1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE –VII, PALONCHA

VOLUME: II B & III

TECHNICAL SPECIFICATIONS
FOR
CHLORINATION PLANT

SPECIFICATION NO.: PE-TS-410-174-A001, REV-1

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

CONTENTS
VOLUME-IIB & III

VOLUME-IIB

SECTION – A
SCOPE OF ENQUIRY

1. 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 **1X800 MW TSGENCO KOTHAGUDEM TPS,STAGE-VII, PALONCHA.**

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil 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 Condensate Polishing Units and external regeneration system.

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.8 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.9 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer (TSGENCO: Telangana State Power Generation Corporation Ltd.) including their consultant (Development Consultants Pvt. Ltd.) 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.

SECTION – B
PROJECT INFORMATION

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 SOURCE OF WATER

Source of water (total quantity of water is 2192 m^3/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 ASH DISPOSAL AREA

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	89 m
Monthly highest temperature	:	44.9 °C
Monthly lowest temperature.	:	12.9 °C
Rainfall		
Average.	:	1031 mm
Max.	:	100 mm/ hr
Mean Wind speed	:	5.8 kmph
Relative Humidity		
Max	:	82%
Min	:	35%
Seismic Zone	:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

SECTION – C

(SPECIFIC TECHNICAL REQUIREMENTS)

SECTION – C1

(SPECIFIC TECHNICAL REQUIREMENTS FOR MECHANICAL)

1.0 GENERAL

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

2.0 SCOPE OF SUPPLY

Broad scope of work of this package includes all equipment and accessories and shall be as per the following (please refer P&ID) and same shall be included in bidder scope. Please also refer Electrical (Section-C1) & C&I (Section-C2) for respective scopes.

1) Entire CW/RW and PW Chlorination and Absorption system as per P&ID (PE-DG-410-174-A001) and Data Sheet-A.
2) Complete Supply of 46 numbers filled chlorine ton container (each of 900 Kg capacity, approx) for CW Chlorination plant with accessories like isolation valves, valve hood etc.
3) Complete Supply of 12 numbers filled chlorine ton container (each of 900 Kg capacity, approx) for RW Chlorination Plant with accessories like isolation valves, valve hood etc.
4) Complete Supply of 2 numbers filled chlorine cylinders (each of 100 Kg capacity, approx) with accessories like isolation valves, valve hood etc for PW Chlorination.
5) Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, 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.
6) Four numbers CW Chlorination each of 160 Kg/Hr.
7) Two numbers RW Chlorination each of 25 Kg/Hr.
8) Two numbers PW Chlorination each of 100 Gm/Hr.
9) Chlorine evaporator (one for each CW and RW chlorinator).
10) Chlorine gas strainers (two for each CW and RW chlorinator).
11) All piping as required and upto the dosing point as Shown in P&ID (PE-DG-410-174-A001).
12) Ejectors as per Data Sheet-A.
13) Booster Pumps (4 numbers for CW Chlorination, 2 numbers for RW chlorination and 2 numbers for PW chlorination) with accessories.
14) Electrical motor with accessories as per system requirement.
15) Chlorine water diffuser and Mixing system (injection quill) as mentioned in Data Sheet-A and as shown in P&ID.
16) Safety and supervisory instruments as specified in Data Sheet-A.
17) Instrumentation as per P&ID (PE-DG-410-174-A001) (minimum) and system requirement.
18) Chlorine absorption system for RW Chlorination & CW chlorination as per Data Sheet-A and P&ID (PE-DG-410-174-A001).
19) Online Residual chlorine analyzer -3 nos (1 of CW, 1 for RW and 1 for PW).
20) Caustic solution preparation cum recirculation tank (one number for each CW and RW).
21) Two numbers Blowers (two for each CW and RW) with accessories as specified in Data Sheet-A.
22) Chlorine gas duct as per Data Sheet-A.
23) All tanks complete with inlet and outlet connections, all fittings and appurtenances etc. as specified and as required.
24) All necessary valves and fittings for the installations with the actuators necessary for their remote operation.
25) PLC based control panel for CW Chlorination Plant and absorption system.
26) Exhaust fans and ventilation system as required.
27) Electrical scope shall be as per " Electrical scope between BHEL and Vendor".
28) All necessary drains, vents and sampling points, with valves, as specified and as required.
29) Hangers and supports as per the requirement.
30) Wrapping/coating for underground piping.
31) Start-up and commissioning spares as required.
32) All special tools necessary for proper maintenance or adjustment of the equipment packed in permanent box.
33) All necessary flanges and counter flanges to interconnect the pipes.
34) Finish paints for touch up painting of equipment's after erection at site in sealed container.
35) Initial charge of all lubricant & grease and first fill of chlorine and all chemical including initial fill of caustic.

36) Lifting and handling arrangement- Electrical hoist 3 ton capacity 1 No each for CW and RW chlorination plant with trailing cable.
37) Weighing machine (@ 3 Ton capacity digital type)-1 No each for CW and RW Chlorination plant .
38) Monitoring gadgets, instruments and equipment's required for maintenance (till PG test and plant handover).

3.0 SCOPE OF SERVICE

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

1) Erection and commissioning, unloading, storage and handling at site.
2) 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.

4.0 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 equipments being supplied under this specification shall be done by bidders.

5.0 TERMINAL POINT

a. Inlet motive water line: For CW refer Key plan (enclosed), For RW consider a) 100 meter piping distance from PT plant inlet line and b) 50 meter piping distance from Clarified water overhead tank and for PW consider 100 meter piping distance.
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.
d. Dosing point- For CW Upto the dosing point refer Key Plan (consider 200 meter piping distance minimum), for RW consider 100 meter piping distance, for PW consider 100 meter piping distance.
e. All drains: To be terminated at Common drain.

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

6.0 EXCLUSIONS

a) Service air, upto the terminal point.
b) Air-conditioning and firefighting 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.

7.0 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.
b) Approved subvendor list is enclosed elsewhere of this specification. However, any additional sub-vendor shall be subject to BHEL and Customer approval.

8.0 DESIGN/CONSTRUCTION

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

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

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

9.0 DRAWING/DOCUEMNTS 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.

a) Detailed piping and instrument or engineering P&ID for process and utility, showing all equipments, machinery, piping and instruments. All pipes should be indicated with diameter, pipe class, pipe number, fluid flowing through it as per the Employer's legend to be furnished later.
b) Detailed configuration drawings, BOMs, Data Sheets, General arrangements and cross-sectional/assembly drags, along with the manufacturer's catalogue for all the items/equipment including control & instrumentation supplied by the bidder.
c) Detailed installation drawings for all instruments and instrumentation schedule.
d) Preparation and finalization of functional write-up and detailed logic diagram, for all control system, electrical wiring and schematic drgs for the development of logic diagrams, GA and layout drgs of control panels, junction boxes, bill of material for panel drgs and terminal, chart for all the panel drgs, inter connection diagram for cabling, cable schedule, earthing layout and cable tray layout drawings..
e) Design calculation of process and mechanical design, equipments and systems. The bidder shall show, explain and prove the validity of the basis/procedures and methods used in these calculations.
f) Details civil scope drawing for all civil works.
g) Detailed piping layout drawings, pipe support drawings, complete bill of materials of the piping, valve schedule etc.
h) Submission of 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)

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

- Deviation/clarification, if any, in the BHEL format only.
- Unpriced Schedule duly filled.
- Electrical load data format (filled).
- Compliance certificate.

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

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

LIST OF SUB VENDORS (TABLE-1)

SR No.	Items	Approved Vendor	Place / Location	Remarks
1.0	Horziontal/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 & Basket Type)	Multitetex Filtration Engg Ltd.	Noida	
		Sarojini Enterprises	Kolkata	
		Otoklin Filters	Mumbai	
		BHATIA ENGINEERING CO.	Delhi	
		JAYPEE INDUSTRIES PVT. LTD.	Delhi	
		FILTERATION 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
		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	Sikrandrabad	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/C hhatral	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	
		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	
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	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	
		GIC(Gauges Bourdon)	Panvel	
17.0	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	
		SOR	USA	
		Dressor	USA	
		Delta control	UK	
		Trafag	Ranipet	
		GIC(Gauges Bourdon)	Panvel	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		Switzer	Chennai	
18.0	Level Switch (Float/Displacer)	DK Instruments	Kolkata	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		SBEM	Pune	
		Flow Star	Faridabad	
19.0	Level Indicator	Flow Star	Faridabad	
		Scientific Devices	Mumbai	
		Gauges Bourden	Panvel	
		SBEM	Pune	
		Pune Techtrol	Pune	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		DK Instruments	Kolkata	
20.0	OWS/PC	HP/Compaq /Dell/HCL/IBM/Lenovo		
21.0	Printer	HP/Cannon/Epson/Xeror/IBM/Lexmark		
22.0	UPS	HITACHI-HIREL	Gandhinagar	
		APC	Bangalore	
		Delta	Gurgaon	
		Emerson	Mumbai	
		DB Power	Pune	
		Aplab	Mumbai	
23.0	Control / Power Cable	Cords Cable	Bhiwadi	
		Radiant Cables	Hyderabad	
		PolyCab	Daman	
		KEI	Bhiwadi	
		Nicco	Kolkata	
		Ravin Cables	Pune	
		Incab	Pune	
		HVPL	Faridabad	
		Torrent cable	Nadiad	
		Havells	Alwar	
		Paramount	Khushkhera	
		SRI Ram Cables	Bhiwadi	
		Thermocables	Hyderabad	
		Torrent cable	Nadiad	
		Universal Cables	SATNA	
		Gemscab	Bhiwadi	
		Delton	Faridabad	
24.0	Battery Charger for PLC/Diesel Engine	Chloride Power	Kolkata	
		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HBL Power System	Hyderabad	
		Dubas	Bangalore	
		Caldyne	Kolkata	
25.0	Fibre Optic Cable	Birla Ericsson	Rewa	
		Finolex	Pune/Goa	
		Aksh Fibre	Bhiwadi	

26.0	Pressure Transmitter and Diff. pressure Transmitter	Emerson	USA/Pawane	
		Laxons Automation	Daman	
		YIL	Bangalore	
		Siemens	Thane	
		Fuji	China	
		Yokogawa	Japan	
		Honeywell	USA/Pune	
27.0	Level Transmitter	ABB LIMITED		
		Endress + Hauser (India) Pvt. Ltd.,		
		Moore Industries International Inc.		
		NIVO CONTROLS PVT. LTD.		
		Pune Techtrol Pvt. Ltd.		
		EMERSON PROCESS MANAGEMENT (INDIA)		
		SIEMENS LIMITED		
		SMART INSTRUMENTS LTD, BRAZIL		
		SBEM PVT. LTD.		
		Honeywell Automation India Limited		
		TOSHNIWAL INDUSTRIES PVT. LTD.,		
		V. AUTOMAT & INTRUMENTS (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	
		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 FITTING	AURA INCORPORATED	NEW DELHI	
		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)	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
34.0	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	
		K.S.INSTRUMENTS PVT.LTD.	BANGLORE	
		SUCHITRA INDUSTRIES	BANGLORE	
		SHRENIK & COMPANY,	GUJARAT	
35.0	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	

36.0	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
37.0	TEMPERATURE ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	MUMBAI	
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	GOA	
		TECHNO INSTRUMENTS	GUJARAT	
		TEMPSENS INSTRUMENT (I) PVT LTD	UDAIPUR	
		TM TECNOMATIC SPA	ITALY	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		THERMAL INSTRUMENT INDIA PVT. LTD.	MUMBAI	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
38.0	**TEMPERATURE GAUGE**	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	GOA	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGLORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
39.0	**BALL VALVE**	BDK	HUBLI	
		LEADER	JALANDHAR	
		BANKIM	KOLKATA	
		H SARKAR	KOLKATA	
		AV VALVES	AGRA	
		HAWA VALVES	MUMBAI	
		FLOW CHEM	AHMEDABAD	
		STEEL STRON VALVES	MUMBAI	
		AKAY VALVES LTD.	MUMBAI	
		AQUA VALVES PVT.LTD.	KARNATAKA	
		CRESCENT VALVES	MUMBAI	
		FISHER SANMAR LIMITED	CHENNAI	
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		KSB PUMPS LTD.	MUMBAI	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
		PEC VALVES	MUMBAI	
40.0	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	INDORE	
		YASHWANT	MIRAJ	
		GLOBETECH	HOWRAH	
41.0	DIAPHRAGM VALVE	PROCON ENGINEERES	MUMBAI	
		HAWA VALVES	MUMBAI	
		BDK VALVES	HUBLI	
		FOURESS	BANALORE	
		INERVALVE	GUJRAT	
42.0	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
43.0	PLUG VALVE	FISHER SANMAR LIMITED	CHENNAI	
		BDK	HUBLI	
		LARSEN & TOUBRO LTD.	MUMBAI	
		LEADER	JALANDHAR	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
44.0	FLANGES (SS/CS)	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		MS FITTINGS	KOLKATA	
45.0	POSITIVE DISPLACEMETN 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/PFDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
48.0	RUBBER LINING FOR PIPES/TANKS	RISHI INDUTRIES	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	
		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	PRP 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		
58.0	CHLORINE TONNER	ISGEC	YAMUNA NAGAR	
		ANUP ENGG	AHMEDABAD	
59.0	Chain pulley block	INDEF		
		BRADY		
		Lifting Equipment		
		GRIP ENGG		
		Tractel tirfor		
		REVA		
		TECHNO INDUSTRIES		
60.0	HAND PUMP (MOTOR OPERATED BARREL PUMP)	JYOTI		
		SOLVACID		
		SLEEK		
		FLUDIYNE		
		Mach Powerpoint		
61.0	SELF CONTAINED AIR BREATHING APPARATTUS	USHA FIRE SAFETY(P) LTD		
		MEDICAL ENGINEERING		
		JOSEPH LESLIE DRAGER		
		GANDHI UDYOG		
62.0	GAS MASK WITH CANNISTER	VOLTEC(INDIA)		
		JK		
		JOSEPH LESLIE DRAGER		
		MEDICAL ENGINEERING		

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.

