Detailed piping layout drawings, pipe support drawings, complete bill of materials of the piping, valve schedule etc.

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- 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)

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

- Technical Offer (Quantity of Chemicals, Dosage Rate, Calculations, 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.
- 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 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: Bidder to note that BHEL reserve the right for drgs/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drgs/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

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10.0 DESIGN WATER ANALYSIS FOR CW CHLORINATION

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
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: THE CYCLE OF CONCENTRAION FOR CW CHLORINATION IS 6.5. SYSTEM TO BE DESIGNED CONSIDERING THE SAME.

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11.0 DESIGN WATER ANALYSIS FOR RW CHLORINATION

S.No.	CONSTITUENTS	As	CONTENT
1.	Calcium	CaCO ₃	50 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	1.4 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	264.8 ppm
10.	Bicarbonate	CaCO ₃	131 ppm
11.	Carbonate	CaCO ₃	2 ppm
12.	CO ₂	CaCO ₃	1.9 ppm
13.	Sulphate	CaCO ₃	60.4 ppm
14.	Chloride	CaCO ₃	59.3 ppm
15.	Nitrate	CaCO ₃	7 ppm
16.	Phosphate	CaCO ₃	0.6 ppm
17.	Fluoride	CaCO ₃	2.6 ppm
	TOTAL ANIONS	CaCO₃	264.8 ppm
18.	Boron	B	0.52 ppm
19.	Reactive Silica	SiO ₂	14 ppm
20.	Colloidal Silica	SiO ₂	2.9 ppm
21.	Total Silica	SiO ₂	16.9 ppm
22.	Nitrites	NO ₂	1.8 ppm
23.	Manganese	Mn	0.06 ppm
24.	Aluminium	Al	0.33 ppm
25.	Copper	Cu	0.84 ppm
26.	Zinc	Zn	0.24 ppm
27.	Total Hardness	CaCO ₃	109.7 ppm
28.	Total Suspended Solid		250 ppm
29.	Total Dissolved Solids		397 ppm
30.	Conductivity at 25°C		610 μS/cm
31.	pH value at 25°C	-	8.3
32.	Turbidity		500 NTU
33.	Colour	Hazen	20
34.	Residual Cl ₂		0.5 ppm

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35.	TOC		8.9 ppm
36.	BOD ₃ at 27°C		12 ppm
37.	COD		40 ppm
38.	Dissolved Oxygen		6.3 ppm
39.	Oil & Grease		<1 ppm

12.0 DESIGN WATER ANALYSIS FOR PW CHLORINATION

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
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

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28.	BOD ₃ at 27°C	12 ppm
29.	COD	40 ppm
30.	Dissolved Oxygen	6.3 ppm
31.	Oil & Grease	<1 ppm

SECTION – 4

1.0 SUB VENDOR LIST

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

SECTION – 5

1.0 PAINTING SCHEDULE

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

SECTION – 6

LIST OF MANDATORY SPARES

1.1 Mandatory Spares required for CW Gas Chlorination 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.

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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 Agitators (for each service)	
2.1	Gear Box Unit Complete	1 No.
2.2	Bearing for Gear Box Unit	1 Set
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set
2.4	Coupling Bolts	1 Set
2.5	Coupling shim pack (if applicable)	4 Sets
2.6	Oil seals	4 Sets
3	Spares for Valves	
3.1.i	Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.1.ii	Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.1.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.
3.2.i	Non return valves (NRV)	2 nos. of each size & type
3.2.ii	ii) Flaps for above NRV	2 nos. of each size
3.3	Gate/Globe/Ball valves/plug valve/needle valve	
3.3.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.3.ii	Above 4"	1 no. each type and size.
3.4	Butter fly valve	
3.4.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.4.ii	Above 4"	1 no. each type and size
4	Spares for Air Blowers for each service	
4.1	Impeller with shaft	1 Set
4.2	Bearings	1 Set
4.3	Oil seals	5 Sets
4.4	Filter	1 Set
5	Pneumatic Control Valve	
5.1	Pneumatic Diaphragm for Diaphragm	2 Nos. for each type of Actuator

	SPECIFICATION FOR GAS CHLORINATION SYSTEM	SPEC.NO.ROS: 6185
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	actuated valve	
5.3	Gland Packing	1 set for each type of Control Valve
5.4	Plug, Seat, Cage, Stem etc.	1 set for each type of Control Valve
5.5	Retainer Ring, Seal Ring etc.	1 set for each type of Control Valve
5.6	Gasket	2 Sets. for each type of Control Valve
5.7	Position Transmitter complete set	10% of total quantity used in the system for each type and model.
5.8	Control Valve E/P Positioner complete Set	10% of total quantity used in the system for each type and model.
5.9	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2 Nos. for each type & ratings
5.1	Solenoid Coil for Pneumatic type On/Off Valve	5 Nos. for each type & ratings
5.11	Position Limit Switch for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
6.0	Electrical Items	
6.1	Driving End & Non-Driving End Bearing	3 Set for each type and rating of Motor
6.2	Cooling Fan	2 No. for each type and rating of Motor
6.3	Motor Terminal Block	5 No. for each type and rating of Motor
6.4	Complete Set of Coupling	1Set for each Application
7.0	EC&I Items	
A	Field Instruments	
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	Temperature Element (RTD/Thermo-couple) with thermowell	10% of each type , range and immersion length . Minimum 5 nos.
B	PLC/ Proprietary Control System	
1	Network cards, Communication Interface cards	5% for each type or but minimum 1 no.
2	I/O Cards (Each type)	5% for each type but minimum 2 nos.
3	Controller Cards	2 nos.
4	SER Cards	5% for each type or but minimum 1 no.
5	All other Electronic Modules	5% for each type but minimum 1 no.
6	Relays	10% of total quantity
7	Power Supply Modules & Power Packs for control system	5% for each type and range but minimum 1 no. .
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	10% of total nos. used for each type and model in the system or minimum 2(two) No. whichever is more.
9	MCB (Miniature case circuit breaker)	10% or minimum 10 nos. whichever is Higher for each type and rating.

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10	Fuses	200% or minimum 50 no's for each type and rating
11	Racks for housing I/O & Processor Modules	1(One) no. each type used in the system
12	Prefab interconnecting cables with connectors	10% of total nos. used in the system or minimum 4(four)nos. whichever is more for each type.
13	Network communication cable with end connectors	10% of total nos. used in the system or minimum 4(four)nos. whichever is more for each type.
14	I/O bus cables with connectors for remote I/O units	1 no. of each type & length
15	Fibre optic cable Converter / Deconverter	1 no.
16	Cooling Fans	2 nos. for each cabinet
17	Loose Connectors	5 nos. of each type
18	Colour TFT Monitor	1 no. complete set
19	Hard Disk Drive for the work Station	1 no. complete set
20	Key board , mouse / trackball with connecting cables and plugs	1 no. each type.
21	Printers Catriges	2 nos. of each type
22	SMPS for printers	1 no. of each type/ rating
23	SVGA cards for printers	1 no. of each type
24	Key Board & Cursor control device	1 no. of each type
25	Complete Set of Operators Work Station	1no. complete set
26	Terminal Block	10% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	2 (two) no. complete set
28	Blank CD/DVD	50 (fifty) nos.

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

1.2 Mandatory Spares required for CW Gas Chlorination 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.

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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 Agitators (for each service)	
2.1	Gear Box Unit Complete	1 No.
2.2	Bearing for Gear Box Unit	1 Set
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set
2.4	Coupling Bolts	1 Set
2.5	Coupling shim pack (if applicable)	4 Sets
2.6	Oil seals	4 Sets
3	Spares for Valves	
3.1.i	Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.1.ii	Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.1.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.
3.2.i	Non return valves (NRV)	2 nos. of each size & type
3.2.ii	ii) Flaps for above NRV	2 nos. of each size
3.3	Gate/Globe/Ball valves/plug valve/needle valve	
3.3.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.3.ii	Above 4"	1 no. each type and size.
3.4	Butter fly valve	

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3.4.i	Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
3.4.ii	Above 4"	1 no. each type and size
4	Spares for Air Blowers for each service	
4.1	Impeller with shaft	1 Set
4.2	Bearings	1 Set
4.3	Oil seals	5 Sets
4.4	Filter	1 Set
5	Pneumatic Control Valve	
5.1	Pneumatic Diaphragm for Diaphragm actuated valve	2 Nos. for each type of Actuator
5.3	Gland Packing	1 set for each type of Control Valve
5.4	Plug, Seat, Cage, Stem etc.	1 set for each type of Control Valve
5.5	Retainer Ring, Seal Ring etc.	1 set for each type of Control Valve
5.6	Gasket	2 Sets. for each type of Control Valve
5.7	Position Transmitter complete set	10% of total quantity used in the system for each type and model.
5.8	Control Valve E/P Positioner complete Set	10% of total quantity used in the system for each type and model.
5.9	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2 Nos. for each type & ratings
5.1	Solenoid Coil for Pneumatic type On/Off Valve	5 Nos. for each type & ratings
5.11	Position Limit Switch for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
6.0	Electrical Items	
6.1	Driving End & Non-Driving End Bearing	3 Set for each type and rating of Motor
6.2	Cooling Fan	2 No. for each type and rating of Motor
6.3	Motor Terminal Block	5 No. for each type and rating of Motor
6.4	Complete Set of Coupling	1Set for each Application
7	C&I Items	
A	Field Instruments	
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	Temperature Element (RTD/Thermo-couple) with thermowell	10% of each type , range and immersion length. Minimum 5 nos.
B	PLC/ Proprietary Control System	
1	Network cards, Communication Interface	5% for each type or but minimum 1 no.

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	cards	
2	I/O Cards (Each type)	5% for each type but minimum 2 nos.
3	Controller Cards	2 nos.
4	SER Cards	5% for each type or but minimum 1 no.
5	All other Electronic Modules	5% for each type but minimum 1 no.
6	Relays	10% of total quantity
7	Power Supply Modules & Power Packs for control system	5% for each type and range but minimum 1 no. .
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	10% of total nos. used for each type and model in the system or minimum 2(two) no. whichever is more.
9	MCB (Miniature case circuit breaker)	10% or minimum 10 nos. whichever is higher for each type and rating.
10	Fuses	200% or minimum 50 no's for each type and rating
11	Racks for housing I/O & Processor Modules	1(One) no. each type used in the system
12	Prefab interconnecting cables with connectors	10% of total nos. used in the system or minimum 4(four)nos. whichever is more for each type.
13	Network communication cable with end connectors	10% of total nos. used in the system or minimum 4(four)nos. whichever is more for each type.
14	I/O bus cables with connectors for remote I/O units	1 no. of each type & length
15	Fibre optic cable Converter / DE converter	1 no.
16	Cooling Fans	2 nos. for each cabinet
17	Loose Connectors	5 nos. of each type
18	Colour TFT Monitor	1 no. complete set
19	Hard Disk Drive for the work Station	1 no. complete set
20	Key board , mouse / trackball with connecting cables and plugs	1 no. each type.
21	Printers Cartridges	2 nos. of each type
22	SMPS for printers	1 no. of each type/ rating
23	SVGA cards for printers	1 no. of each type
24	Key Board & Cursor control device	1 no. of each type
25	Complete Set of Operators Work Station	1no. complete set
26	Terminal Block	10% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	2 (two) no. complete set
28	Blank CD/DVD	50 (fifty) nos.

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

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1.3 Mandatory Spares required for Raw Water (RW) Gas Chlorination for Unit 1, 2, 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	2 No.
1.2	Shaft Sleeve	4 Nos.
1.3	Impeller	2 No.
1.4	Impeller locking nut and bolt	8 Nos.
1.5	Impeller wear ring	8 Nos.
1.6	Casing wear ring	8 Nos.
1.7	Oil Seal	8 Nos.
1.8	Oil Deflector	6 Nos.
1.9	Oil Ring	6 Nos.
1.1	Gland Packing	800%
1.11	Lantern Ring	6 Nos.
1.12	Mech Seal Assembly	2 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal"	6 Sets
1.14	Oil Level Gauge	6 Nos.
1.15	Coupling	4 Nos.
1.16	Rubber Bush for Coupling	4 Nos.
1.17	O" Rings "	4 Sets
1.18	Suction Strainers Element	6 Nos.
1.19	Bearing for Pump Motor	4 Sets
2	Spares for Agitators (for each service)	
2.1	Gear Box Unit Complete	2 No.
2.2	Bearing for Gear Box Unit	2 Set
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	2 Set
2.4	Coupling Bolts	2 Set
2.5	Coupling shim pack (if applicable)	8 Sets
2.6	Oil seals	8 Sets
3	Spares for Valves	
3.1.i	Manual Diaphragm valves	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.

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3.1.ii	Auto Diaphragm valves	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.1.iii	Spare Diaphragm for above	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.2.i	Non return valves (NRV)	4 nos. of each size & type
3.2.ii	ii) Flaps for above NRV	4 nos. of each size
3.3	Gate/Globe/Ball valves/plug valve/needle valve	
3.3.i	Upto 4"	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.3.ii	Above 4"	2 no. each type and size.
3.4	Butter fly valve	
3.4.i	Upto 4"	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.4.ii	Above 4"	2 no. each type and size
4	Spares for Air Blowers for each service	
4.1	Impeller with shaft	2 Set
4.2	Bearings	2 Set
4.3	Oil seals	10 Sets
4.4	Filter	2 Set
5	Pneumatic Control Valve	
5.1	Pneumatic Diaphragm for Diaphragm actuated valve	4 Nos. for each type of Actuator
5.3	Gland Packing	2 set for each type of Control Valve
5.4	Plug, Seat, Cage, Stem etc.	2 set for each type of Control Valve
5.5	Retainer Ring, Seal Ring etc.	2 set for each type of Control Valve
5.6	Gasket	4 Sets. for each type of Control Valve
5.7	Position Transmitter complete set	20% of total quantity used in the system for each type and model.
5.8	Control Valve E/P Positioner complete Set	20% of total quantity used in the system for each type and model.
5.9	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	4 Nos. for each type & ratings
5.1	Solenoid Coil for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
5.11	Position Limit Switch for Pneumatic type On/Off Valve	20 Nos. for each type & ratings

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6.0	Electrical Items	
6.1	Driving End & Non-Driving End Bearing	6 Set for each type and rating of Motor
6.2	Cooling Fan	4 No. for each type and rating of Motor
6.3	Motor Terminal Block	10 No. for each type and rating of Motor
6.4	Complete Set of Coupling	2 Set for each Application
7	C&I Items	
A	Field Instruments	
1	Transmitters/ Gauges/Switches etc. along with relevant accessories	20% of total or at least four (whichever is higher) for each type along with Accessories.
2	Temperature Element (RTD/Thermo-couple) with thermo well	20% of each type , range and immersion length. Minimum 10 nos.
B	PLC/ Proprietary Control System	
1	Network cards, Communication Interface cards	10% for each type or but minimum 2 no.
2	I/O Cards (Each type)	10% for each type but minimum 4 nos.
3	Controller Cards	4 nos.
4	SER Cards	10% for each type or but minimum 2 no.
5	All other Electronic Modules	10% for each type but minimum 2 no.
6	Relays	20% of total quantity
7	Power Supply Modules & Power Packs for control system	10% for each type and range but minimum 2 nos.
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	20% of total nos. used for each type and model in the system or minimum 4(four) no. whichever is more.
9	MCB (Miniature case circuit breaker)	20% or minimum 20 nos. whichever is Higher for each type and rating.
10	Fuses	400% or minimum 100 no's for each type and rating
11	Racks for housing I/O & Processor Modules	2(Two) no. each type used in the system
12	Prefab interconnecting cables with connectors	20% of total nos. used in the system or minimum 8 (Eight)nos. whichever is more for each type.
13	Network communication cable with end connectors	20% of total nos. used in the system or minimum 8(eight)nos. whichever is more for each type.
14	I/O bus cables with connectors for remote I/O units	2 no. of each type & length
15	Fiber optic cable Converter / DE converter	2 no.
16	Cooling Fans	4 nos. for each cabinet
17	Loose Connectors	10 nos. of each type
18	Colour TFT Monitor	2 no. complete set
19	Hard Disk Drive for the work Station	2 no. complete set

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20	Key board , mouse / trackball with connecting cables and plugs	2 no. each type.
21	Printers Cartridges	4 nos. of each type
22	SMPS for printers	2 no. of each type/ rating
23	SVGA cards for printers	2 no. of each type
24	Key Board & Cursor control device	2 no. of each type
25	Complete Set of Operators Work Station	2 no. complete set
26	Terminal Block	20% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	4 no. complete set
28	Blank CD/DVD	100 nos.