TABLE-2

DRAWING/DOCUMENT DISTRIBUTION SCHEDULE

		TSGENCO								DCPL, KOLKATA			Equipment Vendor	PEM	BHEL site
S no.	Description	Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/KTPS	SE/ Civil KTPS	SE/E&M/ KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS			
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	2	1	1
B	Vendor Drawings														
1	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S	4+S	-
2	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1	4+S	-
3	Final and any revision thereof														
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S	4+S	-
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S	4+S	-
C.	Design Drawings														
1	Preliminary														
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S	4+S	-
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S	4+S	-
2	Released for construction														
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S	1+S	4+S
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S	1+S	4+S
3	Return marked 'As built'														
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1	1+S	4+S
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1	1+S	4+S
4	As built drawings														
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S	1+S	4+S
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S	1+S	4+S
D	Progress Report Monthly														
1	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	S	1+S
2	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1	Nil	-	-
E	Test & Inspection Reports														
1	Equipment manufacturer														
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	S	S
	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	S	S
2	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1	-	S	S
F	Instruction Manuals/Data Books														
1	Equipment manufacturer														
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	1+S	4+S
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	1+S	4+S
2	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil		
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1	S	1+S	4+S
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	1+S	4+S
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	S	1+S

S – Source, T – Transparency & Soft Copy on CD.

Note: Editable EXcell, Word and Autocad copy of applicable document shall be submitted by bidder/vendor whenever required by BHEL/Customer for review.

LIST OF MANDATORY SPARES TABLE-3

S.No.	Mandatory Spare	
1	**Spares for Horizontal Centrifugal Pumps (for each service)**	
1.1	Shaft	1 No.
1.2	Shaft Sleeve	2 Nos.
1.3	Impeller	1 No.
1.4	Impeller locking nut and bolt	4 Nos.
1.5	Impeller wear ring	4 Nos.
1.6	Casing wear ring	4 Nos.
1.7	Oil Seal	4 Nos.
1.8	Oil Deflector	3 Nos.
1.9	Oil Ring	3 Nos.
1.1	Gland Packing	400%
1.11	Lantern Ring	3 Nos.
1.12	Mech Seal Assembly	1 No.
1.13	Stationary/Carbon Packing and O" Ring for Mechanical Seal"	3 Sets
1.14	Oil Level Gauge	3 Nos.
1.15	Coupling	2 Nos.
1.16	Rubber Bush for Coupling	2 Nos.
1.17	O" Rings "	2 Sets
1.18	Suction Strainers Element	3 Nos.
1.19	Bearing for Pump Motor	2 Sets
2	**Spares for 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.
	ii) Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	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
	ii) Flaps for above NRV	2 nos. of each size
3.3	Gate/Globe/Ballvalves/plug valve/needle valve	
	i) Upto 4”	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	ii) Above 4”	1 no. each type and size.
	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.
	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	**Electrical Items**	
6.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
6.2	Cooling Fan	2No. for each type and rating of Motor
6.3	Motor Terminal Block	5No. 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 eachtype 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.
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.**

PAINTING SPECIFICATION

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

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.

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.

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

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 :

a) Surface preparation shall be done either manually or by any other approved method.

b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.

e) 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 :

a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.

b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.

d) 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.

e) 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 hume pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

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 :

a) 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.

b) 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.

c) 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 :

a) 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.

b) 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.

c) 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.

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 that 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

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 ±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

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 ASTMD 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) :

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.

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) 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.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) 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.

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.

DATA SHEET-A (FOR CW CHLORINATION WITH ABSORPTION SYSTEM)

1.0	**CHLORINE TON-CONTAINERS**	
1.1	Number	Forty Six (46) [Sixteen (16) numbers Ton Containers will be connected to manifolds and other Thirty (30) 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/cm2 (g).
1.6	Design Temperature	65^0C
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	
	a) Container valves	
	i Number	One set for each Chlorine Ton-Container.
	ii Design Standard	IS-3224 or Equivalent.
	b) Eductor Tubes	
	i Number	Two (2) numbers eductor pipes shall be provided for each, each terminating into an isolating valve.
	ii 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	One (1) chlorine automatic changeover facility with manifolds, valves, instruments & fittings.
2.0	**EVAPORATORS**	
2.1	Number	Four (4) numbers
2.2	Description for each Evaporator	
2.3	Location	Indoor.
2.4	Capacity	Not less than 160 Kg/Hr.
2.5	Type	Electrically heated constant temperature immersion water bath type.
2.6	Material of construction	
	a) Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless
	b) Bottom flange(inlet chamber)	SA 105
	c) Counter Flange	IS 2062 Gr.B
	d) Flange: Outlet Chamber	IS 2062 Gr.B
	e) Outlet Chamber Pipe	IS: 3589 2001 ERW pipe
	f) Gas outlet pipe	SA 106 Gr. B Seamless
	g) Top Flange (Inner Chamber)	SA 105
	h) Gasket	Asbestos free gasket as per ISO 14001
	i) Inner chamber pipe	SA 106 Gr. B
	j) Super heat baffle pipe	SA 106 Gr. B

	k) Base plate	IS 2062 Gr.B
	l) Inlet and outlet pipe flange	SA 105
	m) 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	
	a) Rupture Disc	
	i Number	One (1) for each Evaporator.
	ii Type	Bellow/Diaphragm type with local facility for adjustment of set point.
	iii Size	Suitable.
	iv Allowable Pressure	28 kg/cm^2 (approx)
	v Material of construction	Body – Silver coated Carbon Steel.
	b) Expansion Chamber	
	i Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
	ii Size	Bidder need to specify
	iii Thickness	Sch 80
	iv Design code	ASME SEC VIII Div 1
	v Fluid Handled	Chlorine Gas/ Chlorine Liquid
	vi Design Pressure	40 Kg/cm^2 (g).
	vii Radiography	100% on all butt weld joints
	viii Hydro Test Pressure	60 Kg/cm^2 (g).
	c) Heating element.	
	i Number/ Unit	As per manufacturer standard
	ii Capacity	As per manufacturer standard
	iii Type	Immersion type, 3-phase, 415 V, 50 Hz.
	iv MOC	SS 304 Coil Body MS IS: 2062 Gr. B
	d) Pressure Relief Valve	
	i Number	One (1) for each stream.
	ii Type	Screwed end full port.
	iii Size	Suitable
	iv Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
	v Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
	vi Body Test Pressure	60 Kg/cm^2.
	e) Water Chamber	
	i Size and thickness	As per manufacturer standard
	ii Insulation Material	Glass Wool Aluminum Sheet
	iii Temp of water bath	80 ^{0}C
	iv Fluid handled	Water
	v Design pressure	Water
	vi Hydro-test pressure	Water fill test
	vii Joint efficiency	0.7
	viii Radiography	Nil
	ix Corrosion allowance	1.5 mm

	f) Electrically interlocked shut-off valve at the gas discharge line from Evaporator	Shall be provided.
	g) Cathodic protection system	
	i Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided. with Ammeter
	ii Purpose	Shall be provided. to protect Water Bath and outside of Evaporator.
	h) 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
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	
	a) Body	Carbon Steel as per ASTM A 105.
	b) Diaphragm	PTFE.
	c) 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	Four (4) numbers
5.2	Description for each Chlorinator	
5.3	Location	Indoor.
5.4	Capacity, Kg/hr	160 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	
	d) Vacuum Stabilizing valve	
	i Number	1 number
	ii Type	Diaphragm Type
	iii Material	
	i. Body	PVC
	ii. Diaphragm	PTFE

	iii. Seat	PTFE
	iv. Spring	Hastealloy ‘C’
	v. Trim & Fasteners	Monel
	e) Flow rate valve	
	i Number/ Unit	1 number
	ii Type	Manual
	iii Material	
	a. Body	PVC
	b. Plug	Silver
	c. Seat	PTFE
	d. Spring / ‘O’ ring	Hastealloy ‘C’
	f) Pressure relief valve	
	a. Number/Unit	1 number
	b. Type	Spring loaded type
	c. Material	
	i. Body	PVC
	ii. Loading Bolt	PVC
	iii. Seat	PTFE
	iv. Spring	Hastealloy ‘C’
	v. Trim & Fasteners	Monel
	vi. ‘O’ ring	Viton
	g) Vacuum regulating valve	Shall be provided..
	a. Number/Unit	1 number/ unit with each set
	b. Type	Diaphragm type
	c. Material	
	i. Body	Ebonite
	ii. Diaphragm and seat	PTFE
	iii. Spring	Hastealloy ‘C’
	iv. Trim	Monel
	v. Fasteners	Monel
	h) Flow rate indicator	
	i Number/Unit	1 number
	ii Type	Rota meter
	iii Material	Borosilicate Glass & Float: PTFE
	i) Ejector with in-built check valve	
	a. Number/Unit	1 number/unit
	b. Type	Fixed type
	c. Material	
	i. Body	CI with FRP lining inside
	ii. Jet & Throat	Ebonite
	iii. Fasteners	SS304
	iv. Gasket	Neoprene rubber
	j) Porous filter at gas inlet	
	a Number	1 number

	b Material	
	i. Body	CS SA 105
	ii. Filter Media	Glass wool
	k) Vent Piping	
	i Size	As per manufacturer standard
	ii Pressure Standard	10 kg/sq.cm
	iii Total length	As required
	iv Material	PVC
	l) Drain relief valve	
	a Number/ Unit	1 number
	b Type	Spring loaded type
	c Material	
	i. Body	PVC
	ii. Diaphragm	PTFE
	iii. Spring	Hastealloy 'C'
	iv. Trim & Fasteners/ 'O' rings	Monel
	m) Injector	Shall be provided..
	n) Chlorine Detector	Shall be provided.
	o) Diffuser	Shall be provided.

6.0	**CHLORINATOR WATER SUPPLY BOOSTER PUMPS**	
6.1	Number	Four (4) 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 ^{o}C	60 maximum.
6.13	Rated Capacity, m^3/hr	To suit the requirement of the each Chlorinator.
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	
	a) Casing	CI as per IS 210 FG 260
	b) Impeller	SS 316
	c) Shaft	EN 8 as per BS 970
	d) Stuffing Box and Gland	C.I.
	e) Gland Packing	Graphite free Teflon.
	f) Common Base plate	Fabricated Steel as per IS 2062.
	g) 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.	
	a) Basket Strainers	

	i. Numbers	Eight (8) numbers
	ii.Capacity	100% each.
	iii.Location	At suction of Strainer Assembly.
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	
	a) Number	One (1) numbers
	b) Type	Electrically operated.
	c) Duty	To handle Chlorine Ton-Container.
	d) Safe working load	3000 kg maximum.
	Weighting Scale	
	a) Number	One (1) numbers
	b) Type	Platform Dial Type.
	c) Duty	To handle Chlorine Ton-Container.
	d) Range	0 - 3000 kg
9.0	**SAFETY AND SUPERVISORY EQUIPMENT**	
9.1	Gas Mask and Oxygen Breathing equipment along with Breathing Apparatus	
	a) Number	Two (2) numbers
	b) Capacity	One (1) hour minimum.
	c) Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.
9.2	Canister Type Breathing Apparatus	
	a) Number	Two (2) numbers
	b) 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	
	a) Number	Four (4) numbers
	Ammonia bottles	
	a) Number	Four (4) numbers
	b) Capacity	500 ml each.
	c) Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 degree Be) to detect leakage of chlorine.
9.4	Moisture Absorbing Breathing Bottles	
	a) Number	One (1) number for each Chlorine Ton Container.
	b) Capacity	Two (2) 2000 ml silica gel for each bottle.
	c) 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.
	d) Material of construction	Glass body.
9.5	Chlorine Residual Test Kit	
	a) Number	Two (2) numbers
	b) Type	Colorimetric Test Comparator
	c) 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**	

	a) Number	Eleven (11) numbers [Four for connected tonners, five for storage tonners and two at chlorinator room] each having two sensors.
	b) Type	Electronic type.
	c) Alarm	Shall be provided. in case of leakage of Chlorine.
	d) Interlock	Shall be provided.
10.1	Emergency Kit	
	a) Number	Four (4) numbers
	b) Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
10.2	Weather Cock	
	a) Number	One (1) number
10.3	Safety Helmet	
	a) Number	Two (2) numbers
10.4	Goggles	
	a) Number	Two (2) numbers
10.5	Rubber Boots	
	a) Number	Two (2) numbers
10.6	Gloves	
	a) Number	Two (2) numbers
10.7	Colored Vest	
	a) 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.
11.14	Rated speed (RPM)	1500 (Sync.) maximum.
11.15	Voltage, Phase & Frequency (± % Variation)	415 V (±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 ^{0}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.
12.15	Material of construction	
	a) Casing	Polypropylene or FRP.
	b) 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 ^{0}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	
	a) Casing	Polypropylene or FRP.
	b) Impeller	Polypropylene or FRP.
	c) Shaft	EN-8 to BS-970.
	d) Common Base plate	Fabricated Steel as per IS 2062.
	e) Coupling Guard	Carbon Steel.
	f) 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, 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	
	a) Internal	Not required.
	b) External	Not required.
	Provided with accessories as follows:	
	a) Dissolving Basket	Not required.
	b) Inlet	Shall be provided..
	c) Outlet	Shall be provided..
	d) Drain	Shall be provided..
	e) Overflow	Not required.
	f) Vent	Shall be provided..
	g) Manhole	Shall be provided..
	h) Rain protection	Necessary arrangement in order to 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.
	a) Agitator along with drive motor and other accessories	Shall be provided.. All wetted parts of the agitator shall be of SS-316 construction
	b) Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.
	c) Inlet	Shall be provided.
	d) Outlet	Shall be provided.
	e) Drain	Shall be provided.
	f) Overflow	Shall be provided.
	g) Vent	Shall be provided.
	h) Manhole	Shall be provided.
	i) Sample Collection Point	Shall be provided.
	j) Isolation Gates	Not required.
	k) Platform complete with handrails for operation	Shall be provided.

	l) 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.
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	
	a) Casing	Polypropylene
	b) Impeller	Polypropylene
	c) Shaft	EN-8 as per BS-970 / SS 316.
	d) Mechanical Seal	SS-316.
	e) Common Base plate	Fabricated Steel as per IS 2062.
	f) 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.
15.29	Trip interlock	Shall be provided.

DATA SHEET-A (FOR RW CHLORINATION WITH ABSORPTION SYSTEM)

1.0	**CHLORINE TON-CONTAINERS**	
1.1	Type of container	Chlorine Ton Container
1.2	Number required	Twelve (12) [Four (4) will be connected to manifold and other Eight (8) 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/cm2 (g).
1.7	Design Temperature	65^0C
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	
	a) Container valves	
	Number	One set for each Chlorine Ton-Container.
	Design Standard	IS-3224 or Equivalent.
	b) 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
1.14	Instrumentation and Control	Shall be provided as per the requirements of the Bid Specification.
1.15	Changeover Module	One (1) chlorine automatic changeover facility with manifolds, valves, instruments & fittings.
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
2.3.3	Filter Media	Spun Fibre Glass Wool
3.0	**PRESSURE REGULATING VALVE**	
3.1	Number	One (1) number for each stream
3.2	Type	Spring loaded silver diaphragm
3.3	Description for each Valve	
3.4	Material of construction	
3.4.1	Lower Body	EN8
3.4.2	Upper Body	IS 210 FG0200
3.4.3	Diaphragm	Teflon
3.4.4	Main spring	Hastealloy Silver Plated
3.4.5	Loading spring	Carbon Steel
3.4.6	Valve seat	Teflon
3.4.7	Valve plug	Silver
3.5	Size	
3.6	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.
3.7	Spring range	0-10 Kg/cm2.

3.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.
3.9	Body Test Pressure	60 Kg/cm2.
4.0	**CHLORINATORS**	
4.1	Number	Two (2) (one working + one standby)
4.2	Description for each Chlorinator	
4.3	Location	Indoor.
4.4	Design Standard	IS: 10553 Part 2
4.5	Capacity Kg/hr	25
4.6	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self colored, resistant to corrosion by chlorine gas and chlorinated water solution.
4.7	Accessories	
4.7.1	a) Vacuum Stabilizing valve	
I	Number	1 number
Ii	Type	Diaphragm Type
Iii	Material	
Iv	Body	PVC
V	Diaphragm	PTFE
Vi	Seat	PTFE
Vii	Spring	Hastealloy ‘C’
viii	Trim & Fasteners	Monel
4.7.2	b) Flow rate valve	
I	Number/ Unit	1 number
Ii	Type	Manual
Iii	Material	
Iv	Body	PVC
V	Plug	Silver
Vi	Seat	PTFE
vii	Spring / ‘O’ ring	Viton
4.7.3	c) Pressure relief valve	
I	Number/Unit	1 number
Ii	Type	Spring loaded type
Iii	Material	
Iv	Body	PVC
V	Loading Bolt	PVC
Vi	Seat	PTFE
Vii	Spring	Hastealloy ‘C’
Viii	Trim & Fasteners	Monel
ix	‘O’ ring	Viton
4.7.4	Vacuum regulating valve	
I	Number/Unit	1 number/ unit with each set
Ii	Type	Diaphragm type
Iii	Material	
Iv	Body	Ebonite
V	Trim	Monel
Vi	Fasteners	Monel
4.7.5	Flow rate indicator	
I	Number/Unit	1 number
Ii	Type	Rota meter
Iii	Material	Borosilicate Glass & Float: PTFE
4.7.6	Ejector with in-built check valve	
I	Number/Unit	1 number/unit
Ii	Type	Fixed type
Iii	Material	
iv	Body	Ebonite
4.7.7	Porous filter at gas inlet	
I	Number	1 number
Ii	Material	
Iii	Body	Monel
iv	Filter Media	Spun Fibre Glass Wool
4.7.8	Vent Piping	

I	Size	As per system requirment
Ii	Pressure Standard	10 kg/sq.cm
Iii	Total length	As required
iv	Material	PVC
4.7.9	Drain relief valve	
I	Number/ Unit	1 number
Ii	Type	Spring loaded type
Iii	Material	
Iv	Body	PVC
V	Diaphragm	PTFE
Vi	Trim & Fasteners/ 'O' rings	Viton
Vii	Injector	Shall be provided..
Viii	Chlorine Detector	Shall be provided.
ix	Diffuser	Shall be provided.
5.0	**CHLORINATOR WATER SUPPLY BOOSTER PUMPS**	
5.1	Number	Two (2) [One in operation and other as stand-by].
5.2	Description for each Pump	
5.3	Type	Horizontal Centrifugal Non Clog type
5.4	Location	Indoor.
5.5	Fluid to be handled	Service Water.
5.6	Type of Impeller	Semi Open or Open
5.7	Design standard	As per IS-5659 & IS-5120.
5.8	Service temperature, in oC	60 maximum.
5.9	Duty	Continuous and to be suitable for parallel operation.
5.10	Suction Condition	Flooded.
5.11	Range of operation	20 % - 120 %.
5.12	Rated Capacity, m3/hr	To suit the requirement of the each Chlorinator.
5.13	Tentative head to be developed at rated capacity, MLC	Each pump shall have adequate head to meet the requirements of respective Chlorination System
5.14	Pump speed (RPM)	1500 preferred.
5.15	Material of construction	
	a) Casing	CI as per IS 210 FG 260
	b) Impeller	Bronze as per IS 318
	c) Shaft	EN 8 as per BS 970
	d) Shaft sleeve	SS 410
	e) Stuffing Box and Gland	C.I.
5.16	Gland Packing	Graphite free Teflon.
5.17	Common Base plate	Fabricated Steel as per IS 2062.
	h) Nuts and bolts	SS-316
5.18	Type of drive	Electrical Motor
5.19	Rated speed (RPM)	1500 (Sync.) maximum.
5.20	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), Phase, 50 HZ (+3 to – 5%).
5.21	Type of coupling between Pump & Motor	Flexible Spacer.
5.22	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).
5.23	Start and stop facility provided both at local and panel	Shall be provided..
5.24	Trip interlock	
5.25	Accessories Shall be provided.	
5.26	Basket Strainers	
5.27	Number	Two (2) numbers
5.28	Capacity	100% each.
5.29	Location	At suction and discharge of Strainer Assembly.
6.0	**CHLORINATED WATER DIFFUSER AND MIXING SYSTEM**	
6.1	Location for injection of chlorinated water	Stilling Chamber
6.2	Device for injection of chlorinated water	Diffusers.
6.3	Location of diffusers	Well below (minimum 300 mm) water level.
6.4	Material of construction	Schedule 80 CPVC
6.5	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
6.6	Other accessories	All supporting arrangement for willing with inserts like "U" clamps.
7.0	**LIFTING AND HANDLING DEVICES**	

7.1	Monorail hoist	
7.2	Number	One (1) number each of 3000 kg capacity.
7.3	Type	Electrically operated.
7.4	Duty	To handle Chlorine Ton-Container.
7.5	Accessories	Lifting bar with load indicator and Monorail.
8.0	**SAFETY AND SUPERVISORY EQUIPMENT**	
i.	Ammonia bottles	
	Number	Two (2) numbers
	Capacity	500 ml each.
	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 deg. Be) to detect leakage of chlorine.
ii.	Residual Chlorine Analyzer	
	Number	Two (2) numbers
	Type	Colorimetric Test Comparator
	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.
iii.	Chlorine Leak Detector	
	Number	Four (4) numbers (One (1) for connected Chlorine Ton-Container, two for storage tonner area and one at chlorinator room) each of two sensors.
	Type	Electronic type.
	Alarm	Shall be provided. in case of leakage of Chlorine.
	Interlock	Shall be provided.
iv.	Emergency Kit	
	Number	Two (2) numbers
	Breathing Apparatus	Four (4) numbers
	Oxygen Cylinders	Four (4) numbers
	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
v.	Weather Cock	
	Number	One (1) number
vi.	Safety shower	
	a) Number	One (1) number
vii.	Moisture Absorbing Breathing Apparatus	
	a) Number	One (1)
viii.	Safety Helmet	
	a) Number	Two (2) numbers
ix.	Goggles	
	a) Number	Two (2) numbers
x.	Rubber Boots	
	a) Number	Two (2) numbers
xi.	Gloves	
	a) Number	Two (2) numbers
xii.	Colored Vest	
	a) Number	Two (2) numbers
	LEAKED CHLORINE ABSORPTION SYSTEM	
9.0	**EXHAUST FANS**	
9.1	Number	As per system requirement.
9.2	Description for each Fan	
9.3	Location	Indoor.
9.4	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
9.5	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to suction of Blowers of Chlorine Absorption System.
9.6	Duty	Intermittent.
9.7	Type	Bifurcated type.
9.8	Rated Capacity	As per system requirement.
9.9	Head to be developed at rated capacity	As per system requirement.
9.10	Material of construction	Polypropylene or FRP.
9.11	Type of drive	Electrical Motor
9.12	Rated speed (RPM)	1500 (Sync.) maximum.

9.13	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to –5%).
9.14	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).
9.15	Painting for complete set of Fan & Motor	
9.16	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
9.17	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.
9.18	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.
9.19	**BLOWERS OF CHLORINE ABSORPTION SYSTEM**	
9.20	Number	Two (2) number (1W+1S)
10.0	Description for each Blower	
10.1	Location	Outdoor.
10.2	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.
10.3	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to Chlorine Absorption Tower.
10.4	Duty	Intermittent.
10.5	Type of Blower	Horizontal, rotary oil free, motor driven, preferably bifurcated type.
10.6	Type of Impeller	Fan Blade.
10.7	Design standard	As per Bid Specification.
10.8	Service temperature, in 0C	60 maximum.
10.9	Rated Capacity	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container, within one hour (maximum).
10.10	Permissible tolerance in rated capacity, in %	As per IS-4894.
10.11	Head to be developed at rated capacity	As per system requirement.
10.12	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.
10.13	Material of construction	
10.14	Casing	Polypropylene or FRP.
10.15	Impeller	Polypropylene or FRP.
	Shaft	EN-8 to BS-970.
	Common Base plate	Fabricated Steel as per IS 2062.
10.16	Coupling Guard	Carbon Steel.
10.17	Nuts and bolts	Haste Alloy C
10.18	Type of drive	Electrical Motor
10.19	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.
10.20	Rated speed (RPM)	1500 (Sync.) maximum.
10.21	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to –5%).
10.22	Type of coupling between Blower & Motor	Direct.
10.23	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).
10.24	Painting for complete set of Blower & Motor	
10.25	Tests and Inspection	
10.26	Material Test required for	Casing, Impeller and Shaft.
10.27	Hydro-test	As per IS-4894.
10.28	Dynamic Balancing Test	Shall be provided..
	Performance Test	
	Test Code	As per IS-4894.
	Tests to be done for determination of	Head-Capacity Curve and BHP-Capacity Curve.

	Test to be carried out	On prototype model at rated speed.
	Test for satisfactory operation of Blower at site	Required.
	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
10.29	Start interlock	Shall be provided..
10.30	Accessories Shall be provided.	Common Base Frame, Suction Filter, Suction Silencer, Discharge Silencer, Discharge Damper.
11.0	**CHLORINE ABSORPTION TOWER**	
11.1	Numbers Shall be provided.	One (1).
11.2	Description	
11.3	Type	Vertical Cylindrical Packed Absorption Tower. The Absorption Tower shall be mounted on the Caustic Solution Preparation cum Recirculation Tank (Described hereinafter).
11.4	Type of fluid to be handled	20% w/w (maximum) caustic solution and chlorine gas.
11.5	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).
11.6	Caustic Flow Rate, m3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
11.7	Cl2 content at outlet of Chlorine Absorption Tower	Free residual chlorine shall not be more than 0.1 ppm.
11.8	Size	Bidder to indicate.
11.9	Design Pressure, Kg/cm2.g	As per system requirement.
11.10	Design Temperature, °C	80
11.11	Design Code	As per system requirement.
11.12	Code for Tests and Inspections	As per system requirement.
11.13	Material of Construction	FRP with PP lining from inside of minimum 3 mm thick or CPVC
11.14	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
11.15	Provided with accessories as follows:	
A	Dissolving Basket	Not required.
B	Inlet	Shall be provided.
C	Outlet	Shall be provided.
D	Drain	Shall be provided.
E	Overflow	Not required.
F	Vent	Shall be provided.
G	Manhole	Shall be provided.
H	Rain protection	Necessary arrangement in order to prevent rain water entry needs Shall be provided.
12.0	**CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION TANK**	
12.1	Numbers Shall be provided.	One (1).
12.2	Description	
12.3	Type	Vertical cylindrical with flat bottom.
12.4	Type of fluid to be handled	20% w/w (maximum) caustic solution.
12.5	Effective capacity, in m3	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container +20% margin
12.6	Minimum Free Board, in mm	300.
12.7	Design Temperature, °C	80
12.8	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
12.9	Protection	
	a) Internal	Natural rubber [thickness - 4.5 mm in three (3) layers, shore hardness 60o – 70o A], suitable to withstand the design temperature.
12.10	Provided with accessories as follows:	
a	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.