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

1.4 Mandatory Spares required for Portable Water (PW) Gas Chlorination Unit 1, 2, 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	2 No.
1.2	Shaft Sleeve	4 Nos.
1.3	Impeller	2 No.
1.4	Impeller locking nut and bolt	8 Nos.
1.5	Impeller wear ring	8 Nos.
1.6	Casing wear ring	8 Nos.
1.7	Oil Seal	8 Nos.
1.8	Oil Deflector	6 Nos.
1.9	Oil Ring	6 Nos.
1.1	Gland Packing	800%
1.11	Lantern Ring	6 Nos.
1.12	Mech Seal Assembly	2 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal"	6 Sets
1.14	Oil Level Gauge	6 Nos.
1.15	Coupling	4 Nos.
1.16	Rubber Bush for Coupling	4 Nos.
1.17	O" Rings "	4 Sets
1.18	Suction Strainers Element	6 Nos.
1.19	Bearing for Pump Motor	4 Sets
2	Spares for Agitators (for each service)	

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2.1	Gear Box Unit Complete	2 No.
2.2	Bearing for Gear Box Unit	2 Set
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	2 Set
2.4	Coupling Bolts	2 Set
2.5	Coupling shim pack (if applicable)	8 Sets
2.6	Oil seals	8 Sets
3	Spares for Valves	
3.1.i	Manual Diaphragm valves	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.1.ii	Auto Diaphragm valves	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.1.iii	Spare Diaphragm for above	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.2.i	Non return valves (NRV)	4 nos. of each size & type
3.2.ii	ii) Flaps for above NRV	4 nos. of each size
3.3	Gate/Globe/Ball valves/plug valve/needle valve	
3.3.i	Upto 4"	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.3.ii	Above 4"	2 no. each type and size.
3.4	Butter fly valve	
3.4.i	Upto 4"	20% of total quantity used for each type and size with minimum no. four (4) for each type and size.
3.4.ii	Above 4"	2 no. each type and size
4	Spares for Air Blowers for each service	
4.1	Impeller with shaft	2 Set
4.2	Bearings	2 Set
4.3	Oil seals	10 Sets
4.4	Filter	2 Set
5	Pneumatic Control Valve	
5.1	Pneumatic Diaphragm for Diaphragm actuated valve	4 Nos. for each type of Actuator
5.3	Gland Packing	2 set for each type of Control Valve
5.4	Plug, Seat, Cage, Stem etc.	2 set for each type of Control Valve
5.5	Retainer Ring, Seal Ring etc.	2 set for each type of

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		Control Valve
5.6	Gasket	4 Sets. for each type of Control Valve
5.7	Position Transmitter complete set	20% of total quantity used in the system for each type and model.
5.8	Control Valve E/P Positioner complete Set	20% of total quantity used in the system for each type and model.
5.9	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	4 Nos. for each type & ratings
5.1	Solenoid Coil for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
5.11	Position Limit Switch for Pneumatic type On/Off Valve	20 Nos. for each type & ratings
6.0	Electrical Items	
6.1	Driving End & Non-Driving End Bearing	6 Set for each type and rating of Motor
6.2	Cooling Fan	4 No. for each type and rating of Motor
6.3	Motor Terminal Block	10 No. for each type and rating of Motor
6.4	Complete Set of Coupling	2 Set for each Application
7.0	C&I Items	
A	Field Instruments	
1	Transmitters/ Gauges/Switches etc. along with relevant accessories	20% of total or at least four (whichever is higher) for each type along with Accessories.
2	Temperature Element (RTD/Thermo-couple) with thermowell	20% of each type , range and immersion length . Minimum 10 nos.
B	PLC/ Proprietary Control System	
1	Network cards, Communication Interface cards	10% for each type or but minimum 2 no.
2	I/O Cards (Each type)	10% for each type but minimum 4 nos.
3	Controller Cards	4 nos.
4	SER Cards	10% for each type or but minimum 2 no.
5	All other Electronic Modules	10% for each type but minimum 2 no.
6	Relays	20% of total quantity
7	Power Supply Modules & Power Packs for control system	10% for each type and range but minimum 2 nos.
8	Network Items (Network switch/ LIU unit/ Transceiver/ FO patch cord etc.)	20% of total nos. used for each type and model in the system or minimum 4(four) no. whichever is more.
9	MCB (Miniature case circuit breaker)	20% or minimum 20 nos. whichever is higher for each type and rating.
10	Fuses	400% or minimum 100 no's for each type and rating
11	Racks for housing I/O & Processor Modules	2(Two) no. each type used in the system
12	Prefab interconnecting cables with connectors	20% of total nos. used in the system or minimum 8(eight)nos. whichever is more

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		for each type.
13	Network communication cable with end connectors	20% of total nos. used in the system or minimum 8(eight)nos. whichever is more for each type.
14	I/O bus cables with connectors for remote I/O units	2 no. of each type & length
15	Fibre optic cable Converter / Deconverter	2 no.
16	Cooling Fans	4 nos. for each cabinet
17	Loose Connectors	10 nos. of each type
18	Colour TFT Monitor	2 no. complete set
19	Hard Disk Drive for the work Station	2 no. complete set
20	Key board , mouse / trackball with connecting cables and plugs	2 no. each type.
21	Printers Catriges	4 nos. of each type
22	SMPS for printers	2 no. of each type/ rating
23	SVGA cards for printers	2 no. of each type
24	Key Board & Cursor control device	2 no. of each type
25	Complete Set of Operators Work Station	2no. complete set
26	Terminal Block	20% of total nos. used in the system for each type and rating.
27	Read-Write CD/DVD	4 (four) nos. complete set
28	Blank CD/DVD	100 (Hundred) nos.

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

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SECTION – 7

DATA SHEETS CHOLRINATION SYSTEM

1.1 DATA SHEET FOR CW CHLORINATION WITH ABSORPTION SYSTEM FOR UNIT 1&2

1.0	CHLORINE TON-CONTAINERS	
1.1	Number	Ninety (90) [Twenty (20) numbers Ton Containers will be connected to manifolds and other Seventy (70) numbers Ton Containers will be kept as storage].
1.2	Description for each Chlorine Ton Container	
1.3	Chlorine capacity, each	Not less than 900 Kg.
1.4	Material of construction	ASTM-A-285 Gr.C/ASTM A 515 Gr.70.
1.5	Design pressure	19.9 Kg/cm ² (g).
1.6	Design Temperature	65 ⁰ C
1.7	Corrosion allowance	1.5 mm (minimum).
1.8	Radiography	100 %.
1.9	Heat treatment	Fully stress relieved.
1.10	Mounting	Each Chlorine Ton-Container shall be mounted on two (2) numbers metallic bracket type Roller Supports. These brackets will be mounted on civil foundation and all necessary anchor bolts, inserts, nuts etc.
1.11	Applicable Code	Design, fabrication and testing to conform to the regulations of Chief Controller of Explosives, Govt. of India/ Chlorine Institute, U.S.A.
1.12	Accessories	
1.12.1	Container valves	
1.12.1.1	Number	One set for each Chlorine Ton-Container.
1.12.1.1	Design Standard	IS-3224 or Equivalent.
1.12.2	Eductor Tubes	
	Number	Two (2) numbers educator pipes shall be provided for each, each terminating into an isolating valve.
	Purpose	One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine.
1.13	Instrumentation and Control	Shall be provided as per the requirements of the Bid Specification.
1.14	Changeover Module	As per requirement to complete the system

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		in all respects. (Chlorine automatic changeover facility with manifolds, valves, instruments & fittings etc.)
2.0	EVAPORATORS	
2.1	Number	Five (4W+1S) numbers
2.2	Description for each Evaporator	
2.3	Location	Indoor.
2.4	Capacity	Not less than 225 Kg/Hr.
2.5	Type	Electrically heated constant temperature immersion water bath type.
2.6	Material of construction	
2.6.1	Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless
2.6.2	Bottom flange(inlet chamber)	SA 105
2.6.3	Counter Flange	IS 2062 Gr.B
2.6.4	Flange: Outlet Chamber	IS 2062 Gr.B
2.6.5	Outlet Chamber Pipe	IS: 3589 2001 ERW pipe
2.6.6	Gas outlet pipe	SA 106 Gr. B Seamless
2.6.7	Top Flange (Inner Chamber)	SA 105
2.6.8	Gasket	Asbestos free gasket as per ISO 14001
2.6.8.1	Inner chamber pipe	SA 106 Gr. B
2.6.9	Super heat baffle pipe	SA 106 Gr. B
2.6.10	Base plate	IS 2062 Gr.B
2.6.11	Inlet and outlet pipe flange	SA 105
2.6.12	Overflow and drain piping	MS IS: 1239 Heavy (Galv)
2.7	Corrosion Allowance	3 mm (minimum)
2.8	Radiography	100 %.
2.9	Heat treatment	Fully stress-relieved.
2.9	Accessories	
2.9.1	Rupture Disc	
2.9.1.1	Number	One (1) for each Evaporator.
2.9.1.2	Type	Bellow/Diaphragm type with local facility for adjustment of set point.
2.9.1.3	Size	Suitable.
2.9.1.4	Allowable Pressure	28 kg/cm ² (approx)
2.9.1.5	Material of construction	Body – Silver coated Carbon Steel.
2.9.2	Expansion Chamber	
2.9.2.1	Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
2.9.2.2	Size	Bidder need to specify
2.9.2.3	Thickness	Sch 80
2.9.2.4	Design code	ASME SEC VIII Div 1

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2.9.2.5	Fluid Handled	Chlorine Gas/ Chlorine Liquid
2.9.2.6	Design Pressure	40 Kg/cm ² (g).
2.9.2.7	Radiography	100% on all butt weld joints
2.9.2.8	Hydro Test Pressure	60 Kg/cm ² (g).
2.9.3	Heating element.	
2.9.3.1	Number/ Unit	As per manufacturer standard
2.9.3.2	Capacity	As per manufacturer standard
2.9.3.3	Type	Immersion type, 3-phase, 415 V, 50 Hz.
2.9.3.4	MOC	SS 304 Coil Body MS IS: 2062 Gr. B
2.9.4	Pressure Relief Valve	
2.9.4.1	Number	One (1) for each stream.
2.9.4.2	Type	Screwed end full port.
2.9.4.3	Size	Suitable
2.9.4.4	Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
2.9.4.5	Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
2.9.4.6	Body Test Pressure	60 Kg/cm ² .
2.9.5	Water Chamber	
2.9.5.1	Size and thickness	As per manufacturer standard
2.9.5.2	Insulation Material	Glass Wool Aluminum Sheet
2.9.5.3	Temp of water bath	80 °C
2.9.5.4	Fluid handled	Water
2.9.5.5	Design pressure	Water
2.9.5.6	Hydro-test pressure	Water fill test
2.9.5.7	Joint efficiency	0.7
2.9.5.8	Radiography	Nil
2.9.5.9	Corrosion allowance	1.5 mm
2.9.6	Electrically interlocked shut-off valve at the gas discharge line from Evaporator	Shall be provided.
2.9.7	Cathodic protection system	
2.9.7.1	Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided with Ammeter
2.9.7.2	Purpose	Shall be provided to protect Water Bath and outside of Evaporator.
2.9.8	One (1) number Control Cubicle complete with necessary contactors, fuses, push buttons, indication lamps, ammeters and other instruments for each Evaporator	Shall be provided.

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3.0	CHLORINE STRAINERS	
3.1	Number	Two (2) for each Chlorinator
3.2	Description for each Strainer	
3.3	Application	To trap any liquid chlorine "Mist" and solid impurities from reaching the chlorinator.
3.4	Capacity	100 % for each Chlorinator.
3.5	Material of construction	Carbon steel SA 105
3.6	Filter Media	Spun Fibre Glass Wool
4.0	PRESSURE REGULATING VALVE	
4.1	Number	One (1) for each stream.
4.2	Description for each Valve	
4.3	Type	Spring loaded silver diaphragm
4.4	Material of construction	
4.4.1	Body	Carbon Steel as per ASTM A 105.
4.4.2	Diaphragm	PTFE.
4.4.3	Trim	Monel.
4.5	Size	Suitable
4.6	Location and mounting	Gas line from evaporator to chlorinator to Subject chlorinators to less pressure during operation.
4.7	Spring range	0-10 Kg/cm ² .
4.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.
4.9	Body Test Pressure	60 Kg/cm ² .
5.0	CHLORINATORS	
5.1	Number	Five (4W+1S) numbers
5.2	Description for each Chlorinator	
5.3	Location	Indoor.
5.4	Capacity, Kg/hr	225 Kg/hr.
5.5	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self-colored, resistant to corrosion by chlorine gas and chlorinated water solution.
5.6	Design Standard	IS: 10553 Part 2
5.7	Accessories	
5.7.1	Vacuum Stabilizing valve	
5.7.1.1	Number	1 number
5.7.1.2	Type	Diaphragm Type
5.7.1.3	Material	
5.7.1.3.1	Body	PVC
5.7.1.3.2	Diaphragm	PTFE
5.7.1.3.3	Seat	PTFE
5.7.1.3.4	Spring	Hastealloy 'C'
5.7.1.3.5.	Trim & Fasteners	Monel

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5.7.2	Flow rate valve	
5.7.2.1	Number/ Unit	1 number
5.7.2.2	Type	Manual
5.7.2.3	Material	
5.7.2.3.1	Body	PVC
5.7.2.3.2	Plug	Silver
5.7.2.3.3	Seat	PTFE
5.7.2.3.4	Spring / 'O' ring	Hastealloy 'C'
5.7.3	Pressure relief valve	
5.7.3.1	Number/Unit	1 number
5.7.3.2.	Type	Spring loaded type
5.7.3.3	Material	
5.7.3.3.1.	Body	PVC
5.7.3.3.2.	Loading Bolt	PVC
5.7.3.3.3.	Seat	PTFE
5.7.3.3.4	Spring	Hastealloy 'C'
5.7.3.3.5.	Trim & Fasteners	Monel
5.7.3.3.6.	'O' ring	Viton
5.7.4	Vacuum regulating valve	Shall be provided..
5.7.4.1.	Number/Unit	1 number/ unit with each set
5.7.4.2.	Type	Diaphragm type
5.7.4.3.	Material	
5.7.4.3.1.	Body	Ebonite
5.7.4.3.2.	Diaphragm and seat	PTFE
5.7.4.3.3.	Spring	Hastealloy 'C'
5.7.4.3.4.	Trim	Monel
5.7.4.3.5.	Fasteners	Monel
5.7.5	Flow rate indicator	
5.7.5.1	Number/Unit	1 number
5.7.5.2	Type	Rota meter
5.7.5.3	Material	Borosilicate Glass & Float: PTFE
5.7.6	Ejector with in-built check valve	
5.7.6.1	Number/Unit	1 number/unit
5.7.6.2	Type	Fixed type
5.7.6.3	Material	
5.7.6.3.1.	Body	CI with FRP lining inside
5.7.6.3.2.	Jet & Throat	Ebonite
5.7.6.3.3.	Fasteners	SS304
5.7.6.3.4.	Gasket	Neoprene rubber
5.7.7	Porous filter at gas inlet	
5.7.7.1	Number	1 number
5.7.7.2	Material	
5.7.7.2.1	Body	CS SA 105
5.7.7.2.2.	Filter Media	Glass wool