b	Inlet	Shall be provided.
C	Outlet	Shall be provided.
D	Drain	Shall be provided.
E	Overflow	Shall be provided.
F	Vent	Shall be provided.
G	Manhole	Shall be provided.
H	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.
I	Sample Collection Point	Shall be provided..
J	Isolation Gates	Not required.
K	Platform complete with handrails for operation	Shall be provided..
L	Staircase	Shall be provided. for access from finished ground level to top of Operation Platform.
M	Level gauge glass	One (1) number Shall be provided..
N	Instrumentation and Control	To be given as per the requirements of the Bid Specification
13.0	**CAUSTIC SOLUTION PREPARATION-CUM- RECIRCULATION PUMPS**	
13.1	Number	Two (2) [One (1) number to be under operation and the other as standby].
13.2	Description for each Pump	
13.3	Location	Outdoor.
13.4	Fluid to be handled	20% w/w (maximum) caustic solution.
13.5	Service	To absorb chlorine leaked from Chlorine Ton Containers.
13.6	Duty	Continuous and to be suitable for parallel operation.
13.7	Type of Pump	Horizontal Centrifugal Non Clog type
13.8	Type of Impeller	Semi Open or Open
13.9	Design standard	As per IS-5659 & IS-5120.
13.10	Service temperature, in degree C	80 maximum.
13.11	Rated Capacity, in m3/hr	To be indicated by the Bidder
13.12	Permissible tolerance in rated capacity, in %	As per IS-5659.
13.13	Range of operation	20 % - 120 %.
13.14	Suction Condition	Flooded.
13.15	Head to be developed at rated capacity	To be finalized during Detailed Engineering stage.
13.16	Shut Off Head	To be suitable for stable operation at rated duty point.
13.17	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659.
13.18	Material of construction	PP
a	Casing	SS-316.
B	Impeller	SS-316.
C	Shaft	EN-8 to BS-970.
D	Mechanical Seal	SS-316.
E	Common Base plate	Fabricated Steel as per IS 2062.
F	Nuts and bolts	SS-316
G	Type of drive	Electrical Motor
H	Rated speed (RPM)	1500 (Sync.) maximum.
I	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to –5%).
J	Type of coupling between Pump & Motor	Flexible Spacer.
K	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).
L	Suction Strainer along with flushing connection	Shall be provided..
M	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
n	Trip interlock	Shall be provided..
14.0	**CHLORINATED WATER DIFFUSER AND MIXING SYSTEM**	
14.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
14.2	Device for injection of chlorinated water	Diffusers.
14.3	Location of diffusers	Well below minimum water level.
14.4	Material of construction	CPVC SCH80
14.5	Number	Require number to achieve proper mixing.
14.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec

DATA SHEET-A (FOR PW CHLORINATION SYSTEM)

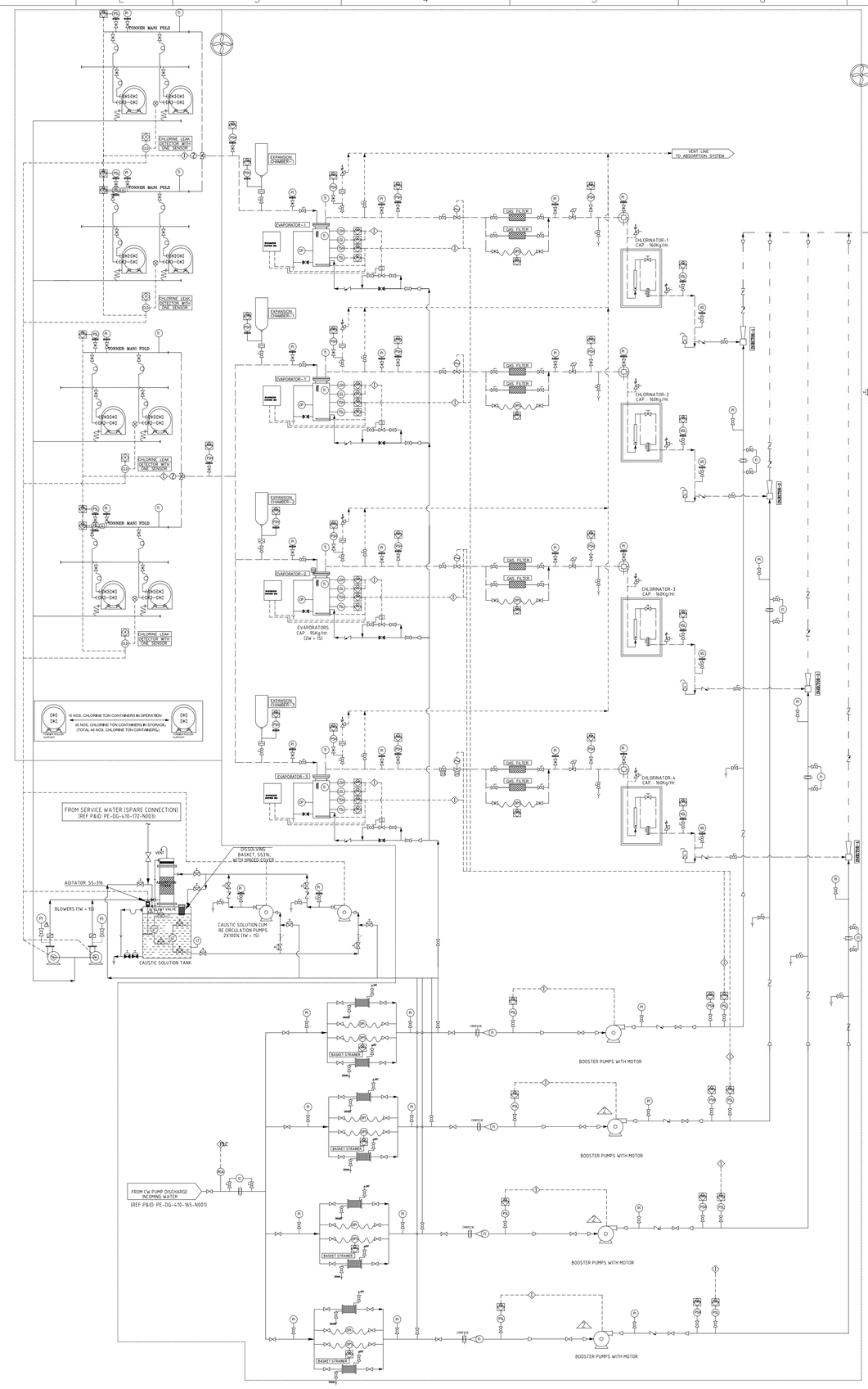
1.0	**CHLORINE CYLINDER**	
1.1	Number	Two (2).
1.2	Description for each Chlorine Cylinder	
1.3	Capacity	Not less than 100 Kg.
1.4	Material of construction	ASTM-A-285 Gr.C/ASTM A 515 Gr.70.
1.5	Design Temperature	65 deg C
1.6	Design pressure	19.9 Kg/cm2 (g).
1.7	Corrosion allowance	1.5 mm (minimum).
1.8	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	
	a) Cylinder Valve valves	
I	Number	One set for each Chlorine Cylinder
ii	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	
I	Capacity	100 % for each Chlorinator.
Ii	Material of construction	Carbon steel SA 105
iii	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/cm2 at 500C
3.4	Design Pressure	19.9
3.5	Service	Dry Chlorine Gas
3.6	Location	For Strainer Isolation
I	Material of construction	
Ii	Body	ASTM A 216 Gr. WCB
Iii	Ball	Monel
Iv	Stem	Monel
V	Seat	PTFE
vi	Code for Test and Inspection	BS 6755 Pt.I
4.0	**CHLORINE GAS PIPE LINE**	
A)	Material of Construction	PVC (sch 80)
5.0	**PRESSURE REGULATING VALVE**	
A)	Number	One (1) for each stream.
B)	Description for each Valve	
i	Material of construction	
	a) Body	Carbon Steel as per ASTM A 105.
	b) Diaphragm	PTFE
iv	c) Trim	Monel
v	Size	
vi	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.
vii	Spring range	0-10 Kg/cm^2.
viii	Flange	Ends shall be flanged and flange sealing done by lead gasket.
ix	Body Test Pressure	60 Kg/cm^2.

6.0	**CHLORINATOR**	
A)	Number	Two (2) [One in operation and other as stand-by].
B)	Description for each Chlorinator	
I	Location	Indoor.
Ii	Design Standard	IS: 10553 Part 2
Iii	Capacity	100 gm /hr.
Iv	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self-colored, resistant to corrosion by chlorine gas and chlorinated water solution.
v	Accessories	
	a) Inlet Chlorine Pressure Reducing Valve.	Shall be provided..
	b) Chlorine Feed Rate Adjuster	Shall be provided..
	c) Automatic pressure vacuum relief valve	Shall be provided..
	d) Vacuum Controller	
	e) Number	One (1) for each Chlorinator.
	f) Material	ABS (Acryl nitrile Butadiene Styrene) Plastic Chamber and Teflon diaphragm with inlet valve having tantalum seat and special alloy spring of tantalum.
	g) Injector	
	Number	One (1) for each Chlorinator.
	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.
	h) Diffuser	Shall be provided..
7.0	**CHLORINATOR WATER BOOSTER PUMPS**	
A)	Number	Two (2) [One in operation and other as stand-by].
B)	Description for each Pump	
i.	Location	Indoor.
ii.	Fluid to be handled	Filtered Water
iii.	Service	To supply motive water for Chlorinator.
iv.	Duty	Intermittent and suitable for parallel operation
v.	Type of Pump	Horizontal Centrifugal Non Clog type
vi.	Type of Impeller	Semi Open or Open
vii.	Design standard	As per IS-5659 & IS-5120.
viii.	Service temperature, in deg. C	60 maximum.
ix.	Rated Capacity, in m3/hr	Bidder need to specify
x.	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
xi.	Range of operation	20 % - 120 %.
xii.	Suction Condition	Flooded.
xiii.	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).
xiv.	Shut Off Head	To be suitable for stable operation at rated duty point.
xv.	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.
xvi.	Material of construction	
	a) Casing	CI as per IS 210 FG 260
	b) Impeller	Bronze as per IS 318
	c) Shaft	EN 8 as per BS 970
	d) Stuffing Box and Gland	C.I.
	e) Gland Packing	Graphite free Teflon.
	f) Common Base plate	Fabricated Steel as per IS 2062.
	g) Nuts and bolts	SS-316
xvii.	Type of drive	Electrical Motor
xviii.	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).
xix.	Painting for complete set of Pump & Motor	Refer painting specification.
xx.	Tests and Inspection	
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
	b) Hydro-test	As per IS-5118.
	c) Dynamic Balancing Test	Shall be provided.
xxi.	Performance Test	
	a) Test Code	Hydraulic Institute Standard.
	b) Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency-Capacity Curve and NPSH-Capacity Curve.
	c) Test to be carried out	On prototype model at rated speed.
	d) Test for satisfactory operation of pump at site	Required.
xxii.	Instruments along with alarms, interlocks and accessories	Shall be provided. as per the requirements of the Tender Specification and Drawings, enclosed with it.
xxiii.	Accessories Shall be provided.	Two (2) numbers Suction Strainers at upstream of Suction Header - common for all the Pumps.
xxiv.	Start and stop facility provided both at local and panel	Shall be provided.
xxv.	Trip interlock	Shall be provided.
xxvi.	Accessories Shall be provided.	
	a) Suction Strainers (basket type)	Two (2) numbers at upstream of Suction Header - common for all the Pumps as addressed earlier.
xxvii.	Chlorine Water Dosing	At Potable water sump
7.0	**CHLORINATED WATER DIFFUSER AND MIXING SYSTEM (INJECTION QUILL)**	
7.1	Location for injection of chlorinated water	Cooling Tower Basin and other strategic points.
7.2	Device for injection of chlorinated water	Injection quill.
7.3	Location of diffusers	Well below minimum water level.
7.4	Material of construction	CPVC SCH80
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	**Safety equipment**	
A)	Chlorine leak detector	One number with two sensor.

P&ID

NOTE-1: .THIS P&ID IS FOR TENDER PURPOSE ONLY, FINAL P&ID SHALL BE SUBMITTED DURING DETAIL ENGINEERING.



PIPING:		
Chlorine liquid handling pipe:		
i)Material:		
a) Tubing	Annealed Cu as per ASTM B 88 Cadmium plated of type 'K'.	
b) Nipple	Silver coated Cu nipple.	
ii)Hydro test pressure for tubing	40 Kg/cm2 (g).	
Pipe handling chlorine:		
MATERIAL OF CONSTRUCTION:	DRY LIQUID CHLORINE	CHLORINATED WATER SERVICE.
PIPE	CARBON STEEL TO ASTM A 106 GR B SEAMLESS SCH. 80.	PVC SCH 80
FITTINGS	CARBON STEEL ASTM A 105 GR I, 2000 RATING.	PVC
FLANGES	CARBON STEEL TO ASTM A 181 GRI, CLASS 300.	--

WATER LINE
CHLORINE GAS LINE
CHLORINE LIQUID LINE

L E G E N D

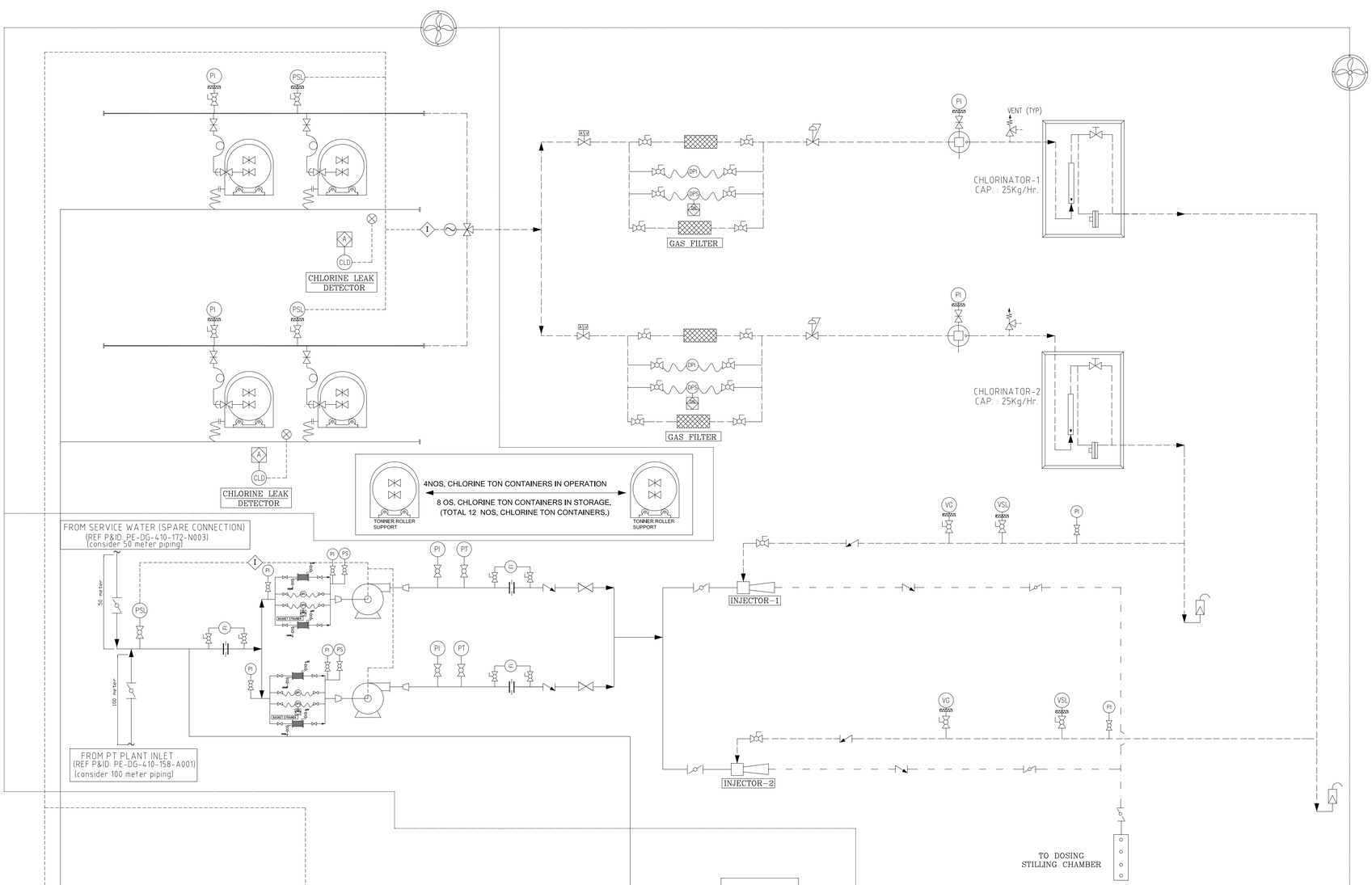
	NEEDLE VALVE (IS 3224/BS 341)		DIAPHRAGM SEAL
	BALL VALVE		FLANGE CONNECTION
	DIAPHRAM VALVE	PS	PRESSURE SWITCH
	GATE VALVE	WTI	WATER TEMPERATURE INDICATOR
	SAFETY RELIEF VALVE	PI	PRESSURE INDICATOR
	NON-RETURN VALVE	VI	VACUUM INDICATOR
	MOTOR OPERATED PRESSURE REDUCING VALVE	LI	LEVEL INDICATOR
	PRESSURE REDUCING VALVE	CTI	CONTACT TYPE TEMP. INDICATOR
	BUTTERFLY VALVE (OPEN)	TS	TEMPERATURE SWITCH
	BUTTERFLY VALVE (CLOSED)	CPI	CONTACT TYPE PRESSURE INDICATOR
	Y-TYPE STRAINER	H A	ALARM HIGH
	3-WAY BALL VALVE	L A	ALARM LOW
	SOLENOID VALVE	AM	AMMETER
	RUPTURE DISC		ELECTRIC SIGNAL
VRV	VACUUM REGULATING VALVE		GAS FILTER
DRV	DRAIN RELIEF VALVE		VALVES AS PER RECOMMENDATIONS OF CHLORINE INSTITUTE IS3224/BS 341.
VSV	VACUUM STABILIZING VALVE	GPI	GAS PRESSURE INDICATOR
RV	RATE VALVE	GTI	GAS TEMPERATURE INDICATOR
GFI	GAS FLOW INDICATOR (ROTAMETER)	CTS	TEMPERATURE CONTROL SWITCH
PVR	PRESSURE VACUUM RELIEF	VS	VACCUUM SWITCH
DPR	DIFFERENTIAL PRESSURE REGULATOR	DPS	DIFFERENTIAL PRESSURE SWITCH
ET	EXPANSION TANK	DPI	DIFFERENTIAL PRESSURE INDICATOR
H	HEATER		BASKET STRAINER
LD	LEAK DETECTOR	RCA	RESIDUAL CHLORINE ANALYZER
ASV	AUTO SHUT OFF VALVE		

CW CHLORINATION

OWNER	TELANGANA STATE POWER GENERATION CORPORATION LIMITED.				
PROJECT	1X800 MW KOTHAGUDEM TPS.				
BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT NOIDA	DEPT CODE MAX		NAME	SIGN	DATE
		DRN	F SAHA		
		DESN	J PAL		
		CHD	K KESHAV		
		APPD	PK		
TITLE: P&ID FOR CW CHLORINATION PLANT AND ABSORPTION SYSTEM.					
DEPT.	SCALE	DRAWING NO. PE-DG-410-174-A001			
SIGN					
DATE		SHEET 1 OF 3		REV 1	

TECH SPEC NO.
PE-TS-410-174-A001, REV-01

NOTE–1: THIS P&ID IS FOR TENDER PURPOSE ONLY, FINAL P&ID SHALL BE SUBMITTED DURING DETAIL ENGINEERING.



PIPING:		
Chlorine liquid handling pipe:		
i)Material:		
a) Tubing	Annealed Cu as per ASTM B 88 Cadmium plated of type 'K'.	
b) Nipple	Silver coated Cu nipple.	
ii)Hydro test pressure for tubing	40 Kg/cm2 (g).	
Pipe handling chlorine:		
MATERIAL OF CONSTRUCTION:	DRY LIQUID CHLORINE	CHLORINATED WATER SERVICE.
PIPE	CARBON STEEL TO ASTM A 106 GR B SEAMLESS SCH. 80.	PVC SCH 80
FITTINGS	CARBON STEEL ASTM A 105 GR I, 2000 RATING.	PVC
FLANGES	CARBON STEEL TO ASTM A 181 GRI, CLASS 300.	--

WATER LINE

CHLORINE GAS LINE

CHLORINE LIQUID LINE

LEGEND

	NEEDLE VALVE (IS 3224/BS 341)		DIAPHRAGM SEAL
	BALL VALVE		FLANGE CONNECTION
	DIAPHRAGM VALVE	PS	PRESSURE SWITCH
	GATE VALVE	WTI	WATER TEMPERATURE INDICATOR
	SAFETY RELIEF VALVE	PI	PRESSURE INDICATOR
	NON–RETURN VALVE	VI	VACUUM INDICATOR
	MOTOR OPERATED PRESSURE REDUCING VALVE	LI	LEVEL INDICATOR
	PRESSURE REDUCING VALVE	CTI	CONTACT TYPE TEMP. INDICATOR
	BUTTERFLY VALVE (OPEN)	TS	TEMPERATURE SWITCH
	BUTTERFLY VALVE (CLOSED)	CPI	CONTACT TYPE PRESSURE INDICATOR
	Y–TYPE STRAINER	H A	ALARM HIGH
	3–WAY BALL VALVE	L A	ALARM LOW
S	SOLENOID VALVE	AM	AMMETER
	RUPTURE DISC		ELECTRIC SIGNAL
VRV	VACUUM REGULATING VALVE		GAS FILTER
DRV	DRAIN RELIEF VALVE		VALVES AS PER RECOMMENDATIONS OF CHLORINE INSTITUTE IS3224/BS 341.
VSV	VACUUM STABILIZING VALVE	GPI	GAS PRESSURE INDICATOR
RV	RATE VALVE	GTI	GAS TEMPERATURE INDICATOR
GFI	GAS FLOW INDICATOR (ROTAMETER)	CTS	TEMPERATURE CONTROL SWITCH
PVR	PRESSURE VACUUM RELIEF	VS	VACCUUM SWITCH
DPR	DIFFERENTIAL PRESSURE REGULATOR	DPS	DIFFERENTIAL PRESSURE SWITCH
ET	EXPANSION TANK	DPI	DIFFERENTIAL PRESSURE INDICATOR
H	HEATER		BASKET STRAINER
LD	LEAK DETECTOR	RCA	RESIDUAL CHLORINE ANALYZER
ASV	AUTO SHUT OFF VALVE		

RAW WATER CHLORINATION

RAW WATER CHLORINATION

OWNER	TELANGANA STATE POWER GENERATION CORPORATION LIMITED.
PROJECT	1X800 MW KOTHAGUDEM TPS.
	BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT NOIDA
TITLE	P&ID FOR RW CHLORINATION PLANT AND ABSORPTION SYSTEM.
DRAWING NO.	PE–DG–410–174–A001
SHEET	2 OF 3
REV	1

DEPT CODE		NAME	SIGN	DATE
MAX	DRN	F SAHA		
	DESN	J PAL		
	CHD	K KESHAV		
	APPD	PK		

DEPT. / SIGN / DATE

SCALE

CUSTOMER'S DRAWING NO.

NOTE–1: .THIS P&ID IS FOR TENDER PURPOSE ONLY, FINAL P&ID SHALL BE SUBMITTED DURING DETAIL ENGINEERING.

CUSTOMER'S DRAWING NO.

FLEXIBLE HOSE(LDPE)

VENT LINE TO OUTSIDE THE CHLORINATOR ROOM

FLEXIBLE HOSE(LDPE)

AUTO SWITCH OVER FACILITY

CHLORINE CYLINDER

CHLORINE CYLINDER

CHLORINE LEAK DETECTOR WITH ONE SENSOR

BOOSTER PUMPS WITH MOTOR (1W + 1S) $1m^3/h.$ @ 80m DIFF. HEAD

BOOSTER PUMPS

BOOSTER PUMPS

FROM POTABLE WATER PUMP DISCHARGE AT DM PLANT

(REF P&ID: PE-DG-410-163-A001)

CHLORINATOR CAP : 100Gm/Hr (1W + 1S)

CHLORINATOR CAP : 100Gm/Hr (1W + 1S)

GAS FILTER

GAS FILTER

INJECTOR–1

INJECTOR–1

TO POTABLE WATER PUMP DISCHARGE AT DM PLANT

(REF P&ID: PE-DG-410-163-A001)

PLC (DMP)

RCA PLACED ON POTABLE WATER PUMPS DISCHARGE

PIPING:		
Chlorine liquid handling pipe:		
i)Material:		
a) Tubing	Annealed Cu as per ASTM B 88 Cadmium plated of type 'K'.	
b) Nipple	Silver coated Cu nipple.	
ii)Hydro test pressure for tubing	40 Kg/cm2 (g).	
Pipe handling chlorine:		
MATERIAL OF CONSTRUCTION:	DRY LIQUID CHLORINE	CHLORINATED WATER SERVICE.
PIPE	CARBON STEEL TO ASTM A 106 GR B SEAMLESS SCH. 80.	PVC SCH 80
FITTINGS	CARBON STEEL ASTM A 105 GR I, 2000 RATING.	PVC
FLANGES	CARBON STEEL TO ASTM A 181 GRI, CLASS 300.	--

WATER LINE

CHLORINE GAS LINE

CHLORINE LIQUID LINE

LEGEND

	NEEDLE VALVE (IS 3224/BS 341)		DIAPHRAGM SEAL
	BALL VALVE		FLANGE CONNECTION
	DIAPHRAGM VALVE	PS	PRESSURE SWITCH
	GATE VALVE	WTI	WATER TEMPERATURE INDICATOR
	SAFETY RELIEF VALVE	PI	PRESSURE INDICATOR
	NON–RETURN VALVE	VI	VACUUM INDICATOR
	MOTOR OPERATED PRESSURE REDUCING VALVE	LI	LEVEL INDICATOR
	PRESSURE REDUCING VALVE	CTI	CONTACT TYPE TEMP. INDICATOR
	BUTTERFLY VALVE (OPEN)	TS	TEMPERATURE SWITCH
	BUTTERFLY VALVE (CLOSED)	CPI	CONTACT TYPE PRESSURE INDICATOR
	Y–TYPE STRAINER	A	ALARM HIGH
	3–WAY BALL VALVE	A	ALARM LOW
	SOLENOID VALVE	AM	AMMETER
	RUPTURE DISC		ELECTRIC SIGNAL
VRV	VACUUM REGULATING VALVE		GAS FILTER
DRV	DRAIN RELIEF VALVE		VALVES AS PER RECOMMENDATIONS OF CHLORINE INSTITUTE IS.3224/BS 341.
VSV	VACUUM STABILIZING VALVE	GPI	GAS PRESSURE INDICATOR
RV	RATE VALVE	GTI	GAS TEMPERATURE INDICATOR
GFI	GAS FLOW INDICATOR (ROTAMETER)	CTS	TEMPERATURE CONTROL SWITCH
PVR	PRESSURE VACUUM RELIEF	VS	VACCUUM SWITCH
DPR	DIFFERENTIAL PRESSURE REGULATOR	DPS	DIFFERENTIAL PRESSURE SWITCH
ET	EXPANSION TANK	DPI	DIFFERENTIAL PRESSURE INDICATOR
H	HEATER		BASKET STRAINER
LD	LEAK DETECTOR	RCA	RESIDUAL CHLORINE ANALYZER
ASV	AUTO SHUT OFF VALVE		

PW CHLORINATION

OWNER	TELANGANA STATE POWER GENERATION CORPORATION LIMITED.
PROJECT	1X800 MW KOTHAGUDEM TPS.
	BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
MAX	DRN	F SAHA		
	DESN	J PAL		
	CHD	K KESHAV		
	APPD	PK		

TITLE: P&ID FOR PW CHLORINATION PLANT .