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5.7.8	Vent Piping	
5.7.8.1	Size	As per manufacturer standard
5.7.8.2	Pressure Standard	10 kg/sq.cm
5.7.8.3	Total length	As required
5.7.8.4	Material	PVC
5.7.9	Drain relief valve	
5.7.9.1	Number/ Unit	1 number
5.7.9.2	Type	Spring loaded type
5.7.9.3	Material	
5.7.9.3.1	Body	PVC
5.7.9.3.2	Diaphragm	PTFE
5.7.9.3.3.	Spring	Hastealloy 'C'
5.7.9.3.4.	Trim & Fasteners/ 'O' rings	Monel
5.7.10	Injector	Shall be provided..
5.7.11	Chlorine Detector	Shall be provided.
5.7.12	Diffuser	Shall be provided.
6.0	CHLORINATOR WATER SUPPLY BOOSTER PUMPS	
6.1	Number	Five (4W+1S) numbers
6.2	Description for each Pump	
6.3	Type of Pump	Horizontal Centrifugal
6.4	Location	Indoor.
6.5	Fluid to be handled	Circulating Water
6.6	Service	To supply motive water for Chlorinator.
6.7	Duty	Continuous and to be suitable for parallel operation.
6.8	Suction Condition	Flooded.
6.9	Type of Pump	Horizontal Centrifugal Non Clog type
6.10	Type of Impeller	Semi Open or Open
6.11	Design standard	As per IS-5659 & IS-5120.
6.12	Service temperature, in °C	60 maximum.
6.13	Rated Capacity, m ³ /hr	To suit the requirement of the each Chlorinator and shall be decided as per supplier recommendation during detailed engineering & as per codal requirement.
6.14	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
6.15	Range of operation	20 % - 120 %.
6.16	Suction Condition	Flooded.
6.17	Tentative head to be developed at rated capacity	Each pump should have adequate head to meet the requirements of Chlorination System.
6.18	Material of construction	
6.18.1	Casing	CI as per IS 210 FG 260
6.18.2	Impeller	SS 316
6.18.3	Shaft	EN 8 as per BS 970

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6.18.4	Stuffing Box and Gland	C.I.
6.18.5	Gland Packing	Graphite free Teflon.
6.18.6	Common Base plate	Fabricated Steel as per IS 2062.
6.18.7	Nuts and bolts	SS-316
6.19	Type of drive	Electrical Motor
6.20	Rated speed (RPM)	1500 (Sync.) maximum.
6.21	Type of coupling between Pump & Motor	Flexible Spacer.
6.22	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).
6.23	Trip interlock	Provided.
6.24	Accessories Shall be provided.	
6.24.1	Basket Strainers	
6.24.1.1	Numbers	Ten (10) numbers
6.24.1.2	Capacity	100% each.
6.24.1.3	Location	At suction of Strainer Assembly.
6.24.1.4	Mesh	40
6.24.1.5	Body MOC	IS 1239
7.0	CHLORINATED WATER DIFFUSER AND MIXING SYSTEM	
7.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
7.2	Device for injection of chlorinated water	Diffusers.
7.3	Location of diffusers	Well below minimum water level.
7.4	Material of construction	CPVC SCH80 DIFFUSER.
7.5	Number	Required number to achieve proper mixing.
7.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
8.0	LIFTING AND HANDLING DEVICES	
8.1	Monorail hoist	
8.1.1	Number	One (1) numbers
8.1.2	Type	Electrically operated.
8.1.3	Duty	To handle Chlorine Ton-Container.
8.1.4	Safe working load	3000 kg maximum.
8.2	Weighting Scale	
8.2.1	Number	One (1) numbers
8.2.2	Type	Platform Dial Type.
8.2.3	Duty	To handle Chlorine Ton-Container.
8.2.4	Range	0 - 3000 kg
9.0	SAFETY AND SUPERVISORY EQUIPMENT	
9.1	Gas Mask and Oxygen Breathing equipment along with Breathing Apparatus	

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9.1.1	Number	Two (2) numbers
9.1.2	Capacity	One (1) hour minimum.
9.1.3	Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.
9.2	Canister Type Breathing Apparatus	
9.2.1	Number	Two (2) numbers
9.2.2	Type	The moisture content from exhaled air of the User should react with granular chemical in Breathing Apparatus and liberates oxygen. The released Oxygen should enter a breathing bag from which the User can inhale.
9.3	Orthotolidine Impregnated Leak Detectors	
9.3.1	Number	Four (4) numbers
9.4	Ammonia bottles	
9.4.1	Number	Four (4) numbers
9.4.2	Capacity	500 ml each.
9.4.3	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 degree Be) to detect leakage of chlorine.
9.5	Moisture Absorbing Breathing Bottles	
9.5.1	Number	One (1) number for each Chlorine Ton Container.
9.5.2	Capacity	Two (2) 2000 ml silica gel for each bottle.
9.5.3	Type	The moisture absorber shall be fitted to the connection pipe to the Chlorine Ton Container, as soon as the container detached from the system. The breather shall absorb the moisture and allow dry air in the system to prevent corrosion of pipes and system.
9.5.4	Material of construction	Glass body.
9.6	Chlorine Residual Test Kit	
9.6.1	Number	Two (2) numbers
9.6.2	Type	Colorimetric Test Comparator
9.6.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.
10.0	CHLORINE LEAK DETECTOR	
10.0.1	Number	Sixteen (16) numbers [10 for connected tonners, 4 for storage tonners and 2 at chlorinator room] each having two sensors.
10.0.2	Type	Electronic type.

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10.0.3	Alarm	Shall be provided. in case of leakage of Chlorine.
10.0.4	Interlock	Shall be provided.
10.1	Emergency Kit	
10.1.1	Number	Four (4) numbers
10.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
10.2	Weather Cock	
10.2.1	Number	One (1) number
10.3	Safety Helmet	
10.3.1	Number	Two (2) numbers
10.4	Goggles	
10.4.1	Number	Two (2) numbers
10.5	Rubber Boots	
10.5.1	Number	Two (2) numbers
10.6	Gloves	
10.6.1	Number	Two (2) numbers
10.7	Colored Vest	
10.7.1	Number	Two (2) numbers
11.0	LEAKED CHLORINE ABSORPTION SYSTEM	
11.1	EXHAUST FANS	
11.2	Number	Shall be as per requirement & as per manufacturer standard
11.3	Description for each Fan	
11.4	Location	Indoor.
11.5	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
11.6	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to suction of Blowers of Chlorine Absorption System.
11.7	Duty	Intermittent.
11.8	Type	Bifurcated type.
11.9	Rated Capacity	As per manufacturer standard
11.10	Head to be developed at rated capacity	As per manufacturer standard
11.11	Material of construction	Polypropylene or FRP.
11.12	Type of drive	Electrical Motor
11.13	Criteria for 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 be less than the maximum power required by the Blower.
11.14	Rated speed (RPM)	1500 (Sync.) maximum.

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11.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V ($\pm 10\%$), 3 Phase, 50 HZ (+3 to -5%).
11.16	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
11.17	Painting for complete set of Fan & Motor	
11.18	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.
11.19	Start interlock	Shall be provided.. In case of leakage of Chlorine, the Atmospheric Ventilation Fans will stop and Exhaust Fans will take automatic start. However, the Atmospheric Ventilation Fans will be started and Exhaust Fans will be stopped in manual mode.
11.20	Accessories Shall be provided.	Each Exhaust Fan needs Shall be provided. with motorized damper. The complete electrical wiring and interlock facility as mentioned above shall be provided for both Exhaust Fans as well as Atmosphere Ventilation Fans.
12.0	BLOWERS OF CHLORINE ABSORPTION SYSTEM	
12.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
12.2	Description for each Blower	
12.3	Location	Outdoor.
12.4	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
12.5	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
12.6	Duty	Intermittent.
12.7	Type of Blower	Centrifugal.
12.8	Type of Impeller	Fan Blade.
12.9	Design standard	As per manufacturer standard
12.10	Service temperature, in $^{\circ}\text{C}$	60 maximum.
12.11	Rated Capacity for each, m^3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container, within one hour (maximum).
12.12	Permissible tolerance in rated capacity, in %	As per IS-4894.
12.13	Head to be developed at rated capacity	As per system requirement
12.14	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.

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12.15	Material of construction	
	Casing	Polypropylene or FRP.
	Impeller	Polypropylene or FRP.
12.16	Location	Outdoor.
12.17	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
12.18	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
12.19	Duty	Intermittent.
12.20	Type of Blower	Centrifugal.
12.21	Type of Impeller	Fan Blade.
12.22	Design standard	As per manufacturer standard.
12.23	Service temperature, in °C	60 maximum.
12.24	Rated Capacity for each, m ³ /hr	Adequate for absorption of chlorine leaked from one (1) number Completely filled Chlorine Ton Container, within one hour (maximum).
12.25	Permissible tolerance in rated capacity, in %	As per IS-4894.
12.26	Head to be developed at rated capacity	Bidder need to specify, in order to comply with the requirements of Bid Specification.
12.27	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.
12.28	Material of construction	
12.28.1	Casing	Polypropylene or FRP.
12.28.2	Impeller	Polypropylene or FRP.
12.28.3	Shaft	EN-8 to BS-970.
12.28.4	Common Base plate	Fabricated Steel as per IS 2062.
12.28.5	Coupling Guard	Carbon Steel.
12.28.6	Nuts and bolts	Haste Alloy -C
12.29	Type of drive	Electrical Motor
12.30	Criteria for 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 be less than the maximum power required by the Blower.
12.31	Rated speed (RPM)	1500 (Sync.) maximum.
12.32	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to -5%).
12.33	Type of coupling between Blower & Motor	Direct.
12.34	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
12.35	Accessories Shall be provided.	Common Base Frame, Suction Filter,

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		Suction Silencer, Discharge Silencer, Discharge Damper.
13.0	CHLORINE ABSORPTION TOWER	
13.1	Numbers Shall be provided.	One (1).
13.2	Description	
13.3	Type	Packed Tower
13.4	Type of fluid to be handled	20% w/w (maximum) caustic solution and chlorine gas.
13.5	Rated Absorption Capacity, kg of chlorine/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
13.6	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
13.7	Caustic Flow Rate, m ³ /hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
13.8	Cl ₂ content at outlet of Chlorine Absorption Tower	Free residual chlorine shall not be more than 0.1 ppm.
13.9	Design Temperature, °C	80
13.10	Location	The absorber shall be mounted on the caustic solution preparation-cum recirculation tank.
13.11	Design Code	As per manufacturer standard
13.12	Material of Construction	FRP
13.13	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
13.14	Protection	
13.14.1	Internal	Not required.
13.14.2	External	Not required.
13.15	Provided with accessories as follows:	
13.15.1	Dissolving Basket	Not required.
13.15.2	Inlet	Shall be provided..
13.15.3	Outlet	Shall be provided..
13.15.4	Drain	Shall be provided..
13.15.5	Overflow	Not required.
13.15.6	Vent	Shall be provided..
13.15.7	Manhole	Shall be provided..
13.15.8	Rain protection	Necessary arrangement in order to prevent rain water entry needs Shall be

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		provided.
14.0	CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION TANK	
14.1	Numbers Shall be provided.	One (1).
14.2	Description	
14.3	Type	Vertical cylindrical with flat bottom.
14.4	Type of fluid to be handled	20% w/w (maximum) caustic solution at operating temperature 80 deg C maximum.
14.5	Effective capacity, in m ³	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container plus 20% margin.
14.6	Minimum Free Board, in mm	300.
14.7	Design Temperature, °C	80
14.8	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
14.8.1	Agitator along with drive motor and other accessories	Shall be provided.. All wetted parts of the agitator shall be of SS-316 construction
14.8.2	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.
14.8.3	Inlet	Shall be provided.
14.8.4	Outlet	Shall be provided.
14.8.5	Drain	Shall be provided.
14.8.6	Overflow	Shall be provided.
14.8.7	Vent	Shall be provided.
14.8.8	Manhole	Shall be provided.
14.8.9	Sample Collection Point	Shall be provided.
14.8.10	Isolation Gates	Not required.
14.8.11	Platform complete with handrails for operation	Shall be provided.
14.8.12	Staircase	Shall be provided. For access from finished ground level to top of Operation Platform.
15.0	CAUSTIC SOLUTION PREPARATION-CUM- RECIRCULATION PUMPS	
15.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
15.2	Description for each Pump	
15.3	Type of Pump	Horizontal Centrifugal
15.4	Location	Outdoor.
15.5	Fluid to be handled	20% w/w (maximum) caustic solution at operating temperature 80 degree maximum
15.6	Service	To absorb chlorine leaked from Chlorine Ton Containers.

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15.7	Duty	Intermittent
15.8	Suction Condition	Flooded.
15.9	Type of Pump	Horizontal Centrifugal Non Clog type
15.10	Type of Impeller	Semi Open or Open
15.11	Design standard	As per IS-5659 & IS-5120.
15.12	Service temperature, in degree C	80 maximum.
15.13	Rated Capacity, in m ³ /hr	Suitable for absorption of chlorine leaked from one (1) completely filled Chlorine Ton Container, within one hour (Maximum) plus 20% margin.
15.14	Permissible tolerance in rated capacity, in %	As per IS-5659.
15.15	Range of operation	20 % - 120 %.
15.16	Suction Condition	Flooded.
15.17	Tentative head to be developed at rated capacity, MLC	Each pump is to have adequate head to meet the requirements of Chlorine Absorption System
15.18	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659.
15.19	Material of construction	
15.19.1	Casing	Polypropylene
15.19.2	Impeller	Polypropylene
15.19.3	Shaft	EN-8 as per BS-970 / SS 316.
15.19.4	Mechanical Seal	SS-316.
15.19.5	Common Base plate	Fabricated Steel as per IS 2062.
15.19.6	Nuts and bolts	SS-316
15.20	Type of drive	Electrical Motor
15.21	Criteria for 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.
15.22	Rated speed (RPM)	1500 (Sync.) maximum.
15.23	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to -5%).
15.24	Type of coupling between Pump & Motor	Flexible Spacer.
15.25	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).
15.26	Painting for complete set of Pump & Motor	Shall be as per tender specification
15.27	Suction Strainer along with flushing connection	Shall be provided.
15.28	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.