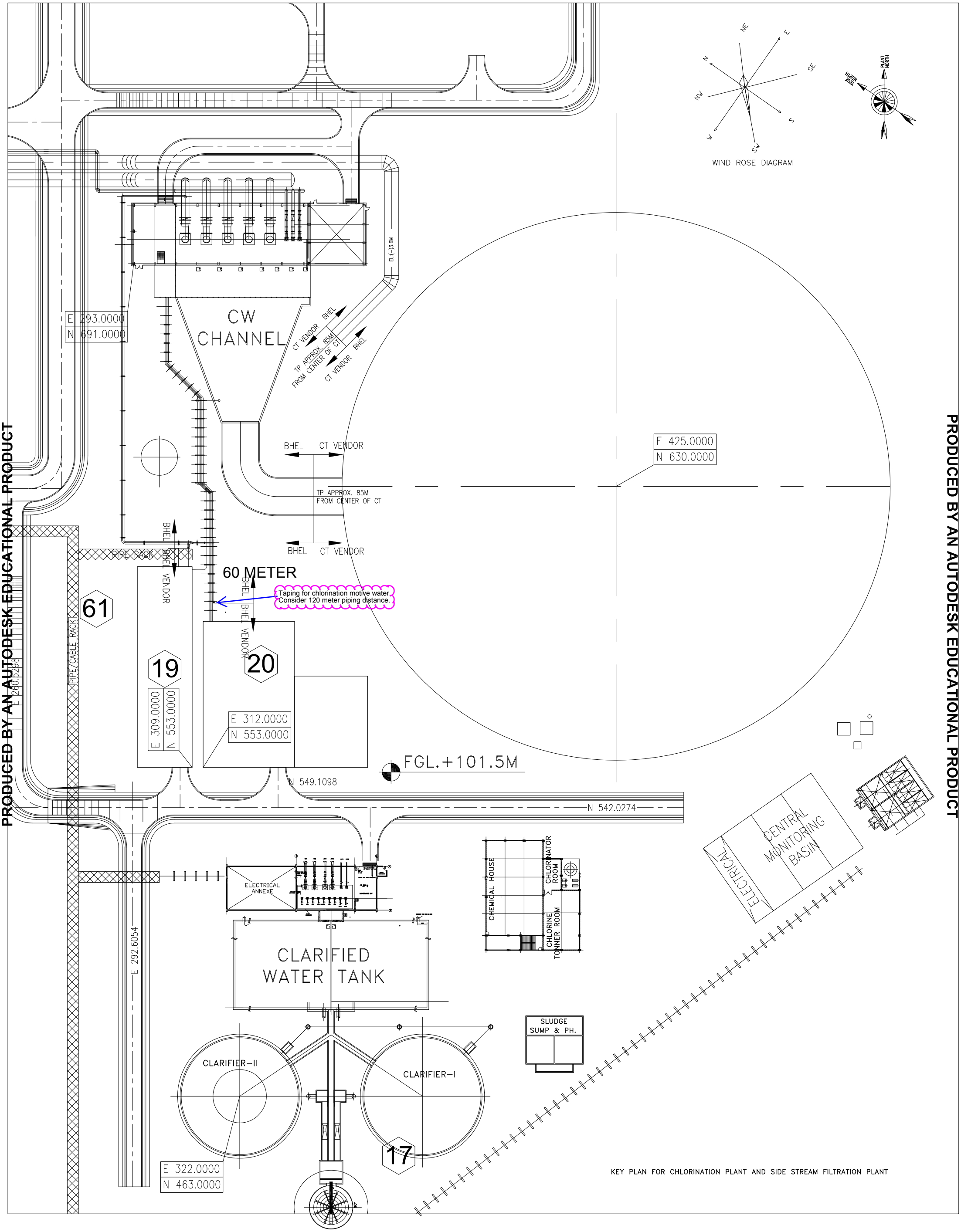
DEPT. | SCALE | DRAWING NO. PE–DG–410–174–A001

SIGN | DATE | SHEET 3 OF 3 | REV 1

SIZE–A1

TECH SPEC NO.
PE-TS-410-174-A001, REV-01

KEY PLAN



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

SECTION – C2

(SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL)

ELECTRICAL EQUIPMENT SPECIFICATION

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

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 equipments.

d) Electrical load requirement for CHLORINATION 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.

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 Chlorination 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
4.2 Technical specification – Specification for Electric Motors/Actuators
4.3 Datasheets & quality plan for motors.
4.4 Load Data Format. (Annexure –II)
4.5 BHEL Cable listing format (Annexure –III)

ELECTRICAL LOAD FORMAT

LOAD TITLE	RATING (KW / A)		FULL LOAD CURRENT FLC(A)	UNIT (U)/STN. (S)	Nos.		VOLTAGE CODE*	FEEDER CODE*	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME> 5 SEC (Y)	LOCATION (Tag. No.)	RATING & FLC CHECKED FROM MOTOR/VALVE APPROVED DATASHEET (Y/N)	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	KKS NO.
	NAME PALTE	MAX. CONT. DEMAND (MCR)			RUNNING	STANDBY									SIZE CODE	Nos					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

NOTES: 1. COLUMN 1 TO 14 & 20 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATTIONS : * VOLTAGE CODE (7):- (AC) A=11 KV, B=6.6.KV, C= 3.3 KV, D=415 V, E = 240 V (1 PH), F = 110 V (DC) : G =220V, H = 110 V, J = 48 V, K = +24V, L= -24V

: **FEEDER CODE (8) :- U = UNIDIRECTIONAL STARTER, B = BIDIRECTIONAL STARTER, S = SUPPLY FEEDER, D = SUPPLY FEEDER (CONTACTOR CONTROLLED)

BHEL	LOAD DATA (ELECTRICAL)		JOB NO.						ORIGINATING AGENCY		PEM (ELECTRICAL)	
			PROJECT TITLE						NAME		DATA FILLED UP ON	
			SYSTEM / S						SIGN.		DATA ENTERED ON	
			DEPTT. /SECTION						SHEET 1/2	REV. R0	DE'S SIGN. & DATE	

ELECTRICAL SCOPE FOR VENDOR AND BHEL

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: CHLORINATION PLANT

REV: 0 DATE: 04.03.15

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.

PACKAGE: CHLORINATION PLANT REV: 0 DATE: 04.03.15

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.

SECTION – C3

(SPECIFIC TECHNICAL REQUIREMENTS FOR C&I)

SPECIFIC TECHNICAL REQUIREMENT

1. Bidder to include Field instrumentation and Field Junction Box (JB's), in his scope of supply. Field instrument specification and Data Sheet are given elsewhere in this spec.

2. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope and details are given elsewhere in this spec. JB to PLC shall be provided by BHEL as free issue whereas cable schedule, cable interconnections and wiring diagram for the same shall be in bidders' scope.

3. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.

4. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.

5. PLC control system as defined in the enclosed specs and DATA Sheets shall be in bidder scope. The PLC system shall comprise of (i) PLC based local panel (ii) UPS Power supply (iii) Operator interface in the form of CRT, keyboard and OWS along with required furniture.

6. PLC shall have the facility to synchronize its time with BHEL supplied GPS. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and GPS shall be in BHEL scope.

7. PLC shall be connected to DCS through serial link with OPC Compliant for monitoring/Control. For detailed , please refer PLC Architecture Diagram.

8. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.

9. The requirements given below are to be read in conjunction with detailed Technical specification enclosed.

10. For any other cable type, the scope of cable and cable type in 'Electrical scope split sheet' in Electrical portion of the specification shall be final.

11. 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.

12. Supplied system shall provide group alarms to be hardwired to plant DCS.

13. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

14. Provision for earthing of the panel to be provided by vendor.

15. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.

16. Layout & space requirement of panel to be specified during detailed engineering.

17. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type. Typical Hook Up diagram of all types of drives is attached for use(subject to Customer approval).

18. 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.

19. 415 V AC (3 Phase, 3 Wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.

20. Bidder to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided on Junction Boxes.

21. Bidder to delegate/depute their person/experts as per owner/consultant requirements.

22. All the furniture for OWS/ Printer required for the system shall be in bidder's scope of supply.

23. The make of all the items shall be from approved sub-vendor list.

24. 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.

25. Bidder shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering.

NOTES:

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

SECTION-D

(GENERAL TECHNICAL REQUIREMENT)

SECTION-D1

(GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL)

1.0 DESIGN PHILOSOPHY 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 CHLORINATION PLANT CAPACITY

CW & ACW Flow Capacity	=	[CW:84210 + ACW: 3419] 87629 m^3
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose	=	(87629X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	438.145 Kg./hr
Chlorinator selected based on shock dosing	=	4 @ 160 kg/hr (3W +1S)
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs
Daily Chlorine requirement as per shock dose	=	1.5X 438.145 Kg./hr
	=	657.215 Kg/Day
Chlorine requirement as per continuous dose		(87629 X 1)/1000 Kg/hr
	=	87.629 Kg/hr
Daily Chlorine requirement as per continuous dose	=	87.629 X 22.5 = 1971.65 Kg/Day.
Total Chlorine requirement	=	(657.215+1971.65) Kg/Day.
	=	2628.86 Kg/Day.
Chlorine consumption for 15 days	=	39433.01 Kg
Filled Chlorine tonners required (@900 Kg)	=	43.814 nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	46 nos.

1.2 EQUIPMENT DESIGN CRITERIA

Four Nos. (3W+1S) streams of gas chlorination system have been provided. The chlorination plant shall consist of the following main equipments & accessories:

- Chlorine ton containers,
- Pipe manifold with accessories
- Evaporator
- Chlorinator
- CW booster pumps
- Basket Strainers
- Chlorine gas leak detector & safety equipments
- Chlorine gas absorption system
- Lifting & handling devices
- Associated piping, instrumentations & necessary controls.

1.2.1 CHLORINE TON CONTAINER

Forty Six (46) numbers Chlorine Ton Containers, each provided with isolation valves, educator tubes, two (2) numbers Roller Supports, safety accessories and Automatic Switch Over facility.
The design, fabrication and testing of ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

1.2.2 PIPE MANIFOLD WITH ACCESSORIES

Four (4) numbers 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.

1.2.3 EVAPORATOR

Four (4) numbers electrically heated water bath type Chlorine Evaporators, each with all accessories.

1.2.4 CHLORINATOR

Four (4) numbers Chlorinators, each vacuum operated aqueous solution feed type complete with all accessories. Each Chlorinator should have the items as follows:
1.0 Remote Vacuum Regulator.
2.0 Cabinet with:
a) Chlorine Gas Flow meter.
b) Differential Pressure Regulator.
c) Flow Control Valve.
3.0 Fixed throat type Remote Ejector.

1.2.5 BOOSTER WATER PUMPS

Four (4) numbers Water Supply Booster Pumps each complete with electrical drive motor and all other accessories to supply water to the Evaporators and Chlorinators.

1.2.6 BASKET STRAINERS

Eight (8) numbers (Two (2) numbers at upstream of Suction Header – each of three pumps and two (2) numbers for two (2) numbers the Pumps dedicated for stand-by chlorinator.

1.2.7 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The material of construction of the diffuser shall be CPVC. Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

1.2.8 HOIST MONO-RAILS

An electrically operated monorail hoist shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg.

1.2.9 WEIGHING SCALE

Weighing scale of 3 ton capacity of platform dial type shall be provided. Weighing scale shall be suitable for fixing on the ground.

1.2.10 OTHER MISC. ACCESSORIES

System shall also have following:

- Associated piping and valves required for the system.
- All necessary instruments and controls required for easy and safe operation of the system.

1.2.11 SAFETY & SUPERVISORY INSTRUMENT

GAS MASK & OXYGEN BREATHING EQUIPMENT

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.

CHLORINE LEAK DETECTOR.

Chlorine detector for audio-visual alarm for detecting chlorine leaks in the rooms.

EMERGENCY KIT

Four (4) numbers with all accessories shall be provided to seal off Chlorine Ton-Containers.

1.2.12 CHLORINE LEAK ABSORPTION SYSTEM

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:

- Sixteen (16) numbers Full FRP hoods to enclose Chlorine Ton Containers connected to manifolds, each with flexible hose arrangement for connection to FRP Duct Work.
- Half hood shall be provided for rest of the cylinder (which are not connected).
- 2 Nos. (1 working + 1 stand-by) Blowers.
- 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.
- One (1) no. absorption tower (FRP) with packing.
- One (1) no. alkali storage tank.
- 2x100% (1 working + 1 standby) alkali solution cum recirculation pumps.
- FRP Duct Work to Absorption System with all accessories as required
- 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.

2.0 DESIGN PHILOSOPHY 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	=	2640 m^3/hr
Chlorine dosing rate (Continuous dosing)	=	5 ppm
Total Chlorine consumption rate for Continuous dosing	=	(2640x5)/1000
Chlorine requirement	=	13.2 Kg./hr
Chlorinator selected	=	2 nos @ 25 Kg/Hr (1W+1S)
Chlorine requirement as per continuous dose	=	13.2x24=316.8 Kg./day
Chlorine consumption for 15 days	=	4752 kg
Filled Chlorine tonners required (@900 Kg)	=	5.28 nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	12 nos.

2.2 EQUIPMENT DESIGN CRITERIA

Two Nos. (1W+1S) streams of gas chlorination system have been provided. Each stream shall consist of the following main equipments & accessories:

* Chlorine ton containers,
* Pipe manifold with accessories

* Evaporator
* Chlorinator
* RW booster pumps
* Strainers
* Chlorine gas leak detector & safety equipment
* Chlorine gas absorption system
* Lifting & handling devices
* Associated piping, instrumentations & necessary controls.

2.2.1 CHLORINE TON CONTAINER

Twelve (12) numbers Chlorine Ton Containers, each provided with isolation valves, educator tubes, two (2) numbers Roller Supports, safety accessories and Automatic Switch Over facility.
The design, fabrication and testing of ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

2.2.2 PIPE MANIFOLD WITH ACCESSORIES

Two (2) numbers Chlorine Manifolds each with all accessories.

2.2.3 CHLORINATOR

Two (2) numbers Chlorinators each vacuum operated aqueous solution feed type complete with all accessories.
Each Chlorinator should have the items as follows:
a) Remote Vacuum Regulator.
b) Chlorine Gas Flow meter.
c) Differential Pressure Regulator.
d) Flow Control Valve.
e) Fixed throat type Remote Ejector.

2.2.4 BOOSTER WATER PUMPS

Two (2) numbers Chlorinator Water Supply Booster Pumps each complete with electrical drive motor and all other accessories.

2.2.5 STRAINERS

Four (4) numbers Strainers in chlorine gas line, two (2) numbers for each of the two (2) numbers Chlorinators.

2.2.6 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The material of construction of the diffuser shall be CPVC (Schedule 80). Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

2.2.7 HOIST MONO-RAILS

An electrically operated monorail hoist shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg.

2.2.8 SAFETY & SUPERVISORY INSTRUMENT

GAS MASK & OXYGEN BREATHING EQUIPMENT

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.

EMERGENCY SHOWER

Emergency shower / eye wash room for personnel safety shall be provided.

CHLORINE DETECTOR.

Chlorine detector for audio-visual alarm for detecting chlorine leaks in the rooms.

EMERGENCY KIT FOR SEALING

Two (2) numbers with all accessories shall be provided to seal off Chlorine Ton-Containers.