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15.29	Trip interlock	Shall be provided.
15.30	Testing	Shall be provided to meet the specification

1.2 DATA SHEET FOR CW CHLORINATION WITH ABSORPTION SYSTEM FOR UNIT 3, 4 & 5

1.0	CHLORINE TON-CONTAINERS	
1.1	Number	One Hundred Thirty Five (135) [Twenty Eight (28) numbers Ton Containers will be connected to manifolds and other One Hundred Seven (107) numbers Ton Containers will be kept as storage].
1.2	Description for each Chlorine Ton Container	
1.3	Chlorine capacity, each	Not less than 900 Kg.
1.4	Material of construction	ASTM-A-285 Gr.C/ASTM A 515 Gr.70.
1.5	Design pressure	19.9 Kg/cm ² (g).
1.6	Design Temperature	65°C
1.7	Corrosion allowance	1.5 mm (minimum).
1.8	Radiography	100 %.
1.9	Heat treatment	Fully stress relieved.
1.10	Mounting	Each Chlorine Ton-Container shall be mounted on two (2) numbers metallic bracket type Roller Supports. These brackets will be mounted on civil foundation and all necessary anchor bolts, inserts, nuts etc.
1.11	Applicable Code	Design, fabrication and testing to conform to the regulations of Chief Controller of Explosives, Govt. of India/ Chlorine Institute, U.S.A.
1.12	Accessories	
1.12.1	Container valves	
1.12.1.1	Number	One set for each Chlorine Ton-Container.
1.12.1.2	Design Standard	IS-3224 or Equivalent.
1.12.2	Eductor Tubes	
	Number	Two (2) numbers eductor pipes shall be provided for each, each terminating into an isolating valve.
	Purpose	One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine.
1.13	Instrumentation and Control	Shall be provided as per the requirements of the Bid Specification.
1.14	Changeover Module	As per requirement to complete the system in all respects. (Chlorine automatic

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		changeover facility with manifolds, valves, instruments & fittings etc.)
2.0	EVAPORATORS	
2.1	Number	Seven (6W+1S) numbers
2.2	Description for each Evaporator	
2.3	Location	Indoor.
2.4	Capacity	Not less than 225 Kg/Hr.
2.5	Type	Electrically heated constant temperature immersion water bath type.
2.6	Material of construction	
2.6.1	Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless
2.6.2	Bottom flange(inlet chamber)	SA 105
2.6.3	Counter Flange	IS 2062 Gr.B
2.6.4	Flange: Outlet Chamber	IS 2062 Gr.B
2.6.5	Outlet Chamber Pipe	IS: 3589 2001 ERW pipe
2.6.6	Gas outlet pipe	SA 106 Gr. B Seamless
2.6.7	Top Flange (Inner Chamber)	SA 105
2.6.8	Gasket	Asbestos free gasket as per ISO 14001
2.6.8.1	Inner chamber pipe	SA 106 Gr. B
2.6.9	Super heat baffle pipe	SA 106 Gr. B
2.6.10	Base plate	IS 2062 Gr.B
2.6.11	Inlet and outlet pipe flange	SA 105
2.6.12	Overflow and drain piping	MS IS: 1239 Heavy (Galv)
2.7	Corrosion Allowance	3 mm (minimum)
2.8	Radiography	100 %.
2.9	Heat treatment	Fully stress-relieved.
2.9	Accessories	
2.9.1	Rupture Disc	
2.9.1.1	Number	One (1) for each Evaporator.
2.9.1.2	Type	Bellow/Diaphragm type with local facility for adjustment of set point.
2.9.1.3	Size	Suitable.
2.9.1.4	Allowable Pressure	28 kg/cm ² (approx)
2.9.1.5	Material of construction	Body – Silver coated Carbon Steel.
2.9.2	Expansion Chamber	
2.9.2.1	Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
2.9.2.2	Size	Bidder need to specify
2.9.2.3	Thickness	Sch 80
2.9.2.4	Design code	ASME SEC VIII Div 1
2.9.2.5	Fluid Handled	Chlorine Gas/ Chlorine Liquid

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2.9.2.6	Design Pressure	40 Kg/cm ² (g).
2.9.2.7	Radiography	100% on all butt weld joints
2.9.2.8	Hydro Test Pressure	60 Kg/cm ² (g).
2.9.3	Heating element.	
2.9.3.1	Number/ Unit	As per manufacturer standard
2.9.3.2	Capacity	As per manufacturer standard
2.9.3.3	Type	Immersion type, 3-phase, 415 V, 50 Hz.
2.9.3.4	MOC	SS 304 Coil Body MS IS: 2062 Gr. B
2.9.4	Pressure Relief Valve	
2.9.4.1	Number	One (1) for each stream.
2.9.4.2	Type	Screwed end full port.
2.9.4.3	Size	Suitable
2.9.4.4	Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
2.9.4.5	Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
2.9.4.6	Body Test Pressure	60 Kg/cm ² .
2.9.5	Water Chamber	
2.9.5.1	Size and thickness	As per manufacturer standard
2.9.5.2	Insulation Material	Glass Wool Aluminum Sheet
2.9.5.3	Temp of water bath	80 °C
2.9.5.4	Fluid handled	Water
2.9.5.v	Design pressure	Water
2.9.5.vi	Hydro-test pressure	Water fill test
2.9.5.7	Joint efficiency	0.7
2.9.5.8	Radiography	Nil
2.9.5.9	Corrosion allowance	1.5 mm
2.9.6	Electrically interlocked shut-off valve at the gas discharge line from Evaporator	Shall be provided.
2.9.7	Cathodic protection system	
2.9.7.1	Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided. with Ammeter
2.9.7.2	Purpose	Shall be provided to protect Water Bath and outside of Evaporator.
2.9.8	One (1) number Control Cubicle complete with necessary contactors, fuses, push buttons, indication lamps, ammeters and other instruments for each Evaporator	Shall be provided.
3.0	CHLORINE STRAINERS	
3.1	Number	Two (2) for each Chlorinator

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3.2	Description for each Strainer	
3.3	Application	To trap any liquid chlorine "Mist" and solid impurities from reaching the chlorinator.
3.4	Capacity	100 % for each Chlorinator.
3.5	Material of construction	Carbon steel SA 105
3.6	Filter Media	Spun Fibre Glass Wool
4.0	PRESSURE REGULATING VALVE	
4.1	Number	One (1) for each stream.
4.2	Description for each Valve	
4.3	Type	Spring loaded silver diaphragm
4.4	Material of construction	
4.4.1	Body	Carbon Steel as per ASTM A 105.
4.4.2	Diaphragm	PTFE.
4.4.3	Trim	Monel.
4.5	Size	Suitable
4.6	Location and mounting	Gas line from evaporator to chlorinator to Subject chlorinators to less pressure during operation.
4.7	Spring range	0-10 Kg/cm ² .
4.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.
4.9	Body Test Pressure	60 Kg/cm ² .
5.0	CHLORINATORS	
5.1	Number	Seven (6W+1S) numbers
5.2	Description for each Chlorinator	
5.3	Location	Indoor.
5.4	Capacity, Kg/hr	225 Kg/hr.
5.5	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self colored, resistant to corrosion by chlorine gas and chlorinated water solution.
5.6	Design Standard	IS: 10553 Part 2
5.7	Accessories	
5.7.1	Vacuum Stabilizing valve	
5.7.2.i	Number	1 number
5.7.1.2	Type	Diaphragm Type
5.7.1.3	Material	
5.7.1.3.1.	Body	PVC
5.7.1.3.2.	Diaphragm	PTFE
5.7.1.3.3.	Seat	PTFE
5.7.1.3.4.	Spring	Hastealloy 'C'

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5.7.1.3.5.	Trim & Fasteners	Monel
5.7.2	Flow rate valve	
5.7.2.1	Number/ Unit	1 number
5.7.2.2	Type	Manual
5.7.2.3	Material	
5.7.2.3.1	Body	PVC
5.7.2.3.2	Plug	Silver
5.7.2.3.3	Seat	PTFE
5.7.2.3.4	Spring / 'O' ring	Hastealloy 'C'
5.7.3	Pressure relief valve	
5.7.3.1	Number/Unit	1 number
5.7.3.2.	Type	Spring loaded type
5.7.3.3.	Material	
5.7.3.3.1.	Body	PVC
5.7.3.3.2.	Loading Bolt	PVC
5.7.3.3.3.	Seat	PTFE
5.7.3.3.4.	Spring	Hastealloy 'C'
5.7.3.3.5.	Trim & Fasteners	Monel
5.7.3.3.6.	'O' ring	Viton
5.7.4	Vacuum regulating valve	Shall be provided..
5.7.4.1.	Number/Unit	1 number/ unit with each set
5.7.4.2.	Type	Diaphragm type
5.7.4.3.	Material	
5.7.4.3.1.	Body	Ebonite
5.7.4.3.2.	Diaphragm and seat	PTFE
5.7.4.3.3.	Spring	Hastealloy 'C'
5.7.4.3.4.	Trim	Monel
5.7.4.3.5.	Fasteners	Monel
5.7.5	Flow rate indicator	
5.7.5.1	Number/Unit	1 number
5.7.5.2	Type	Rota meter
5.7.5.3	Material	Borosilicate Glass & Float: PTFE
5.7.6	Ejector with in-built check valve	
5.7.6.1.	Number/Unit	1 number/unit
5.7.6.2.	Type	Fixed type
5.7.6.3	Material	
5.7.6.3.1.	Body	CI with FRP lining inside
5.7.6.3.2.	Jet & Throat	Ebonite
5.7.6.3.3.	Fasteners	SS304
5.7.6.3.4.	Gasket	Neoprene rubber
5.7.7	Porous filter at gas inlet	
5.7.7.1	Number	1 number
5.7.7.2	Material	
5.7.7.2.1	Body	CS SA 105

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5.7.7.2.2.	Filter Media	Glass wool
5.7.8	Vent Piping	
5.7.8.1	Size	As per manufacturer standard
5.7.8.2	Pressure Standard	10 kg/sq.cm
5.7.8.3	Total length	As required
5.7.8.4	Material	PVC
5.7.9	Drain relief valve	
5.7.9.1	Number/ Unit	1 number
5.7.9.2	Type	Spring loaded type
5.7.9.3	Material	
5.7.9.3.1	Body	PVC
5.7.9.3.2.	Diaphragm	PTFE
5.7.9.3.3.	Spring	Hastealloy 'C'
5.7.9.3.4.	Trim & Fasteners/ 'O' rings	Monel
5.7.10	Injector	Shall be provided..
5.7.11	Chlorine Detector	Shall be provided..
5.7.12	Diffuser	Shall be provided..
6.0	CHLORINATOR WATER SUPPLY BOOSTER PUMPS	
6.1	Number	Seven (6W+1S) numbers
6.2	Description for each Pump	
6.3	Type of Pump	Horizontal Centrifugal
6.4	Location	Indoor.
6.5	Fluid to be handled	Circulating Water
6.6	Service	To supply motive water for Chlorinator.
6.7	Duty	Continuous and to be suitable for parallel operation.
6.8	Suction Condition	Flooded.
6.9	Type of Pump	Horizontal Centrifugal Non Clog type
6.10	Type of Impeller	Semi Open or Open
6.11	Design standard	As per IS-5659 & IS-5120.
6.12	Service temperature, in °C	60 maximum.
6.13	Rated Capacity, m ³ /hr	To suit the requirement of the each Chlorinator & decided as per supplier recommendation during detailed engineering and as per codal requirement.
6.14	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
6.15	Range of operation	20 % - 120 %.
6.16	Suction Condition	Flooded.
6.17	Tentative head to be developed at rated capacity	Each pump should have adequate head to meet the requirements of Chlorination System.
6.18	Material of construction	
6.18.1	Casing	CI as per IS 210 FG 260
6.18.2	Impeller	SS 316

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6.18.3	Shaft	EN 8 as per BS 970
6.18.4	Stuffing Box and Gland	C.I.
6.18.5	Gland Packing	Graphite free Teflon.
6.18.6	Common Base plate	Fabricated Steel as per IS 2062.
6.18.7	Nuts and bolts	SS-316
6.19	Type of drive	Electrical Motor
6.20	Rated speed (RPM)	1500 (Sync.) maximum.
6.21	Type of coupling between Pump & Motor	Flexible Spacer.
6.22	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).
6.23	Trip interlock	Provided.
6.24	Accessories Shall be provided.	
6.24.1	Basket Strainers	
6.24.1.1	Numbers	Fourteen (14) numbers
6.24.1.2	Capacity	100% each.
6.24.1.3	Location	At suction of Strainer Assembly.
6.24.1.4	Mesh	40
6.24.1.5	Body MOC	IS 1239
7.0	CHLORINATED WATER DIFFUSER AND MIXING SYSTEM	
7.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
7.2	Device for injection of chlorinated water	Diffusers.
7.3	Location of diffusers	Well below minimum water level.
7.4	Material of construction	CPVC SCH80 DIFFUSER.
7.5	Number	Require number to achieve proper mixing.
7.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
8.0	LIFTING AND HANDLING DEVICES	
8.1	Monorail hoist	
8.1.1	Number	One (1) numbers
8.1.2	Type	Electrically operated.
8.1.3	Duty	To handle Chlorine Ton-Container.
8.1.4	Safe working load	3000 kg maximum.
8.2	Weighting Scale	
8.2.1	Number	One (1) numbers
8.2.2	Type	Platform Dial Type.
8.2.3	Duty	To handle Chlorine Ton-Container.
8.2.4	Range	0 - 3000 kg
9.0	SAFETY AND SUPERVISORY EQUIPMENT	
9.1	Gas Mask and Oxygen Breathing equipment along with Breathing	

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	Apparatus	
9.1.1	Number	Two (2) numbers
9.1.2	Capacity	One (1) hour minimum.
9.1.3	Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.
9.2	Canister Type Breathing Apparatus	
9.2.1	Number	Two (2) numbers
9.2.2	Type	The moisture content from exhaled air of the User should react with granular chemical in Breathing Apparatus and liberates oxygen. The released Oxygen should enter a breathing bag from which the User can inhale.
9.3	Orthotolidine Impregnated Leak Detectors	
9.3.1	Number	Four (4) numbers
9.4	Ammonia bottles	
9.4.1	Number	Four (4) numbers
9.4.2	Capacity	500 ml each.
9.4.3	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 degree Be) to detect leakage of chlorine.
9.5	Moisture Absorbing Breathing Bottles	
9.5.1	Number	One (1) number for each Chlorine Ton Container.
9.5.2	Capacity	Two (2) 2000 ml silica gel for each bottle.
9.5.3	Type	The moisture absorber shall be fitted to the connection pipe to the Chlorine Ton Container, as soon as the container detached from the system. The breather shall absorb the moisture and allow dry air in the system to prevent corrosion of pipes and system.
9.5.4	Material of construction	Glass body.
9.6	Chlorine Residual Test Kit	
9.6.1	Number	Two (2) numbers
9.6.2	Type	Colorimetric Test Comparator
9.6.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.
10.0	CHLORINE LEAK DETECTOR	
10.0.1	Number	Twenty Three (23) numbers [14 for connected tonners, 6 for storage tonners and 3 at chlorinator room] each having two

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		sensors.
10.0.2	Type	Electronic type.
10.0.3	Alarm	Shall be provided. in case of leakage of Chlorine.
10.0.4	d) Interlock	Shall be provided.
10.1	Emergency Kit	
10.1.1	Number	Four (4) numbers
10.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
10.2	Weather Cock	
10.2.1	Number	One (1) number
10.3	Safety Helmet	
10.3.1	Number	Two (2) numbers
10.4	Goggles	
10.4.1	Number	Two (2) numbers
10.5	Rubber Boots	
10.5.1	Number	Two (2) numbers
10.6	Gloves	
10.6.1	Number	Two (2) numbers
10.7	Colored Vest	
10.7.1	Number	Two (2) numbers
11.0	LEAKED CHLORINE ABSORPTION SYSTEM	
11.1	EXHAUST FANS	
11.2	Number	As per manufacturer standard
11.3	Description for each Fan	
11.4	Location	Indoor.
11.5	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
11.6	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to suction of Blowers of Chlorine Absorption System.
11.7	Duty	Intermittent.
11.8	Type	Bifurcated type.
11.9	Rated Capacity	As per manufacturer standard
11.10	Head to be developed at rated capacity	As per manufacturer standard
11.11	Material of construction	Polypropylene or FRP.
11.12	Type of drive	Electrical Motor
11.13	Criteria for 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 be less than the maximum power required by the Blower.

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11.14	Rated speed (RPM)	1500 (Sync.) maximum.
11.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V ($\pm 10\%$), 3 Phase, 50 HZ (+3 to -5%).
11.16	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
11.17	Painting for complete set of Fan & Motor	
11.18	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.
11.19	Start interlock	Shall be provided.. In case of leakage of Chlorine, the Atmospheric Ventilation Fans will stop and Exhaust Fans will take automatic start. However, the Atmospheric Ventilation Fans will be started and Exhaust Fans will be stopped in manual mode.
11.20	Accessories Shall be provided.	Each Exhaust Fan needs Shall be provided. with motorized damper. The complete electrical wiring and interlock facility as mentioned above shall be provided for both Exhaust Fans as well as Atmosphere Ventilation Fans.
12.0	BLOWERS OF CHLORINE ABSORPTION SYSTEM	
12.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
12.2	Description for each Blower	
12.3	Location	Outdoor.
12.4	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
12.5	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
12.6	Duty	Intermittent.
12.7	Type of Blower	Centrifugal.
12.8	Type of Impeller	Fan Blade.
12.9	Design standard	As per manufacturer standard
12.10	Service temperature, in $^{\circ}\text{C}$	60 maximum.
12.11	Rated Capacity for each, m^3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container, within one hour (maximum).
12.12	Permissible tolerance in rated capacity, in %	As per IS-4894.
12.13	Head to be developed at rated capacity	As per system requirement
12.14	Permissible tolerance in efficiency	As per IS-4894.