CHLORINE LEAK ABSORPTION SYSTEM

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:

- 4 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.
- 2x100% (1 working + 1 standby) alkali solution 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

2.2.9 OTHER MISC. ACCESSORIES

System shall also have following:

- Associated piping and valves required for the system.
- All necessary instruments and controls required for easy and safe operation of the system.

3.0 PLANT 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 transfer pumps shall be provided in DM Plant by BHEL and dosing shall be done at discharge of Potable water pumps.

Total Potable water requirement for plant	=	15 m^3/hr
Chlorine dosing rate (Continuous dosing)	=	1 ppm
Total Chlorine consumption rate for Continuous dosing	=	(15x1)/1000
Chlorine requirement	=	15 gm/hr
Chlorinator selected	=	2 nos @ 100 gm/Hr (1W+1S)
Chlorine requirement as per continuous dose	=	15x24=360 gm/day
Chlorine consumption for 15 days	=	5400 gm
Filled Chlorine cylinder required (@100 Kg)	=	0.054 nos.
Filled Chlorine cylinder that shall be supplied (@100 Kg)	=	2 nos.

3.1 SYSTEM DESCRIPTION

There will be two (2) streams each of capacity 100 g/hr. One (1) stream will be operating and one (1) stream shall be standby. A chlorine dosing system shall be provided to dose concentrated chlorine solution in potable water pump outlet line. For this purpose, filtered water shall be taken from potable water pump discharge. Each stream will consist of followings:

3.2 CHLORINE CYLINDER

Two (2) no. (1w+1sb) Chlorine cylinders shall be provided. Each chlorine cylinder consists of 100 kg chlorine gas (approximately).

3.2 CHLORINATOR

Two (2) no. vacuum operated chlorinators shall be provided to feed the chlorine solution in potable water .The rate of chlorine dosing shall be set manually and shall remain constant until manually changed. The chlorinator shall be mounted directly on the chlorine cylinder and shall be equipped with necessary instrumentation for safe & reliable operation.

Each Chlorinator should have the items as follows:

• Vacuum Regulator.
• Chlorine Gas Flow meter.

- Differential Pressure Regulator.
- Manual Flow Control Valve.
- Fixed throat type Remote Ejector.

3.3 BOOSTER WATER PUMPS

Two (2) no. booster pumps (2x100%) with non-return valves sufficient to produce the required vacuum in ejector shall be provided. Interlocks shall be provided such that booster pump will trip if the potable water pump trips. Each pump suction have one basket strainer.

3.4 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The material of construction of the diffuser/injection quill shall be CPV SCH 80. Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

4.0 LAYOUT CONSIDERATION FOR CW, RW AND PW CHLORINATION PLANT

CW chlorination plant along with safety item shall be housed in CW Treatment building near to CW forebay. 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

SECTION-D2

(GENERAL TECHNICAL REQUIREMENT FOR ELECTRICAL)

GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS

BHEL – PS - PPEI: NOIDA, SECTOR-16A, U.P. – 201301

VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

CONTENT

VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power 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, constant speed, squirrel cage, three/single phase, induction type.

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.

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

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

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. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.

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% 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.

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 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
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

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

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating		:	Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

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 listed-

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

ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner’s cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

PL. REFER PAINTING SCHEDULE OF MECHANICAL SPECIFICATION

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS: 7816 as routine test

d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

j. Test to diagnose rotor bar failure during manufacture.

k. Over speed test as routine test.

l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write-up on forced lubrication system, if any

d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. ~~Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.~~

DATA SHEET A – MOTORS

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply		Description	Consumer
L.V. Supply	(i)	415V, 3Ø, 3W, 50 Hz Effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW upto less than 175kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heating , A.C supply for Control & protective devices.
D.C. Supply		220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%.
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242

DATA SHEET C– MOTORS

LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)

2. Equipment driven by motor

3. Motor type

4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size

2. Type of duty

3. Type of enclosure /Method of cooling/Degree of protection

4. Applicable standard to which motor generally conforms

5. Efficiency class as per IS 12615

6. (a) Whether motor is flame proof Yes/No

   (b) If yes, the gas group to which it conforms as per IS:2148

7. Type of mounting

8. Direction of rotation as viewed from DE END__

9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)

10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)

11. Maximum continuous load demand of driven equipment in KW

12. Rated Voltage (volts)

13. Permissible variation of :

a. Voltage (Volts)

b. Frequency (Hz)

c. Combined voltage and frequency

14. Rated speed at rated voltage and frequency(RPM)

15. At rated Voltage and frequency:

a. Full load current

b. No load current

16. Power Factor at

a. 100% load

b. NO load

c. Starting.

17. Efficiency at rated voltage and frequrecy,

a. 100% load

b. 75% load

c. 50% load

18. Starting current (amps) at

a. 100 % voltage

b. 85% voltage

c. 80% voltage

19. Minimum permissible starting Voltage (Volts)

20. Starting time with minimum permissible voltage

a. Without driven equipment coupled

b. With driven equipment coupled

21. Safe stall time with 100% and 110% of rated voltage

    a. From hot condition

    b. From cold condition

22. Torques :

    a. Starting torque at min. permissible voltage(kg-mtr.)

    b. Pull up torque at rated voltage.

    c. Pull out torque

    d. Min accelerating torque (kg.m) available

    e. Rated torque (kg.m)

23. Stator winding resistance per phase (ohms at 20 Deg.C.)

24. GD^2 value of motors

25. No of permissible successive starts when motor is in hot condition

26. Locked Rotor KVA Input

27. Locked Rotor KVA/KW

28. Vibration limit :Velocity (mm/s)

29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation

    a. Class & Type

    b. Winding Insulation Process

    c. Tropicalised (Yes/No)

d. Temperature rise over specified maximum ambient temperature of 50 deg C

e. Method of temperature measurement

f. Stator winding connection

2. Main Terminal Box

a. Type

b. Location (viewed from NDE side)

c. Entry of cables(bottom/side)

d. Recommended cable size (To be matched with cable size envisaged by owner)

e. Fault level (MVA), Fault level duration (sec)

f. Cable glands & lugs details (shall be suitable for power cable)

3. Type of DE/NDE Bearing

4. Motor Paint shade

5. Weight of

a. Motor stator (KG)

b. Motor Rotor (KG)

c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)

2. Terminal Box for Space Heater (Yes/No)

3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

   i) No and size on motor body

   ii) Nos on terminal Box

7. Vibration pads

   i) Nos and size

   ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

   i) Full load Armature current.(Amp)

   ii) Full load Field current (Amp)

iii) No load Armature current (Amp)

6. Full load Field current (Amp)

7. No load Aramature current (Amp)

8. Minimum permissible field current(Amp) to avoid overspeeding at

   i) Maximum permissible voltage

   ii) Rated voltage

   iii) Minimum Permissible Voltage

9. Resistance (indicative Values) in ohm

   i) Armature winding (Arm + IP + Series) at 25 deg.C

   ii) Field Winding at 25 deg. C

10. Inductance (indicative values)

    i) Armature winding

    ii) Field winding

11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at

    i) 220 V DC

    ii) 250 V DC

    iii) 187 V DC

12. Value of the external resistance (ohm) required to be connected in series with armature during starting only

13. Technical data sheet for external resistance box

14. GA drawing of motor

15. Starting time calculation

16. Starter resistance design calculation

17. Electrical connection diagram of motor

QUALITY PLAN (MOTOR)

	QUALITY PLAN	CUSTOMER :	PROJECT 1X800MW KOTHAGUDEM	SPECIFICATION :
			TITLE	NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION TITLE
	SHEET 1 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE, TYPE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1*		* NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	PARTICULARS	BIDDER/VENDOR
	NAME	
	SIGNATURE	

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE 1X800MW KOTHAGUDEM			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE, TYPE TESTS ON RANDOM SAMPLES THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

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

CABLE SCHEDULE FORMAT

CABLE SCHEDULE FORMAT **ANNEXURE III**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

(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

SECTION-D3

(GENERAL TECHNICAL REQUIREMENT FOR C&I)

OPERATIONA AND CONTROL PHILOSOPHY

A.0 OPERATION, CONTROL PHILOSOPHY & INSTRUMENTATION

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 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 push button 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.

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.

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 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 pushbutton 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.

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.

FIELD INSTRUMENT DATA SHEET WITH CHECK LIST

INSTRUMENTATION DATA SHEET

1.00.00 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
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 ^{O}C
16.	Performance:	:	
	i. Accuracy		$\pm$ 0.075% of Span or better

	ii. Repeatability		± 0.05% of Span or better
17.	Sealing/Isolation	:	Extended diaphragm (Silicon oil/ Flurolub 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 U-bolts 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

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.

LVDT type is not acceptable.

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
13.	Operating Voltage	:	24V DC
14.	Load	:	600 Ohms (min.) at 24 Volts D.C.
15.	Ambient Temperature	:	0 - 50 ^{O}C
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/ Flurolub 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 U-bolts

c. Siphon for steam and hot water services

d. ½" NPT 5-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

1.03.00 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
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 ^{O}C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2” Flanged
22.	Performance - Accuracy	:	$\pm$ 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

	26.	Applications	:	During detail engineering on Owner's approval

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
	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 ºC
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 Hestalloy (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
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 – Polyurethene
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)
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.

2.00.00 **HART HAND HELD CALIBRATOR**

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

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	:	SSt
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 ± 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/ Flurolub filled Remote diaphragm seal with SS-316 capillary 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 2 Valve SS-316 barstock manifold f) ½" 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 ± 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/ Flurolub 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) ½” NPT cable gland
16.	Applications	:	During Detail Engineering on Owner’s

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

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.	Repeatibility	:	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
4.	Application Temperature	:	250°C (Max.)
	Electronic Controller		
5.	Input Supply Voltage	:	240V AC ±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	:	±0.5%
12.	Accessories	:	Co-axial cable for probe connection to controller SS Tag plate ½" 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 ±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 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
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 $\pm$ 1.0 % of span or better
14.	Operating ambient	:	0 - 50 ^{O}C
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

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
4.		:	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
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 ^{O}C
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	:	± 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	:	½" NPT gland and grommet
	e)	Others	:	Terminal head cover with SS chain and suitable gasket. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
10.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Thermowell (As specified below)
11.	Thermowell connection		:	½" NPT (M) or 150 RF Flanged
12.	Nameplate		:	Tag number, service engraved in stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

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	:	$\pm$ 1.1^0 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
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
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

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.

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

Instrumentation Quality Plan

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

PLC DETAILS

PLC SPECIFICATION

1.00.0 **GENERAL**

1.01.0 Each of the relevant BOP areas and different auxiliary systems shall be provided with dedicated PLC or proprietary control systems for overall operation and control.

1.01.01 There shall be redundant bidirectional OPC link between DDCMIS network and each Package PLC including PADO for monitoring / performance activities.

1.02.00 These control systems shall conform to high standard of engineering meeting all applicable codes and standard, design and workmanship and shall meet the functional requirements in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental condition.

1.03.00 Further this part of the specification details the common technical and functional requirements applicable for all the systems unless specified elsewhere in the specification. Only specific requirements are indicated in this section .However , Bidder shall also adhere to the Section-VI , Subsection A (DDCMIS) of this volume of the specification for other basic and detailed scope & services , philosophy & technical requirements of different hardwares and softwares including response time , loading , interface , redundancy criteria , display , logs ,spares criteria , drawings and document submission etc.

1.04.00 All local PLCs shall be supplied from one manufacturer for all plants and shall provide single unified hardware and software platform for realizing all the control and monitoring functions.

1.05.00 In general local PLC, ,Proprietary control system by third party system integrators shall not be allowed and only main PLC/ Proprietary control system manufacturer shall be allowed to do the design engineering , system integration etc. Owner will be the final authority in allowing third partysystem integrators, if required, for only small applications.

1.06.00 Local control and monitoring facility of the equipments from the respective package control room and local panels is required.

1.06.01 The redundant upper level network of each Package PLC system will be connected to redundant server to be located in Plant Engineer's room. Suitable Fibre optic cable shall be used for redundant interconnections.

1.06.02 The hot redundant Server shall continuously update all the inputs. The switchover to the hot standby Server shall be smooth and bump less with proper indication to the operator.

1.06.03 Local PLC Workstations shall be capable of programming activities for control systems of the package including set point change , logic build up & modifications , graphics build up & modifications etc .

1.06.04 Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.

1.06.05 Alarm monitoring / reporting, generation of logs, trends, calculations, printing of logs & reports etc. shall be available in local workstations as well as in remote DDCMIS network workstations .In case of failure of DDCMIS network, control and monitoring of the individual packages shall still be possible from the Operator Work Stations in the respective package control room.

1.06.06 The system shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition and without endangering the safety of equipment without having any influence on the process being controlled.

2.00.00 **GENERAL TECHNICAL REQUIREMENTS**

2.01.00 Bidders scope of supply shall include , but not limited to , Hot standby local PLC / Proprietary control & monitoring system for each of BOP areas and shall consist of IO cards, remote and Local IO rack, control rack, redundant Power supply modules, redundant communication /networking and interconnection Cables, redundant processor and communication cards, redundant Servers, operator work stations / GUI , LVS(if applicable) , printer, redundant networking hardware etc. , system cabinets ,startup, commissioning, mandatory and recommended spares, drawing, documents and training to owner's personnel at site and at vendors works etc.

2.02.00 All types of programming packages shall be licensed with facility of editing and configuration. For each of the PLC / proprietary control system, the programming software shall be supplied in a laptop for each package preloaded with package in addition to other types of devices such as CD, DAT etc.

2.03.00 In addition to the Operator and/ cum Engineering workstations, Bidder shall also supply LCD screen based display unit, control switches and other operational keys (GUI). Bidder shall also provide minimum of one no. laptop computer for each PLC based package and with latest hardware configuration and loaded with suitable operating, application program including licensed softwares as a backup engineering cum programming and configuration station. **This loaded laptop shall be handed over by Bidder well in advance of FAT to Owner's head office at Hyderabad.**

2.04.00 The System shall allow dependable and effective control of the process equipment and shall be designed for maximum integrity and reliability. Integrity shall be maintained by providing a dual hot redundant system .The System shall have a capability to monitor and take actions for distributed functions from a central location.