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	at rated capacity, in %	
12.15	Material of construction	
	Casing	Polypropylene or FRP.
	Impeller	Polypropylene or FRP.
12.16	Location	Outdoor.
12.17	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
12.18	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
12.19	Duty	Intermittent.
12.20	Type of Blower	Centrifugal.
12.21	Type of Impeller	Fan Blade.
12.22	Design standard	As per manufacturer standard.
12.23	Service temperature, in °C	60 maximum.
12.24	Rated Capacity for each, m ³ /hr	Adequate for absorption of chlorine leaked from one (1) number Completely filled Chlorine Ton Container, within one hour (maximum).
12.25	Permissible tolerance in rated capacity, in %	As per IS-4894.
12.26	Head to be developed at rated capacity	Bidder need to specify, in order to comply with the requirements of Bid Specification.
12.27	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.
12.28	Material of construction	
12.28.1	Casing	Polypropylene or FRP.
12.28.2	Impeller	Polypropylene or FRP.
12.28.3	Shaft	EN-8 to BS-970.
12.28.4	Common Base plate	Fabricated Steel as per IS 2062.
12.28.5	Coupling Guard	Carbon Steel.
12.28.6	Nuts and bolts	Haste Alloy -C
12.29	Type of drive	Electrical Motor
12.30	Criteria for 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 be less than the maximum power required by the Blower.
12.31	Rated speed (RPM)	1500 (Sync.) maximum.
12.32	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to -5%).
12.33	Type of coupling between Blower & Motor	Direct.
12.34	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).

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12.35	Accessories Shall be provided.	Common Base Frame, Suction Filter, Suction Silencer, Discharge Silencer, Discharge Damper.
13.0	CHLORINE ABSORPTION TOWER	
13.1	Numbers Shall be provided.	One (1).
13.2	Description	
13.3	Type	Packed Tower
13.4	Type of fluid to be handled	20% w/w (maximum) caustic solution and chlorine gas.
13.5	Rated Absorption Capacity, kg of chlorine/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
13.6	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
13.7	Caustic Flow Rate, m ³ /hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
13.8	Cl ₂ content at outlet of Chlorine Absorption Tower	Free residual chlorine shall not be more than 0.1 ppm.
13.9	Design Temperature, °C	80
13.10	Location	The absorber shall be mounted on the caustic solution preparation-cum recirculation tank.
13.11	Design Code	As per manufacturer standard
13.12	Material of Construction	FRP
13.13	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
13.14	Protection	
13.14.1	Internal	Not required.
13.14.2	External	Not required.
13.15	Provided with accessories as follows:	
13.15.1	Dissolving Basket	Not required.
13.15.2	Inlet	Shall be provided.
13.15.3	Outlet	Shall be provided.
13.15.4	Drain	Shall be provided.
13.15.5	Overflow	Not required.
13.15.6	Vent	Shall be provided.
13.15.7	Manhole	Shall be provided.
13.15.8	Rain protection	Necessary arrangement in order to

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		prevent rain water entry needs Shall be provided.
14.0	CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION TANK	
14.1	Numbers Shall be provided.	One (1).
14.2	Description	
14.3	Type	Vertical cylindrical with flat bottom.
14.4	Type of fluid to be handled	20% w/w (maximum) caustic solution at operating temperature 80 deg C maximum.
14.5	Effective capacity, in m ³	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container plus 20% margin.
14.6	Minimum Free Board, in mm	300.
14.7	Design Temperature, °C	80
14.8	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
14.8.1	Agitator along with drive motor and other accessories	Shall be provided.. All wetted parts of the agitator shall be of SS-316 construction
14.8.2	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.
14.8.3	Inlet	Shall be provided.
14.8.4	Outlet	Shall be provided.
14.8.5	Drain	Shall be provided.
14.8.6	Overflow	Shall be provided.
14.8.7	Vent	Shall be provided.
14.8.8	Manhole	Shall be provided.
14.8.9	Sample Collection Point	Shall be provided.
14.8.10	Isolation Gates	Not required.
14.8.11	Platform complete with handrails for operation	Shall be provided.
14.8.12	Staircase	Shall be provided. for access from finished ground level to top of Operation Platform.
15.0	CAUSTIC SOLUTION PREPARATION-CUM- RECIRCULATION PUMPS	
15.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
15.2	Description for each Pump	
15.3	Type of Pump	Horizontal Centrifugal
15.4	Location	Outdoor.
15.5	Fluid to be handled	20% w/w (maximum) caustic solution at operating temperature 80 degree maximum
15.6	Service	To absorb chlorine leaked from Chlorine Ton Containers.

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15.7	Duty	Intermittent
15.8	Suction Condition	Flooded.
15.9	Type of Pump	Horizontal Centrifugal Non Clog type
15.10	Type of Impeller	Semi Open or Open
15.11	Design standard	As per IS-5659 & IS-5120.
15.12	Service temperature, in degree C	80 maximum.
15.13	Rated Capacity, in m ³ /hr	Suitable for absorption of chlorine leaked from one (1) completely filled Chlorine Ton Container, within one hour (Maximum) plus 20% margin.
15.14	Permissible tolerance in rated capacity, in %	As per IS-5659.
15.15	Range of operation	20 % - 120 %.
15.16	Suction Condition	Flooded.
15.17	Tentative head to be developed at rated capacity, MLC	Each pump is to have adequate head to meet the requirements of Chlorine Absorption System
15.18	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659.
15.19	Material of construction	
15.19.1	Casing	Polypropylene
15.19.2	Impeller	Polypropylene
15.19.3	Shaft	EN-8 as per BS-970 / SS 316.
15.19.4	Mechanical Seal	SS-316.
15.19.5	Common Base plate	Fabricated Steel as per IS 2062.
15.19.6	Nuts and bolts	SS-316
15.20	Type of drive	Electrical Motor
15.21	Criteria for 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.
15.22	Rated speed (RPM)	1500 (Sync.) maximum.
15.23	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to -5%).
15.24	Type of coupling between Pump & Motor	Flexible Spacer.
15.25	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).
15.26	Painting for complete set of Pump & Motor	
15.27	Suction Strainer along with flushing connection	Shall be provided.
15.28	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.

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15.29	Trip interlock	Shall be provided.
15.30	Testing	Shall be provided as per tender specification

2.0 DATA SHEET FOR RW CHLORINATION WITH ABSORPTION SYSTEM

1.0	CHLORINE TON-CONTAINERS	
1.1	Type of container	Chlorine Ton Container
1.2	Number required	Twenty (20) [Eight (8) will be connected to manifold and other Twelve (12) will be kept in storage]
1.3	Description for each Chlorine Ton-Container	
1.4	Chlorine capacity, each	Not less than 900 Kg.
1.5	Material of construction	ASTM-A-285 Gr. C/ASTM A 515 Gr.70.
1.6	Design pressure	19.9 Kg/cm ² (g).
1.7	Design Temperature	65°C
1.8	Corrosion allowance	1.5 mm (minimum).
1.9	Radiography	100 %.
1.10	Heat treatment	Fully stress-relieved.
1.11	Mounting	Each Chlorine Ton-Container shall be mounted on two (2) numbers metallic bracket type Roller Supports.
1.12	Applicable Code	Design, fabrication and testing to conform to the regulations of Chief Controller of Explosives, Govt. of India/ Chlorine Institute, U.S.A.
1.13	Accessories	
1.13.1	Container valves	
1.13.1.1	Number	One set for each Chlorine Ton-Container.
1.13.1.2	Design Standard	IS-3224 or Equivalent.
1.13.2	Eductor Tubes	
1.13.2.1	Number	Two (2) numbers eductor pipes shall be provided for each, each terminating into an isolating valve.
1.13.2.2	Purpose	One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine
1.14	Instrumentation and Control	Shall be provided as per the requirements of the Bid Specification.
1.15	Changeover Module	As per requirement to complete the system in all respects. (Chlorine automatic changeover facility with manifolds, valves, instruments & fittings etc.)
2.0	EVAPORATORS	

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2.1	Number	Two (2) numbers
2.2	Description for each Evaporator	
2.3	Location	Indoor.
2.4	Capacity	Not less than 60 Kg/Hr.
2.5	Type	Electrically heated constant temperature immersion water bath type.
2.6	Material of construction	
2.6.1	Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless
2.6.2	Bottom flange(inlet chamber)	SA 105
2.6.3	Counter Flange	IS 2062 Gr.B
2.6.4	Flange: Outlet Chamber	IS 2062 Gr.B
2.6.5	Outlet Chamber Pipe	IS: 3589 2001 ERW pipe
2.6.6	Gas outlet pipe	SA 106 Gr. B Seamless
2.6.7	Top Flange (Inner Chamber)	SA 105
2.6.8	Gasket	Asbestos free gasket as per ISO 14001
2.6.9.1	Inner chamber pipe	SA 106 Gr. B
2.6.10	Super heat baffle pipe	SA 106 Gr. B
2.6.11	Base plate	IS 2062 Gr.B
2.6.12	Inlet and outlet pipe flange	SA 105
2.6.13	Overflow and drain piping	MS IS: 1239 Heavy (Galv)
2.7	Corrosion Allowance	3 mm (minimum)
2.8	Radiography	100 %.
2.9	Heat treatment	Fully stress-relieved.
2.9	Accessories	
2.9.1	Rupture Disc	
2.9.1.1	Number	One (1) for each Evaporator.
2.9.1.2	Type	Bellow/Diaphragm type with local facility for adjustment of set point.
2.9.1.3	Size	Suitable.
2.9.1.4	Allowable Pressure	28 kg/cm ² (approx)
2.9.1.5	Material of construction	Body – Silver coated Carbon Steel.
2.9.2	Expansion Chamber	
2.9.2.1	Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
2.9.2.2	Size	Bidder need to specify
2.9.2.3	Thickness	Sch 80
2.9.2.4	Design code	ASME SEC VIII Div 1
2.9.2.5	Fluid Handled	Chlorine Gas/ Chlorine Liquid
2.9.2.6	Design Pressure	40 Kg/cm ² (g).
2.9.2.7	Radiography	100% on all butt weld joints
2.9.2.8	Hydro Test Pressure	60 Kg/cm ² (g).

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2.9.3	Heating element.	
2.9.3.1	Number/ Unit	As per manufacturer standard
2.9.3.2	Capacity	As per manufacturer standard
2.9.3.3	Type	Immersion type, 3-phase, 415 V, 50 Hz.
2.9.3.4	MOC	SS 304 Coil Body MS IS: 2062 Gr. B
2.9.4	Pressure Relief Valve	
2.9.4.1	Number	One (1) for each stream.
2.9.4.2	Type	Screwed end full port.
2.9.4.3	Size	Suitable
2.9.4.4	Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
2.9.4.5	Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
2.9.4.6	Body Test Pressure	60 Kg/cm ² .
2.9.5	Water Chamber	
2.9.5.1	Size and thickness	As per manufacturer standard
2.9.5.2	Insulation Material	Glass Wool Aluminum Sheet
2.9.5.3	Temp of water bath	80 °C
2.9.5.4	Fluid handled	Water
2.9.5.5	Design pressure	Water
2.9.5.6	Hydro-test pressure	Water fill test
2.9.5.7	Joint efficiency	0.7
2.9.5.8	Radiography	Nil
2.9.5.9	Corrosion allowance	1.5 mm
2.9.6	Electrically interlocked shut-off valve at the gas discharge line from Evaporator	Shall be provided.
2.9.7	Cathodic protection system	
2.9.7.1	Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided. with Ammeter
2.9.7.2	Purpose	Shall be provided. to protect Water Bath and outside of Evaporator.
2.9.8	One (1) number Control Cubicle complete with necessary contactors, fuses, push buttons, indication lamps, ammeters and other instruments for each Evaporator	Shall be provided.
3.0	CHLORINE GAS STRAINERS	
3.1	Number	Two (2) for each Chlorinator [One in operation and other as stand-by].
3.2	Application	To trap any liquid chlorine "Mist" and solid impurities from reaching the chlorinator.

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3.3	Description for each Strainer	
3.3.1	Capacity	100 % for each Chlorinator.
3.3.2	Material of construction	Carbon steel SA 105
3.3.3	Filter Media	Spun Fibre Glass Wool
4.0	PRESSURE REGULATING VALVE	
4.1	Number	One (1) number for each stream
4.2	Type	Spring loaded silver diaphragm
4.3	Description for each Valve	
4.4	Material of construction	
4.4.1	Lower Body	EN8
4.4.2	Upper Body	IS 210 FG0200
4.4.3	Diaphragm	Teflon
4.4.4	Main spring	Hastealloy Silver Plated
4.4.5	Loading spring	Carbon Steel
4.4.6	Valve seat	Teflon
4.4.7	Valve plug	Silver
4.5	Size	
4.6	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.
4.7	Spring range	0-10 Kg/cm ² .
4.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.
4.9	Body Test Pressure	60 Kg/cm ² .
5.0	CHLORINATORS	
5.1	Number	Two (2) (one working + one standby)
5.2	Description for each Chlorinator	
5.3	Location	Indoor.
5.4	Design Standard	IS: 10553 Part 2
5.5	Capacity Kg/hr	60
5.6	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self colored, resistant to corrosion by chlorine gas and chlorinated water solution.
5.7	Accessories	
5.7.1	Vacuum Stabilizing valve	
5.7.1.1	Number	1 number
5.7.1.2	Type	Diaphragm Type
5.7.1.3	Material	
5.7.1.4	Body	PVC
5.7.1.5	Diaphragm	PTFE
5.7.1.6	Seat	PTFE
5.7.1.7	Spring	Hastealloy 'C'
5.7.1.8	Trim & Fasteners	Monel
5.7.2	Flow rate valve	

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5.7.2.1	Number/ Unit	1 number
5.7.2.2	Type	Manual
5.7.2.3	Material	
5.7.2.4	Body	PVC
5.7.2.5	Plug	Silver
5.7.2.6	Seat	PTFE
5.7.2.7	Spring / 'O' ring	Viton
5.7.3	Pressure relief valve	
5.7.3.1	Number/Unit	1 number
5.7.3.2	Type	Spring loaded type
5.7.3.3	Material	
5.7.3.4	Body	PVC
5.7.3.5	Loading Bolt	PVC
5.7.3.6	Seat	PTFE
5.7.3.7	Spring	Hastealloy 'C'
5.7.3.8	Trim & Fasteners	Monel
5.7.3.9	'O' ring	Viton
5.7.4	Vacuum regulating valve	
5.7.4.1	Number/Unit	1 number/ unit with each set
5.7.4.2	Type	Diaphragm type
5.7.4.3	Material	
5.7.4.4	Body	Ebonite
5.7.4.5	Trim	Monel
5.7.4.6	Fasteners	Monel
5.7.5	Flow rate indicator	
5.7.5.1	Number/Unit	1 number
5.7.5.2	Type	Rota meter
5.7.5.3	Material	Borosilicate Glass & Float: PTFE
5.7.6	Ejector with in-built check valve	
5.7.6.1	Number/Unit	1 number/unit
5.7.6.2	Type	Fixed type
5.7.6.3	Material	
5.7.6.4	Body	Ebonite
5.7.7	Porous filter at gas inlet	
5.7.7.1	Number	1 number
5.7.7.2	Material	
5.7.7.3	Body	Monel
5.7.7.4	Filter Media	Spun Fibre Glass Wool
5.7.8	Vent Piping	
5.7.8.1	Size	As per system requirment
5.7.8.2	Pressure Standard	10 kg/sq.cm
5.7.8.3	Total length	As required
5.7.8.4	Material	PVC
5.7.9	Drain relief valve	
5.7.9.1	Number/ Unit	1 number

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5.7.9.2	Type	Spring loaded type
5.7.9.3	Material	
5.7.9.4	Body	PVC
5.7.9.5	Diaphragm	PTFE
5.7.9.6	Trim & Fasteners/ 'O' rings	Viton
5.7.9.7	Injector	Shall be provided..
5.7.9.8	Chlorine Detector	Shall be provided.
5.7.9.9	Diffuser	Shall be provided.
6.0	CHLORINATOR WATER SUPPLY BOOSTER PUMPS	
6.1	Number	Two (2) [One in operation and other as stand-by].
6.2	Description for each Pump	
6.3	Type	Horizontal Centrifugal Non Clog type
6.4	Location	Indoor.
6.5	Fluid to be handled	Service Water.
6.6	Type of Impeller	Semi Open or Open
6.7	Design standard	As per IS-5659 & IS-5120.
6.8	Service temperature, in oC	60 maximum.
6.9	Duty	Continuous and to be suitable for parallel operation.
6.10	Suction Condition	Flooded.
6.11	Range of operation	20 % - 120 %.
6.12	Rated Capacity, m3/hr	To suit the requirement of the each Chlorinator.
6.13	Tentative head to be developed at rated capacity, MLC	Each pump shall have adequate head to meet the requirements of respective Chlorination System
6.14	Pump speed (RPM)	1500 preferred.
6.15	Material of construction	
6.15.1	Casing	CI as per IS 210 FG 260
6.15.2	Impeller	Bronze as per IS 318
6.15.3	Shaft	EN 8 as per BS 970
6.15.3	Shaft sleeve	SS 410
6.15.3	Stuffing Box and Gland	C.I.
6.16	Gland Packing	Graphite free Teflon.
6.17	Common Base plate	Fabricated Steel as per IS 2062.
6.17.1	Nuts and bolts	SS-316
6.18	Type of drive	Electrical Motor
6.19	Rated speed (RPM)	1500 (Sync.) maximum.
6.20	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), Phase, 50 HZ (+3 to -5%).
6.21	Type of coupling between Pump & Motor	Flexible Spacer.
6.22	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.5 m from the outer surface of Motor).

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6.23	Start and stop facility provided both at local and panel	Shall be provided..
6.24	Trip interlock	
6.25	Accessories Shall be provided.	
6.26	Basket Strainers	
6.27	Number	Two (2) numbers
6.28	Capacity	100% each.
6.29	Location	At suction and discharge of Strainer Assembly.
6.30	Mesh	40
6.31	Body Material	IS 1239
7.0	CHLORINATED WATER DIFFUSER AND MIXING SYSTEM	
7.1	Location for injection of chlorinated water	Stilling Chamber
7.2	Device for injection of chlorinated water	Diffusers.
7.3	Location of diffusers	Well below (minimum 300 mm) water level.
7.4	Material of construction	Schedule 80 CPVC
7.5	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
7.6	Other accessories	All supporting arrangement for willing with inserts like “U” clamps.
8.0	LIFTING AND HANDLING DEVICES	
8.1	Monorail hoist	
8.2	Number	One (1) number each of 3000 kg capacity.
8.3	Type	Electrically operated.
8.4	Duty	To handle Chlorine Ton-Container.
8.5	Accessories	Lifting bar with load indicator and Monorail.
8.2	Weighting Scale	
8.2.1	Number	One (1) numbers
8.2.2	Type	Platform Dial Type.
8.2.3	Duty	To handle Chlorine Ton-Container.
8.2.4	Range	0 - 3000 kg
9.0	SAFETY AND SUPERVISORY EQUIPMENT	
9.1.	Ammonia bottles	
9.1.1	Number	Two (2) numbers
9.1.2	Capacity	500 ml each.
9.1.3	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 deg. Be) to detect leakage of chlorine.
9.2	Residual Chlorine Analyzer	
9.2.1	Number	Two (2) numbers
9.2.2	Type	Colorimetric Test Comparator
9.2.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.

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9.3	Chlorine Leak Detector	
9.3.1	Number	Six (6) numbers (Four (4) for connected Chlorine Ton-Container, One for storage tonner area and one at chlorinator room) each of two sensors.
9.3.2	Type	Electronic type.
9.3.3	Alarm	Shall be provided. in case of leakage of Chlorine.
9.3.4	Interlock	Shall be provided.
9.4	Emergency Kit	
9.4.1	Number	Two (2) numbers
9.4.2	Breathing Apparatus	Four (4) numbers
9.4.3	Oxygen Cylinders	Four (4) numbers
9.4.4	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
9.5	Weather Cock	
9.5.1	Number	One (1) number
9.6	Safety shower	
9.6.1	Number	One (1) number
9.7	Moisture Absorbing Breathing Apparatus	
9.7.1	Number	One (1)
9.8	Safety Helmet	
9.8.1	Number	Two (2) numbers
9.9	Goggles	
9.9.1	Number	Two (2) numbers
9.10	Rubber Boots	
9.10.1	Number	Two (2) numbers
9.11	Gloves	
9.11.1	Number	Two (2) numbers
9.12	Colored Vest	
9.12.1	Number	Two (2) numbers
10.0	LEAKED CHLORINE ABSORPTION SYSTEM	
10.1	EXHAUST FANS	
10.1.1	Number	As per system requirement.
10.1.2	Description for each Fan	
10.1.3	Location	Indoor.
10.1.4	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
10.1.5	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to suction of Blowers of Chlorine Absorption System.
10.1.6	Duty	Intermittent.
10.1.7	Type	Bifurcated type.

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10.1.8	Rated Capacity	As per system requirement.
10.1.9	Head to be developed at rated capacity	As per system requirement.
10.1.10	Material of construction	Polypropylene or FRP.
10.1.11	Type of drive	Electrical Motor
10.1.12	Rated speed (RPM)	1500 (Sync.) maximum.
10.1.13	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%).
10.1.14	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
10.1.15	Painting for complete set of Fan & Motor	
10.1.16	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
10.1.17	Start interlock	Shall be provided. In case of leakage of Chlorine, the Atmospheric Ventilation Fans will stop and Exhaust Fans will take automatic start. However, the Atmospheric Ventilation Fans will be started and Exhaust Fans will be stopped in manual mode.
10.1.18	Accessories Shall be provided.	Each Exhaust Fan needs Shall be provided. with motorized damper. The complete electrical wiring and interlock facility as mentioned above shall be provided for both Exhaust Fans as well as Atmosphere Ventilation Fans.
11.0	BLOWERS OF CHLORINE ABSORPTION SYSTEM	
11.1	Number	Two (2) number (1W+1S)
11.2	Description for each Blower	
11.3	Location	Outdoor.
11.4	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
11.5	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
11.6	Duty	Intermittent.
11.7	Type of Blower	Horizontal, rotary oil free, motor driven, preferably bifurcated type.
11.8	Type of Impeller	Fan Blade.
11.9	Design standard	As per Bid Specification.
11.10	Service temperature, in $^{\circ}\text{C}$	60 maximum.
11.11	Rated Capacity	Adequate for absorption of chlorine leaked from one (1) number completely filled

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		Chlorine Ton Container, within one hour (maximum).
11.12	Permissible tolerance in rated capacity, in %	As per IS-4894.
11.13	Head to be developed at rated capacity	As per system requirement.
11.14	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.
11.15	Material of construction	
11.16	Casing	Polypropylene or FRP.
11.17	Impeller	Polypropylene or FRP.
11.18	Shaft	EN-8 to BS-970.
11.19	Common Base plate	Fabricated Steel as per IS 2062.
11.20	Coupling Guard	Carbon Steel.
11.21	Nuts and bolts	Haste Alloy C
11.22	Type of drive	Electrical Motor
11.23	Criteria for 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 be less than the maximum power required by the Blower.
11.24	Rated speed (RPM)	1500 (Sync.) maximum.
11.25	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%).
11.26	Type of coupling between Blower & Motor	Direct.
11.27	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
11.28	Painting for complete set of Blower & Motor	
11.29	Tests and Inspection	
11.30	Material Test required for	Casing, Impeller and Shaft.
11.31	Hydro-test	As per IS-4894.
11.32	Dynamic Balancing Test	Shall be provided..
11.34	Performance Test	
11.35	Test Code	As per IS-4894.
11.36	Tests to be done for determination of	Head-Capacity Curve and BHP-Capacity Curve.
11.37	Test to be carried out	On prototype model at rated speed.
11.38	Test for satisfactory operation of Blower at site	Required.
11.39	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
11.40	Start interlock	Shall be provided..

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11.41	Accessories Shall be provided.	Common Base Frame, Suction Filter, Suction Silencer, Discharge Silencer, Discharge Damper.
12.0	CHLORINE ABSORPTION TOWER	
12.1	Numbers Shall be provided.	One (1).
12.2	Description	
12.3	Type	Vertical Cylindrical Packed Absorption Tower. The Absorption Tower shall be mounted on the Caustic Solution Preparation cum Recirculation Tank (Described hereinafter).
12.4	Type of fluid to be handled	20% w/w (maximum) caustic solution and chlorine gas.
12.5	Rated Absorption Capacity, kg of chlorine/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
12.6	Caustic Flow Rate, m3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
12.7	Cl ₂ content at outlet of Chlorine Absorption Tower	Free residual chlorine shall not be more than 0.1 ppm.
12.8	Size	Bidder to indicate.
12.9	Design Pressure, Kg/cm ² .g	As per system requirement.
12.10	Design Temperature, °C	80
12.11	Design Code	As per system requirement.
12.12	Code for Tests and Inspections	As per system requirement.
12.13	Material of Construction	FRP with PP lining from inside of minimum 3 mm thick or CPVC
12.14	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
12.15	Provided with accessories as follows:	
12.15.1	Dissolving Basket	Not required.
12.15.2	Inlet	Shall be provided.
12.15.3	Outlet	Shall be provided.
12.15.4	Drain	Shall be provided.
12.15.5	Overflow	Not required.
12.15.6	Vent	Shall be provided.
12.15.7	Manhole	Shall be provided.
12.15.8	Rain protection	Necessary arrangement in order to prevent rain water entry needs Shall be provided.
13.0	CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION TANK	

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13.1	Numbers Shall be provided.	One (1).
13.2	Description	
13.3	Type	Vertical cylindrical with flat bottom.
13.4	Type of fluid to be handled	20% w/w (maximum) caustic solution.
13.5	Effective capacity, in m3	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container +20% margin
13.6	Minimum Free Board, in mm	300.
13.7	Design Temperature, °C	80
13.8	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
13.9	Protection	
13.9.1	Internal	Natural rubber [thickness - 4.5 mm in three (3) layers, shore hardness 60o – 70o A], suitable to withstand the design temperature.
13.10	Provided with accessories as follows:	
13.10.1	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.
13.10.2	Inlet	Shall be provided.
13.10.3	Outlet	Shall be provided.
13.10.4	Drain	Shall be provided.
13.10.5	Overflow	Shall be provided.
13.10.6	Vent	Shall be provided.
13.10.7	Manhole	Shall be provided.
13.10.8	Agitator along with drive motor and other accessories	Shall be provided.. Agitator shall be motor driven through reduction gear. All wetted parts of the agitator shall be of SS-316 construction.
13.10.9	Sample Collection Point	Shall be provided..
13.10.10	Isolation Gates	Not required.
13.10.11	Platform complete with handrails for operation	Shall be provided..
13.10.12	Staircase	Shall be provided. for access from finished ground level to top of Operation Platform.
13.10.13	Level gauge glass	One (1) number Shall be provided..
13.10.14	Instrumentation and Control	To be given as per the requirements of the Bid Specification
14.0	CAUSTIC SOLUTION PREPARATION-CUM- RECIRCULATION PUMPS	
14.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
14.2	Description for each Pump	
14.3	Location	Outdoor.

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14.4	Fluid to be handled	20% w/w (maximum) caustic solution.
14.5	Service	To absorb chlorine leaked from Chlorine Ton Containers.
14.6	Duty	Continuous and to be suitable for parallel operation.
14.7	Type of Pump	Horizontal Centrifugal Non Clog type
14.8	Type of Impeller	Semi Open or Open
14.9	Design standard	As per IS-5659 & IS-5120.
14.10	Service temperature, in degree C	80 maximum.
14.11	Rated Capacity, in m3/hr	To be indicated by the Bidder
14.12	Permissible tolerance in rated capacity, in %	As per IS-5659.
14.13	Range of operation	20 % - 120 %.
14.14	Suction Condition	Flooded.
14.15	Head to be developed at rated capacity	To be finalized during Detailed Engineering stage.
14.16	Shut Off Head	To be suitable for stable operation at rated duty point.
14.17	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659.
14.18	Material of construction	PP
14.18.1	Casing	SS-316.
14.18.2	Impeller	SS-316.
14.18.3	Shaft	EN-8 to BS-970.
14.18.4	Mechanical Seal	SS-316.
14.18.5	Common Base plate	Fabricated Steel as per IS 2062.
14.18.6	Nuts and bolts	SS-316
14.18.7	Type of drive	Electrical Motor
14.18.8	Rated speed (RPM)	1500 (Sync.) maximum.
14.18.9	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%).
14.18.10	Type of coupling between Pump & Motor	Flexible Spacer.
14.18.11	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.5 m from the outer surface of Motor).
14.18.12	Suction Strainer along with flushing connection	Shall be provided..
14.18.13	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
14.18.14	Trip interlock	Shall be provided..
14.19	Painting	As per Tender Spec
14.20	Testing	Shall be provided to meet the specification

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		requirement
15.0	CHLORINATED WATER DIFFUSER AND MIXING SYSTEM	
15.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
15.2	Device for injection of chlorinated water	Diffusers.
15.3	Location of diffusers	Well below minimum water level.
15.4	Material of construction	CPVC SCH80
15.5	Number	Require number to achieve proper mixing.
15.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4m/sec

3.0 DATA SHEET FOR PW CHLORINATION SYSTEM

1.0	CHLORINE CYLINDER	
1.1	Number	Two (2).
1.2	Description for each Chlorine Cylinder	
1.3	Capacity	Not less than 100 Kg.
1.4	Material of construction	ASTM-A-285 Gr.C/ASTM A 515 Gr.70.
1.5	Design Temperature	65 deg C
1.6	Design pressure	19.9 Kg/cm ² (g).
1.7	Corrosion allowance	1.5 mm (minimum).
1.8	Radiography	100 %
1.9	Heat treatment	Fully stress-relieved.
1.10	Mounting	Chlorine Cylinders are handled by means of a special two wheel Chlorine Cylinder Hand Truck.
1.11	Applicable Code	Design, fabrication and testing to conform to the regulations of Chief Controller of Explosives, Govt. of India/ Chlorine Institute, U.S.A.
1.12	Accessories	
1.12.1	Cylinder Valve valves	
1.12.1.1	Number	One set for each Chlorine Cylinder
1.12.1.2	Design Standard	IS-3224 or Equivalent.
2.0	CHLORINE GAS STRAINERS	
2.1	Number	Two (2) for each Chlorinator [One in operation and other as stand-by].
2.2	Application	To trap any liquid chlorine "Mist" and solid impurities from reaching the chlorinator.
2.3	Description for each Strainer	
2.3.1	Capacity	100 % for each Chlorinator.
2.3.2	Material of construction	Carbon steel SA 105

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2.3.3	Filter Media	Spun Fibre Glass Wool
3.0	VALVE FOR CHLORINE GAS STRAINER	
3.1	Description for each Valve	
3.2	Type	Ball as per BS 5351
3.3	Operating Pressure	13.3 Kg/cm ² at 500C
3.4	Design Pressure	19.9
3.5	Service	Dry Chlorine Gas
3.6	Location	For Strainer Isolation
3.6.1	Material of construction	
3.6.2	Body	ASTM A 216 Gr. WCB
3.6.3	Ball	Monel
3.6.4	Stem	Monel
3.6.5	Seat	PTFE
3.6.6	Code for Test and Inspection	BS 6755 Pt.I
4.0	CHLORINE GAS PIPE LINE	
4.1	Material of Construction	PVC (sch 80)
5.0	PRESSURE REGULATING VALVE	
5.1	Number	One (1) for each stream.
5.2	Description for each Valve	
5.2.1	Material of construction	
5.2.1.1	a) Body	Carbon Steel as per ASTM A 105.
5.2.1.2	b) Diaphragm	PTFE
5.2.1.3	c) Trim	Monel
5.3	Size	
5.4	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.
5.5	Spring range	0-10 Kg/cm ² .
5.6	Flange	Ends shall be flanged and flange sealing done by lead gasket.
5.7	Body Test Pressure	60 Kg/cm ² .
6.0	CHLORINATOR	
6.1	Number	Two (2) [One in operation and other as stand-by].
6.2	Description for each Chlorinator	
6.2.1	Location	Indoor.
6.2.2	Design Standard	IS: 10553 Part 2
6.2.3	Capacity	50 gm /hr.
6.2.4	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self-colored, resistant to corrosion by chlorine gas and chlorinated water solution.
6.2.5	Accessories	