2.05.00 The control & Instrumentation shall be through dedicated microprocessor based PLC, Common DDCMIS network, proprietary system for the each of the respective plants covering the total functional requirement of sequence control, regulatory control, interlock & protection, monitoring, alarm, data logging.

2.06.00 The loop cycle time shall be less than 1 sec for close loops and open loops. The switchover from main controller to redundant controller shall be bump less; and shall be within one cycle time i.e. within 50 msec.

2.07.00 Each controller shall have 40% functional capacity to implement additional functional blocks over and above implemented logic / loops under worst loading conditions.

2.08.00 Field Input/Outputs
The System shall meet the following I/O card requirements. The maximum number of inputs / outputs to be connected to each type of module shall be as follows:

a)	Analog input module	8
b).	Analog output module	8
c)	Binary input module	16
d)	Binary output module	16

2.09.00 Communications System

2.09.01 The Bidder shall include a dual hot redundant communication system

2.09.02 The data highway speed shall be 100 Mbps.

2.10.00 Operator Interface

Operator Work Station (OWS) / GUI / LVS shall perform control monitoring and operation of all auxiliaries/ drives. However, Push button stations are also to be provided with RIOs.

2.11.00 Interface with Common DDCMIS system

Each PLC, proprietary control systems shall be interfaced to Common DDC MIS network with bidirectional OPC link .The link shall be redundant.

2.12.00 PLC shall be of latest version and all the modules like Control modules, communication modules, IO modules, and network interface modules etc., modules shall be from the same family of hardwares and softwares and shall be sourced from Bidder's Original Principlal's works.

2.13.00 PLC shall have also, but not limited to, the following requirements,

2.13.01 I/O LAN Speed shall be minimum 5 Mbps - 100 MBPS on Deterministic LAN.

2.13.02 I/Os shall be Rack based and not Din Rail Mountable.

2.13.03 Processors and I/Os shall be of same family.

2.13.04 Diagnostics for DI/DO, AI & AO shall be provided.

2.13.05 All PLC I/O Rack Power Supplies shall be redundant. Only Bulk power supply redundancy will not be acceptable.

2.13.06 Processor selection shall be such that it shall never be loaded more than 50% at any time during the operation.

2.13.07 SOE module (if applicable) must stamp and store 250+ events at card level.

2.13.08 PLC shall store tag details and bit word addresses on upload of logic as well as tag descriptions.

2.13.09 Remote I/O Rack outside control room shall be on Fiber Optic communication only.

2.13.10 Processor shall be self learning in case of failure. No need to configure and program replaced processor.

2.14.00 Operating work stations must be Run time license/servers. Client server architecture no acceptable.

2.15.00 Each operator work station must have minimum 150% tags handling capability.

2.16.00 Auto Tuning feature of PIDs at PLC controller level shall be available.

2.17.00 Programming facility shall be available from Remote IO stations.

2.18.00 Processor shall support minimum twice the overall system IO handling capacity in Redundant configuration.

2.19.00 Online editing of Program shall be possible.

2.20.00 Processors shall be Hot back up.

2.21.00 A utomatic sy nchronization of primar y processor/controller of P LC with secondary processor/controller.

2.22.00 Bumpless switchover to secondary processor/controller of PLC when the primary fails.

2.23.00 Power supply module redundancy shall be true power supply redundancy

2.24.00 Automatic program and data equalization of primary processor/controller of PLC.

2.25.00 Automatic 'Forcing Bit' update in the secondary processor/controller of PLC when any Forcing is applied in the prim ary processor/controller of PLC. (Forcing Bit Table of both the PLCs must be automatically synchronised.)

2.26.00 Softwares

The latest ver sion of all nec essary a pplications and netw orking software shal l be s upplied for the system. The software tool shall have facility to interface with third party software packages. Window base operating system shall be provided. The system shall be OPC compliant. Easy upgradation and future expansion facility shall be available.

All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant. User shall not have to pay any recurring license fee during the usage period of the system.

It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

2.23.00 Redundant Uninterrupted Power Supplies (UPS) shall be provided for each Local PLC.. UPS specification shall be as per requirements indicated in Section V of this specification.

PLC DATA SHEET

PLC DATA SHEET

	DATA SHEET FOR PLC SYSTEM	SPECIFICATION NO.: PE-TS-410-	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 04.03.2015
		SHEET 1 OF 1	

Data Sheet No.:

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
GENERAL	PROJECT	1X800MW KOTHAGUDEM TPS	
	SERVICE		
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR ■ AC ☐ NON-AC*	
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V DC ☐ 48 V DC ☐ 110 V AC	
	LOCATION OF COUPLING RELAYS	☐ MCC ■ PLC PANEL	
	DESKTOP OWS QUANTITY	☐ ONE ☐ TWO ☐ _____ ■ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY_____	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	☐ 19" ■ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS	
	PRINTER	INKJET ☐ A3___NOS ☐ A4___NOS LASER B/W ☐ A3___NOS ☐ A4___NOS COLOR INKJET ☐ A3 __NOS ☐ A4___NOS COLOR LASER ■ A3_1_NOS ☐ A4___NOS	
	PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ■ LAPTOP B) ENGINEERING SOFTWARE ☐ ONE OWS ☐ ALL OWS ☐ LAPTOP	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification. One number Laptop is mandatory.
	SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ■ NIL	
	COMPUTER FURNITURE	BOQ ■ YES ☐ NO INDUSTRIAL GRADE ■ YES ☐ NO	
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ■ MANDATORY SPARE ☐ RECOMMENDED	
	SPARE LIST ATTACHED	■ YES ☐ NO	
REDUNDANCY	CPU	■ YES ☐ NO	
	POWER SUPPLY	■ YES ☐ NO	
	COMMUNICATION	■ YES ☐ NO	
	I/O CARD	☐ YES ☐ NO	
	OTHER ELECTRONICS	☐ YES ☐ NO	**As per vendor practice**

	DATA SHEET FOR PLC SYSTEM	SPECIFICATION NO.: PE-TS-410-	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 04.03.2015
		SHEET 1 OF 1	

Data Sheet No.:

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
No. of CHANNELS PER CARD	ANALOG INPUT	■ 8 NOs ☐ 16 NOs	
	ANALOG OUTPUT	■ 8 NOs ☐ 16 NOs	
	BINARY INPUT	■ 16 NOs ☐ 32 NOs	
	BINARY OUTPUT	■ 16 NOs ☐ 32 NOs	
	RTD** 4	NOs	
	THERMOCOUPLE** 8	NOs	
	ELECTRONIC CARD ISOLATION	☐ GALVANIC ☐ OPTICAL ☐ OTHER	
PANEL	QUANTITY BI	DDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42	
	REMOTE I/O PANEL	■ YES ☐ NO AC REQUIREMENT ■ YES ☐ NO	
	COLOUR# RAL	7032	
	BACK-UP DESK	☐ YES ■ NO	
	MIMIC	☐ YES ■ NO IF YES,THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ■ FACIAS 25 Nos. ☐ OTHERS	
	CONFORMAL COATING	☐ YES ■ NO	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	☐ UTP ■ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B ☐ NTP	
	SOFTLINK	☐ MODBUS ■ OPC IF MODBUS THEN ☐ RS-485 ☐ ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE $$	■ UPS(INDUSTRIAL GRADE) ☐ 24V DC CHARGER	
	BATTERY TYPE	☐ Ni-Cd ■ LEAD ACID ☐ OTHERS	
	BACK-UP TIME	☐ 30 MINS ■ 60 MINS ☐ OTHERS	
	BATTERY CONFIGURATION	☐ 1X100% ■ 2X100% ☐ 2X50%	As per MAX philosophy
CUSTOMER TRAINING	TRAINING	■ REQUIRED ☐ NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	☐ VENDOR'S WORK ☐ PROJECT SITE ☐ OTHERS	

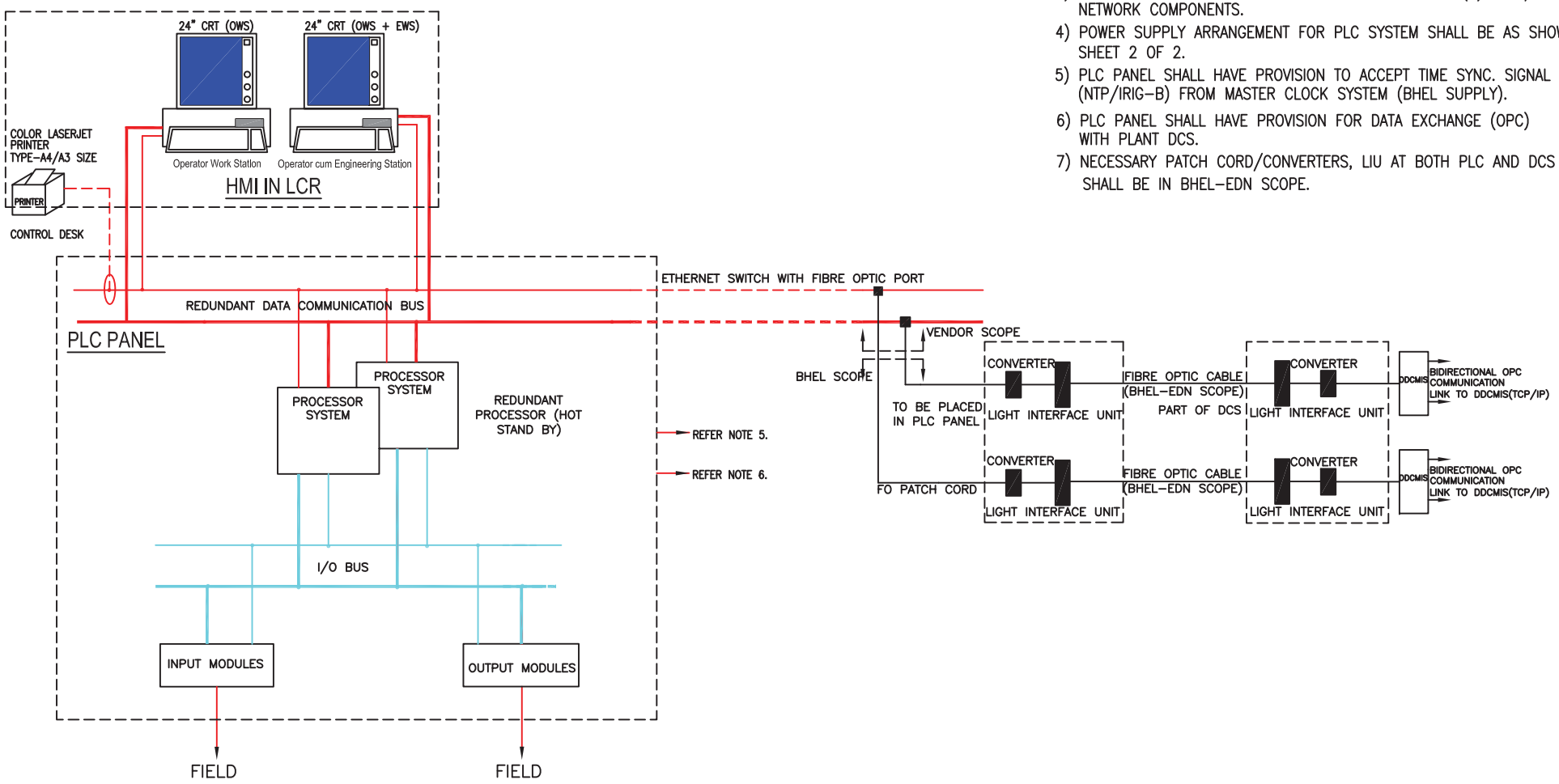
*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.
**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.
PROJECT SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

PLC CONFIGURATION DIAGRAM

PLC CONFIGURATION

NOTES:

1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR,POWER SUPPLY AND COMMUNICATION SYSTEM.
3) UPS POWER SUPPLY SHALL BE USED FOR PLC PANEL(S), OWS/EWS AND NETWORK COMPONENTS.
4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON SHEET 2 OF 2.
5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (BHEL SUPPLY).
6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT DCS.
7) NECESSARY PATCH CORD/CONVERTERS, LIU AT BOTH PLC AND DCS END SHALL BE IN BHEL-EDN SCOPE.



LEGEND: –

PLC	–	PROGRAMMABLE LOGIC CONTROLLER
DCS	–	DISTRIBUTED CONTROL SYSTEM
UPS	–	UNINTERRUPTED POWER SUPPLY
OWS/EWS	–	OPERATOR WORK STATION/ ENGINEERING WORK STATION
HMI	–	HUMAN MACHINE INTERFACE
NTP	–	NETWORK TIME PROTOCOL
OPC	–	OLE PROCESS CONTROL
MCCB	–	MOULDED CASE CIRCUIT BREAKER
MCB	–	MINIATURE CIRCUIT BREAKER
LCR	–	LOCAL CONTROL ROOM
CCR	–	COMMON CONTROL ROOM

BHEL Maharatna Company

PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO.	PE-DM-410-145-I900
		DATE	23.02.2015
TITLE:	PLC CONFIGURATION CW CHLORINATION	REV.NO.	00
		SHT	7 OF 11

PLC QAP AND FAT

PLC Quality Plan

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visua l	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2 2		1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visua l	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2 2		1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visua l	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2 2		1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visua l	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2 2		1	

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

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2 2		1	

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

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
2.0	**Assembly**											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2 1		1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2 2		1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2 1		1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2		1	

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

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	

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

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

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

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

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

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be c hecked for healt hiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control fr om primary processor to standby processor shall be demonstrated fo r uninterrupted control and dat a processing as per vendor's s tandard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Proc essor's LEDs as per manufacturer's product standard.
Vendor shall demons trate, as pe r Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating wors t load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in r edundant mode as per specific ation. Check the healthiness of power supply fr om both the modules ' lamp indication/measurement. Simulate fa ilure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

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

Following response t imes are to be demonstrated as per v endor's standard practice for conformance to contract specifications:

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

5. Diagnostic Verification

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

6. Control Panel /Desk Verification

i) PLC driven annunc iation system should be checked by alar m signal simulation.

ii) Push Button and sele ctor switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & ope ration of Graphics, Trends, Logs, HSR and Alarms, in the for m of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

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

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