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6.2.5.1	Inlet Chlorine Pressure Reducing Valve.	Shall be provided.
6.2.5.2	Chlorine Feed Rate Adjuster	Shall be provided.
6.2.5.3	Automatic pressure vacuum relief valve	Shall be provided.
6.2.5.4	Vacuum Controller	
6.2.5.5	Number	One (1) for each Chlorinator.
6.2.5.6	Material	ABS (Acryl nitrile Butadiene Styrene) Plastic Chamber and Teflon diaphragm with inlet valve having tantalum seat and special alloy spring of tantalum.
6.2.5.7	Injector	
6.2.5.7.1	Number	One (1) for each Chlorinator.
6.2.5.7.2	Material	CI (IS-210 grade) with FRP/RL inside. The injector shall include ebonite jet. The throat studs shall be SS-316 and gasket shall be of rubber.
6.2.5.8	Diffuser	Shall be provided..
7.0	CHLORINATOR WATER BOOSTER PUMPS	
7.1	Number	Two (2) [One in operation and other as stand-by].
7.2	Description for each Pump	
7.2.1	Location	Indoor.
7.2.2	Fluid to be handled	Filtered Water
7.2.3	Service	To supply motive water for Chlorinator.
7.2.4	Duty	Intermittent and suitable for parallel operation
7.2.5	Type of Pump	Horizontal Centrifugal Non Clog type
7.2.6	Type of Impeller	Semi Open or Open
7.2.7	Design standard	As per IS-5659 & IS-5120.
7.2.8	Service temperature, in deg. C	60 maximum.
7.2.9	Rated Capacity, in m3/hr	To suit the requirement of the each Chlorinator and shall be decided as per supplier recommendation during detailed engineering and as per codal requirement
7.2.10	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
7.2.11	Range of operation	20 % - 120 %.
7.2.12	Suction Condition	Flooded.
7.2.13	Head to be developed at rated capacity	To suit the requirement of the each Chlorinator. (C should be considered as 120 to calculate the frictional loss in pipe as per Hagen Williams Equation).
7.2.14	Shut Off Head	To be suitable for stable operation at rate duty

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		point.
7.2.15	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
7.2.16	Material of construction	
7.2.16.1	Casing	CI as per IS 210 FG 260
7.2.16.2	Impeller	Bronze as per IS 318
7.2.16.3	Shaft	EN 8 as per BS 970
7.2.16.4	Stuffing Box and Gland	C.I.
7.2.16.5	Gland Packing	Graphite free Teflon.
7.2.16.6	Common Base plate	Fabricated Steel as per IS 2062.
7.2.16.7	Nuts and bolts	SS-316
7.2.17	Type of drive	Electrical Motor
7.2.18	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).
7.2.19	Painting for complete set of Pump & Motor	Refer painting specification.
7.2.20	Tests and Inspection	
7.2.20.1	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
7.2.20.2	Hydro-test	As per IS-5118.
7.2.20.3	Dynamic Balancing Test	Shall be provided.
7.2.21	Performance Test	
7.2.21.1	Test Code	Hydraulic Institute Standard.
7.2.21.2	Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency-Capacity Curve and NPSH-Capacity Curve.
7.2.21.3	Test to be carried out	On prototype model at rated speed.
7.2.21.4	Test for satisfactory operation of pump at site	Required.
7.2.22	Instruments along with alarms, interlocks and accessories	Shall be provided. as per the requirements of the Tender Specification and Drawings, enclosed with it.
7.2.23	Accessories Shall be provided.	Two (2) numbers Suction Strainers at upstream of Suction Header - common for all the Pumps.
7.2.24	Start and stop facility provided both at local and panel	Shall be provided.
7.2.25	Trip interlock	Shall be provided.
7.2.26	Accessories Shall be provided.	
7.2.26.1	Suction Strainers (basket type)	Two (2) numbers at upstream of Suction Header - common for all the Pumps as addressed earlier. Size as per system

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		requirements.
7.2.27	Chlorine Water Dosing	At the Discharge Header of the Feed pumps of potable water treatment system through Mixing Tee
8.0	CHLORINATED WATER DIFFUSER AND MIXING SYSTEM (INJECTION QUILL)	
8.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
8.2	Device for injection of chlorinated water	Injection quill.
8.3	Location of diffusers	Well below minimum water level.
8.4	Material of construction	CPVC SCH80
8.5	Number	Require number to achieve proper mixing.
8.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
9.0	LIFTING AND HANDLING DEVICES	
9.1	Weighting Scale	
9.1.1	a) Number	One (1) numbers
9.1.2	b) Type	Platform Dial Type.
9.1.3	c) Duty	To handle Chlorine Ton-Container.
9.1.4	d) Range	0 - 200 kg
10.0	SAFETY AND SUPERVISORY EQUIPMENT	
10.1	Gas Mask and Oxygen Breathing equipment along with Breathing Apparatus	
10.1.1	Number	Two (2) numbers
10.1.2	Capacity	One (1) hour minimum.
10.1.3	Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.
10.2	Canister Type Breathing Apparatus	
10.2.1	Number	Two (2) numbers
10.2.2	Type	The moisture content from exhaled air of the User should react with granular chemical in Breathing Apparatus and liberates oxygen. The released Oxygen should enter a breathing bag from which the User can inhale.
10.3	Orthotolidine Impregnated Leak Detectors	
10.3.1	Number	Four (4) numbers
10.4	Ammonia bottles	
10.4.1	Number	Four (4) numbers
10.4.2	Capacity	500 ml each.
10.4.3	Accessories Shall be provided.	Filled up with commercial grade ammonia

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		solution (26 degree Be) to detect leakage of chlorine.
10.5	Moisture Absorbing Breathing Bottles	
10.5.1	Number	One (1) number for each Chlorine Cylinder.
10.5.2	Capacity	Two (2) 2000 ml silica gel for each bottle.
10.5.3	Type	The moisture absorber shall be fitted to the connection pipe to the Chlorine Cylinder, as soon as the container detached from the system. The breather shall absorb the moisture and allow dry air in the system to prevent corrosion of pipes and system.
10.5.4	Material of construction	Glass body.
10.6	Chlorine Residual Test Kit	
10.6.1	Number	Two (2) numbers
10.6.2	Type	Colorimetric Test Comparator
10.6.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.
11.0	CHLORINE LEAK DETECTOR	
11.0.1	Number	Two (2) numbers [one for connected cylinder and one at chlorinator room] each having two sensors.
11.0.2	Type	Electronic type.
11.0.3	Alarm	Shall be provided. in case of leakage of Chlorine.
11.0.4	Interlock	Shall be provided.
11.1	Emergency Kit	
11.1.1	Number	Four (4) numbers
11.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Cylinders.
11.2	Weather Cock	
11.2.1	Number	One (1) number
11.3	Safety Helmet	
11.3.1	Number	Two (2) numbers
11.4	Goggles	
11.4.1	Number	Two (2) numbers
11.5	Rubber Boots	
11.5.1	Number	Two (2) numbers
11.6	Gloves	
11.6.1	Number	Two (2) numbers
11.7	Colored Vest	
11.7.1	Number	Two (2) numbers
12.0	EXHAUST FANS	
12.1	EXHAUST FANS	

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12.2	Number	To meet the system requirements. As per manufacturer standard
12.3	Description for each Fan	
12.4	Location	Indoor.
12.5	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Cylinder.
12.6	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Cylinder, to atmosphere
12.7	Duty	Intermittent.
12.8	Type	Bifurcated type.
12.9	Rated Capacity	As per manufacturer standard
12.10	Head to be developed at rated capacity	As per manufacturer standard
12.11	Material of construction	Polypropylene or FRP.
12.12	Type of drive	Electrical Motor
12.13	Criteria for 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 be less than the maximum power required by the Blower.
12.14	Rated speed (RPM)	1500 (Sync.) maximum.
12.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V ($\pm 10\%$), 3 Phase, 50 HZ (+3 to -5%).
12.16	Noise level (for complete set of Blower & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
12.17	Painting for complete set of Fan & Motor	
12.18	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.
12.19	Start interlock	Shall be provided.. In case of leakage of Chlorine, the Atmospheric Ventilation Fans will stop and Exhaust Fans will take automatic start. However, the Atmospheric Ventilation Fans will be started and Exhaust Fans will be stopped in manual mode.
12.20	Accessories Shall be provided.	Each Exhaust Fan needs Shall be provided. With motorized damper. The complete electrical wiring and interlock facility as mentioned above shall be provided for both Exhaust Fans as well as Atmosphere Ventilation Fans.

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SECTION - 8

DESIGN CRITERIA FOR CW, RW & PW CHLORINATION SYSTEM

1.0 DESIGN CRITERIA FOR CW CHLORINATION PLANT

Gas Chlorination Plant has been designed to dose required quantity of chlorine to Cooling Water system. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed to CW forebay. System has been designed for a continuous dosing 1 ppm & shock dosing at the rate of 5 ppm for half an hour, once in 8 hrs. However, the actual dosing level shall be set by the operator based on residual chlorine measurement at the CW sump.

1.1 CALCULATION FOR CW-1 CHLORINATION PLANT CAPACITY (UNIT-1&2)

CW & ACW Flow Capacity	=	175110 m³/hr
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose	=	(175110X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	875.55 Kg./hr
Chlorinator selected based on shock dosing	=	5 @ 225 kg/hr (4W +1S)
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs.
Daily Chlorine requirement as per shock dose	=	1.5X 875.55 Kg./hr
	=	1313.325 Kg/Day
Chlorine requirement as per continuous dose		(175110 X 1)/1000 Kg/hr
	=	175.11 Kg/hr
Daily Chlorine requirement as per continuous dose	=	175.11 X 22.5 = 3939.975 Kg/Day.
Total Chlorine requirement	=	(1313.325+3939.975) Kg/Day.
	=	5253.3 Kg/Day.
Chlorine consumption for 15 days	=	78799.5 Kg
Filled Chlorine tonners required (@900 Kg)	=	87.555 nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	90 nos.

1.2 CALCULATION FOR CW-2 CHLORINATION PLANT CAPACITY (UNIT-3,4&5)

CW & ACW Flow Capacity	=	262665 m³/hr
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose	=	(262665X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	1313.325 Kg./hr

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Chlorinator selected based on shock dosing	=	7 @ 225 kg/hr (6W +1S)
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs
Daily Chlorine requirement as per shock dose	=	1.5X 1313.325 Kg./hr
	=	1969.9875 Kg/Day
Chlorine requirement as per continuous dose		(262665 X 1)/1000 Kg/hr
	=	262.665 Kg/hr
Daily Chlorine requirement as per continuous dose	=	262.665 X 22.5 = 5909.9625 Kg/Day.
Total Chlorine requirement	=	(1969.9875+5909.9625) Kg/Day.
	=	7879.95 Kg/Day.
Chlorine consumption for 15 days	=	118199.25 Kg
Filled Chlorine tonners required (@900 Kg)	=	131.3325 nos.
Filled Chlorine tonners that shall be supplied (@900 Kg	=	135 nos.

1.3 CHLORINE LEAK ABSORPTION SYSTEM FOR CW GAS CHLORINATION

An automatic chlorine leak absorption system has been provided for Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralisation of about one ton chlorine leakage in one hour.

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system shall mainly comprise of:

Equipment & Accessories for C.W. Chlorine Absorption system: 2 set of leak absorption system shall be provided for the CW chlorination plant. One set for (Unit 1 & 2) and second set for (Unit 3, 4, & 5). The following items shall be provided :

- 1a) Ninety (90) numbers of FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for 2 Units (Unit 1 & 2). One Hundred Thirty Five (135) numbers of FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for 3 Units (Unit 3, 4 & 5) each with flexible hose arrangement for connection to FRP Duct Work.

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- 1b) Adequate number of Ventilation Fans with one (1) number additional ventilation fan as stand by, each complete with electrical drive motor and all other accessories for each of the leak absorption system
- 1c) FRP Duct Work to Absorption System with all accessories as required for each leak absorption system.
- 1d) Two (2) numbers Blowers, each complete with electrical drive motor and all other accessories for each leak absorption system.
- 1e) One (1) number Chlorine Absorption Tower complete with all accessories for each leak absorption system.
- 1f) One (1) number Caustic Solution preparation cum Recirculation Tank, complete with agitator as well as its drive motor & all other accessories for each leak absorption system.
- 1g) Two (2) numbers Caustic Solution Preparation cum Recirculation Pumps, each complete with electrical drive motor and all other accessories for each leak absorption system.
- 1h) Two (2) sets of Safety & Supervisory Equipment & instruments as per requirements for each Gas Chlorination plant for Unit 1 & 2 & Unit 3, 4 & 5.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for 20 air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector.

1.0 DESIGN CRITERIA FOR RW CHLORINATION PLANT

Gas Chlorination Plant has been designed to dose required quantity of chlorine to PT Plant Stilling Chambers. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed in both the stilling chamber. System has been designed for continuous dosing of chlorine at the rate of 5 ppm. However, the actual dosing level shall be set by the operator based on residual chlorine measurement at the Clarifier outlet

2.1 CALCULATION FOR RW CHLORINATION PLANT CAPACITY

Total RW Flow	=	9545 m ³ /hr
Chlorine dosing rate (Continuous dosing)	=	5 ppm
Total Chlorine consumption rate for Continuous dosing	=	(9545x5)/1000

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Chlorine requirement	=	47.725 Kg./hr
Chlorinator selected	=	2 nos @ 60 Kg/Hr (1W+1S)
Chlorine requirement as per continuous dose	=	47.725x24=1145.4 Kg./day
Chlorine consumption for 15 days	=	17181kg
Filled Chlorine tonners required (@900 Kg)	=	19.09nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	20 nos.

2.2. CHLORINE LEAK ABSORPTION SYSTEM FOR RW GAS CHLORINATION

An automatic chlorine leak absorption system has been provided for Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralization of about one ton chlorine leakage in one hour.

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system shall mainly comprise of:

- 20 Nos. of FRP Hood covering full portion of the tonner in service and duct.
- 2 Nos. (1 working + 1 stand-by) Blowers.
- One (1) no. absorption tower (FRP) with packing.
- One (1) no. alkali storage tank.
- 2x 100% (1 working + 1 standby) alkali solutions cum recirculation pumps.
- Adequate numbers of Ventilation Fans with one (1) number additional Ventilation Fan as stand by, each complete with electrical drive motor and all other accessories
- Interconnecting piping valves, ducts, control and instrumentation.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for 20 air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector

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2.0 DESIGN CRITERIA FOR POTABLE WATER CHLORINATION

Chlorine will be dosed (1 ppm continuous) in potable water for disinfection. Residual chlorine of 0.2 ppm will be maintained. Potable water pumps shall be provided in DM Plant and dosing shall be done at discharge of Potable water pumps.

Total Potable water requirement for plant	=	25 m ³ /hr
Chlorine dosing rate (Continuous dosing)	=	1 ppm
Total Chlorine consumption rate for Continuous dosing	=	(25x1)/1000
Chlorine requirement	=	25 gm/hr
Chlorinator selected	=	2 nos @ 50 gm/Hr (1W+1S)
Chlorine requirement as per continuous dose	=	25x24=600 gm/day
Chlorine consumption for 15 days	=	9000 gm
Filled Chlorine cylinder required (@100 Kg)	=	0.09 nos.
Filled Chlorine cylinder that shall be supplied (@100 Kg)	=	2 nos.

3.0 LAYOUT CONSIDERATION FOR CW AND RW CHLORINATION PLANT

CW chlorination plants along with safety item for the Units 1&2 & Unit 3,4&5 shall be housed in respective CW Treatment buildings near to respective CW forebays. RW chlorination plant for PT plant shall also be housed in PT plant chemical house. One number Absorption system separately for RW and CW Chlorination plant shall also be provided and shall be placed outside to the respective building in open area. PW chlorination plant shall be housed in DM plant building

4.0 OPERATION CONTROL PHILOSOPHY & INSTRUMENTATION

5.1 RW CHLORINATION

The operation of RW chlorination system shall be semi-automatic and envisaged through the River Water Pre-Treatment plant PLC.

Each manifold shall have pressure switch which shall be interlocked with a pneumatic auto changeover valve. The pressure switch shall immediately send a signal to the Auto Changeover Valve for change in direction of flow when the chlorine pressure at operating manifold falls below the set point. This is to ensure uninterrupted flow of chlorine to the system. Annunciation signal shall be provided need to specify that the tonner under service is empty and has to be replaced.

The auto shut-off valve will get closed when the temperature of chlorine gas reaches below the set point value or the discharge pressure of the Booster Pumps reaches below the set point set point value. The 'Vacuum Switch Low' will give

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signal to PLC if the system fails to create vacuum. At the same time the 'Pressure Switch Low' provided at the discharge of Booster Pumps will give signal to PLC to close the auto shut-off as addressed above.

In the event of chlorine leakage, the Chlorine Leak Detector shall provide alarm and activate the Caustic Circulation Pump (pre-selected via PLC). After preset time delay the Blower (pre-selected via PLC) will start automatically and the process of neutralization shall be set into operation. Dampers of blowers and valves of Caustic Circulation Pump shall be kept open.

Ton Container Storage Area and Chlorination Room will be properly ventilated by continuously running ventilation fans. When Blowers of Absorption System come into operation through detection of dangerous level of chlorine leakage, the normal ventilation fans should stop and the same will again restart when Blowers stop.

ON/OFF/TRIP status of all pumps, blowers, agitators and drive motors as required, ammeters for drive motors wherever required shall be displayed in PLC workstation.

All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local pushbutton shall be provided. All drive motors shall be connected to PLC and the functions described above shall be performed in PLC. Tripping of different motors, level alarms etc. shall also be annunciated.

Reading of residual chlorine shall be indicated in Chlorination System PLC to control dosing rate of Pre-Treatment Chlorination stream.

5.2 CW CHLORINATION

The operation of the Circulating Water Chlorination System shall be semi-automatic through the same PLC based control system with LCD screen based Graphic User Interface (GUI) located in Control Room inside C.W. Treatment Building.

Each manifold shall have pressure switch which shall be interlocked with a pneumatic auto changeover redundant pressure transmitter's valve. The pressure switch shall immediately send a signal to the Auto Changeover Valve for change in direction of flow when the chlorine pressure at operating manifold falls below the set point. This is to ensure uninterrupted flow of chlorine to the system. Annunciation signal shall be provided need to specify that the tonner under service is empty and has to be replaced. Expansion chamber shall have a pressure switch to provide High Alarm signal in the PLC when the pressure at the inlet of the Evaporator exceeds the set point value. The solenoid valve at water inlet line of Evaporator shall open/close with reference to low/high water level in Evaporator. The auto shut-off valve will get closed when the temperature of chlorine gas reaches below the set point value or the discharge pressure of the Booster Pumps reaches below the set point set point value.

The 'Vacuum Switch Low' will give signal to PLC If the system fails to create vacuum. At the same time the 'Pressure Switch Low' provided at the discharge of

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Booster Pumps will give signal to PLC to close the auto shut-off as addressed above. In the event of chlorine leakage, the Chlorine Leak Detector shall provide alarm and activate the Caustic Circulation Pump (pre-selected via PLC). After preset time delay the Blower (pre-selected via PLC) will start automatically and the process of neutralization shall be set into operation. Dampers of blowers and valves of Caustic Circulation Pump shall be kept open. Reading of residual chlorine shall be indicated in Chlorination System PLC to control dosing rate of CW chlorination stream.

Ton Container Storage Area and Chlorination Room will be properly ventilated by continuously running ventilation fans. When Blowers of Absorption System come into operation through detection of dangerous level of chlorine leakage, the normal ventilation fans should stop and the same will again restart when Blowers stop.

ON/OFF/TRIP status of all pumps, blowers, agitators and drive motors as required, ammeters for drive motors wherever required shall be displayed in PLC display unit (GUI).

All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push Button shall be there. All drive motors shall be connected to PLC and the functions described above shall be performed in PLC. Tripping of different motors, level alarms etc. shall also be annunciated.

5.3 PW CHLORINATION

The operation of PW chlorination system shall be semi-automatic and envisaged through the DM Plant PLC.

The 'Vacuum Switch Low' will give signal to PLC If the system fails to create vacuum. At the same time the 'Pressure Switch Low' provided at the discharge of Booster Pumps will give signal to PLC to close the auto shut-off as addressed above.

All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push button shall be there. All drive motors, valves etc. shall be connected to PLC and the functions described above shall be performed in PLC.

Tripping of different motors, level alarms etc. shall also be annunciated.

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SECTION - 9

TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION

Electrical, Controls & Instrumentation requirements for the various Gas Chlorination system is attached separately as **ROS: 4190, Rev: 00** along with this specification.

SECTION - 10

PERFORMANCE GUARANTEE

The bidder shall guarantee all equipment for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole. On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified.

- a. Gas Chlorination outlet quality
- b. Vibration and noise level of rotating equipment

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

10.1 General

In addition to the guarantees mentioned above, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

All the equipment supplied shall be guaranteed for a minimum period of 12 (twelve) months from the date of successful commissioning of the units.

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
3	Header		1.5-2.4	2.1-2.4

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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:

Sl. No.	Description	Drawing No.
1	Tender P&ID for CW Chlorination Unit 1&2	2-WT-040-00262 Rev: 00
2	Tender P&ID for CW Chlorination. Unit 3, 4&5	2-WT-040-00263 Rev: 00
3	Tender P&ID for RW Chlorination Unit 1,2,3,4&5	3-WT-040-00843 Rev: 00
4	Tender P&ID for PW Chlorination Unit 1,2,3,4&5	3-WT-040-00844 Rev: 00
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.

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NOTE: The common discharge header of the Booster Pumps for CW Gas Chlorination Unit 1&2 & Unit 3,4 & 5 will be of GRP & the same should meet the following requirements :

GRP PIPE AND FITTINGS		
S.NO	Description	BHEL's Requirement
1	Design code	AWWA C950, AWWA M-45, ASTM D 2996, ASTM D 3567, BS 5480, IS12709
2	Interior layer resin	Vinylester
3	Interior layer glass	C-glass fibre
4	Interior layer resin thickness mm	2.0 (minimum)
5	Interior layer surface ratio (Mat: Resin)	10:90
6	structural layer glass	E-glass fibre
7	structural layer ratio (Glass: Resin)	60:40
8	Exterior layer resin	Isophthalic resin
9	Exterior surface ratio (Mat: Resin)	30:70
10	Exterior surface	UV stabilized resin
11	Winding method	Filament wound (Helical)
12	Winding angle	54.7°
13	Additives	Pigment, Dyes, Colouring Agent
14	Stiffness N/m ²	2500 (minimum)
15	Pipe thickness	Vendor to provide calculation
16	Design pressure bar	10
17	Hoop tensile modulus Mpa	22000
18	Axial tensile stress Mpa	45
19	Axial tensile modulus Mpa	8000
20	Hoop bending modulus Mpa	22500
21	Coefficient of linear expansion m/m°C	18x10 ⁻⁶ mm/nm/°c
22	Barcol hardness	Vendor to specify
23	Hazen-William coefficient (C value)	150
	FITTINGS	
24	Bend design	Swept
25	Flange drilling standard	ANSI B16.5#150 ***
26	Flange Thickness	ASTM D 5421

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ANNEXURE -A

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/ variations</i>	<i>Reason for Deviation</i>	<i>cost of withdrawal</i>



TECHNICAL SPECIFICATION FOR

SPEC NO: ROS 4190

REV NO: 00

5 X 800MW TSGENCO YADADRI TPS
CW CHLORINATION UNIT(1,2) & (3,4,5)
RW PW CHLORINATION PLANT UNIT(1,2,3,4,5)

PART OF MECHANICAL SPEC

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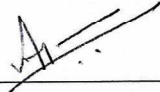
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BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION FOR
ELECTRICAL, CONTROL & INSTRUMENTATION
5 X 800MW TSGENCO YADADRI TPS

APPLICABLE FOR

CW CHLORINATION UNIT(1,2) & (3,4,5)
RW PW CHLORINATION PLANT UNIT(1,2,3,4,5)

07.09.17	AJV 	MKV 	VNS 	Fresh issue
Date	Prepared	Checked	Approved	Remarks

	TECHNICAL SPECIFICATION FOR CW CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
		REV NO: 00
		PART OF MECHANICAL SPEC

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 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 hardwares 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),
1/2" 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

	TECHNICAL SPECIFICATION FOR CW CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
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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 Hestallo (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

	TECHNICAL SPECIFICATION FOR CW CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
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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)

	TECHNICAL SPECIFICATION FOR CW CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
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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

	TECHNICAL SPECIFICATION FOR CW CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
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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 CHLORINATION UNIT(1,2) & (3,4,5) RW PW CHLORINATION PLANT UNIT(1,2,3,4,5) 5 X 800MW TSGENCO YADADRI TPS	SPEC NO: ROS 4190
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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 : $\frac{1}{2}$ " 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
[$\frac{1}{2}$ " Sch 80 X $\frac{1}{2}$ " 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

5.0 SCOPE of SUPPLY

All the required instrumentation, valves (manual, pneumatic, electric, control valves, valves with limit switches) that are essential for operation of the plant shall be part of bidder’s scope. The enclosed tender PID is only a minimum requirement and shall be subjected to approval by Owner/Owner’s consultant at the stage of detailed engineering.

PLC Configuration Diagram shall be subjected to approval by Owner/Owner’s consultant at the stage of detailed engineering.

Sl.	Description	Unit (1&2)	Unit (3,4&5)
1	PLC System for CW chlorination	1 set	1 set

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2	Redundant 2x100% UPS with 2x100% Lead acid Plante type batteries, SCVS, Redundant ACDB.	1 set	1 set
3	MIMIC panel with Back up control panel with I/O interface module	1 set	1 set
4	Operator & Engineering Workstation with necessary licences, programming software	1 set	1 set
5	Operator Workstation with necessary licences, operating software	1 set	1 set
6	A3 Printer	1 Set	1 Set
7	Redundant Optic fiber communication (approx. 1000 m) with fiber to Ethernet converters, patch cords, LIU etc.	1 Set	1 Set
8	Hand held Hart Calibrator	1 Set	1 Set
9	PLC Furniture for Workstation & Printer	1 Set	1 Set

For RW, PW chlorination systems, vendor to provide engineering inputs like Detailed IO list, HMI schematics, Control philosophy, logic charts & valve sequence chart for design of PLC control system by BHEL.

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

PACKAGE: GAS CHLORINATION PACKAGE

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: GAS CHLORINATION PACKAGE

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

[illegible]

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

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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,	
		Baumer Technologies India Pvt. Ltd.	VAPI	



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		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/Xerox/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	Khushkhhera	
		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	
		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HLB Power System	Hyderabad	



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		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	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	



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		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	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	



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		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	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	



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5X800 MW TSGENCO YADADRI TPS**

SPEC NO: ROS: 6185

ANNEXURE : B

REV NO: 00

		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	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	



TITLE:

**TECHNICAL SPECIFICATION FOR
GAS CHLORINATION PLANT
5X800 MW TSGENCO YADADRI TPS**

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REV NO: 00

		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	
50.0	Blower	Everest	Delhi	
		Kay International	Haryana	
		Swam Pneumatics	Delhi	
		Kulkarni brothers	Mumbai	
51.0	TEMPERATURE SWITCH	INDFOSS (INDIA) LTD.	GAZIABAD	



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REV NO: 00

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

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		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-040-00262
DRAWING NO.

A

B

C

D

F

G

H

CHLORINATOR ROOM

NO. OF STREAMS : 05 (4W+1S)

NOTES : 1) THIS P&ID IS FOR TENDER PURPOSE ONLY, FINAL P&ID SHALL BE SUBMITTED DURING DETAILED ENGINEERING FOR APPROVAL BY M/S TSGENCO
2) THE PIPE SIZES SHOWN ARE TENTATIVE ONLY, BIDDER TO SUITABLY CALCULATE THE PIPE SIZES.
3) ADEQUATE NO. OF EXHAUST FANS TO BE CONSIDERED.

FOR TENDER PURPOSE ONLY

BOOSTER PUMPS
QTY : 4W+1S

ABSORPTION SYSTEM - OPEN TO SKY

MAKE-UP WATER LINE
FROM CW DISCHARGE INCOMING WATER

ALL DIMENSIONS ARE IN MILLIMETRES

LEGEND

- PRESSURE INDICATOR WITH DIAPHRAGM SEAL
- PRESSURE SWITCH WITH DIAPHRAGM SEAL
- TEMPERATURE INDICATOR
- DIFFERENTIAL PRESSURE SWITCH
- DIFFERENTIAL PRESSURE INDICATOR
- PRESSURE INDICATOR
- DIFFERENTIAL PRESSURE REGULATOR
- VACUUM SWITCH WITH DIAPHRAGM SEAL
- VACUUM GAUGE WITH DIAPHRAGM SEAL
- FLOW TRANSMITTER
- FLOW SWITCH
- LEVEL INDICATOR
- LEVEL TRANSMITTER
- CHLORINE LEAK DETECTOR WITH SENSOR AND ALARM
- RESIDUAL CHLORINE ANALYSER
- TON VALVE WITH YOKE
- MANIFOLD (NEEDLE) VALVE
- FLOW CONTROL VALVE
- BALL VALVE
- ISOLATION (NEEDLE) VALVE
- BUTTER FLY VALVE
- ISOLATION (GLOBE/GATE) VALVE
- GATE VALVE

- DIAPHRAGM VALVE
- DAMPER
- CHECK VALVE
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- (EMERGENCY) DRAIN RELIEF VALVE
- AUTO SHUT OFF VALVE
- AUTO CHANGE OVER VALVE
- SOLENOID VALVE
- MOTORISED BUTTERFLY VALVE
- STRAINER - (Y-TYPE)
- PRESSURE REDUCING VALVE
- AUTOMATIC VACUUM REGULATOR
- GAS FILTER
- RUPTURE DISC
- INJECTOR

- STRAINER (BASKET)
- HORIZONTAL CENTRIFUGAL PUMP
- BLOWER
- CHLORINE TONNER
- TONNER ROLLER SUPPORT
- DIFFUSER
- WATER LINE
- CHLORINE LINE
- CHLORINE SOLUTION
- INTER LOCK LINE
- DUCTING LINE

PROJECT	YADADRI TPS -5x800 MW			
OWNER	TELANGANA STATE POWER GEN. CORPN. LTD.			
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILIARIES PLANT ; RANIPET PACKAGE : CW GAS CHLORINATION FOR UNIT # 1,2			
TITLE	P & ID FOR CW GAS CHLORINATION SYSTEM (FOR UNIT # 1 & 2)		NAME	SIGN.
DRAWN		ABHINAV	Sd/-	23.12.17
CHECKED		SRIVATSAN	Sd/-	23.12.17
APPROVED		SALIMANALAN	Sd/-	23.12.17
ALL DIMENSIONS ARE IN MILLIMETRES		BHEL DRAWING NO.		REV
PROJECTION		SCALE		00
N.T.S.		2-WT-040-00262		

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Size A2
12