PACKAGE NAME: 5x800MW YADADRI TPS		**TYPICAL QUALITY ASSURANCE PLAN**										
OWNER : TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA		ITEM : CHLORINATION SYSTEM							MANUFACTURE NAME AND ADDRESS			
CONTRACTOR : BHARAT HEAVY ELECTRICALS LIMITED						QAP.NO : REV : DATE : PAGE 6 OF 6						
SR. NO	COMPONENT & /OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QTY OF CHECK	REFERENCE DOC.	ACCEPTANCE NORMS.	FORMAT OF RECORDS	AGENCY			REMARK
									M	C	O	
28	Gate Valves/Globe valve	Check for Material properties,Dimension,Hydraulic, Pneumatic,Workmanship	MINOR	Check for Physical & Chemical properties, Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	
29	CIRL Diaphragm Valves	Check for Material properties,DimensionmHydraulic, Pneumatic,Workmanship.In case of Rubber Lining: Continuity for Rubber Lining,Shore Hardness,Operating life certificate for diaphragm.	MINOR	Check for Physical & Chemical properties, Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	
30	Non Return Valves	Check for Material properties,Dimension Hydraulic,Pneumatic,Workmanship.In Case Of Rubber Lining- Continuity For Rubber Lining,Shore Hardness, Operating Life Certificate For Diaphragm.	MINOR	Check for Physical& chemical properties, Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	
31	Chlorine Tonne containers/Cylinders	Check for Material properties,Dimension,Workmanship, 3rd Party Inspection Report.	MINOR	Check for Physical & Chemical properties,Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	CCOE approval shall be submitted subsequently
32	Strainer	Check for material Properties,Dimension,Hydraulic, Workmanship,Pressure Drop Test.In Case Of FRP/Rubber Lining- Continuity For Lining,Thickness,Shore Hardness.	MINOR	Check for Physical & Chemical properties, Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	Pressure Drop Test shall be checked at Site.
33	Fastners & Gaskets	Check for Material properties.	MINOR	Check for Physical & Chemical properties,Defects.	1/LOT	Appd.Drg/Catalogue/ Related Material/ Specification.	Appd.Drg/Catalogue/ Related Material/ Specification.	IR/TC/COC	P	V	V	

Legends :

IR:Inspection Report.	M.Manufacturer	W.Witness					
TC: Test Certificate.	C:CONTRACTOR (BHEL)	V:Review/Verify					
COC : Certificate of Compliance.	O:Owner(TSGENCO)	P:Perform	Authorized Signatory	Manufactures	Contractor		Approving Authority

INDICATIVE MASTER DRAWINGS LIST (GAS CHLORINATION PLANT) ECI list. TO be consolidated with Mech					
PROJECT : YADADRI 5X800MW					
PACKAGE : BOP - WATER SYSTEM					
CLIENT :					
Sr. No.	**BHEL_DRG_NO**	**VENDOR_DRG_NO.**	**DRAWING TITLE**	**SCH DATE OF SUBMISSION**	**CAT**
1			P & I Diagram RW Chlorination System		A
2			P & I Diagram of CW Chlorination System Stage-1		A
3			P & I Diagram of CW Chlorination System Stage-2		A
4			P & I Diagram of PW Chlorination System		A
5			Equipment Layout - CW Chlorination Stage-1		A
6			Equipment Layout - CW Chlorination Stage-2		A
7			Equipment Layout - RW Chlorination		A
8			Equipment Layout - PW Chlorination		A
9			PROCESS SIZING CALCULATION FOR RW,CW&PW GAS CHLORINATION PLANT		A
10			TECHNICAL DATA SHEET & GA DRAWINGS OF RW,PW&CW MECHANICAL ITEMS		A
11			DATA SHEET OF SAFETY ITEMS		A
12			Data Sheet for Chlorine Tonne Container .		A
13			Data Sheet for Trunnion Type Roller Supports.		A
14			Data Sheet for Flexible Connector & Accessories.		A
15			Data Sheet for Chlorinator for CW System Stage-1 & Stage-2		A
16			Data Sheet for Chlorinator for RW System		A
17			Data Sheet for Chlorinator for PW System		A
18			Data Sheet for Evaporator (CW Chlorination) Stage-1 & Stage-2		A
19			Data Sheet for Evaporator RW Chlorination		A
20			Data Sheet for Valves (All type)		A
21			PIPING LAYOUT OF CW CHLORINATION PLANT		A
22			PIPING LAYOUT OF RW CHLORINATION PLANT		A
23			PIPING LAYOUT OF PW CHLORINATION PLANT		A
24			Data Sheet for Expansion Tank Assembly including GA Drawing, Mechanical Design Calculation & Sizing Calculation		A
25			Data Sheet for Rupture Disc Assembly		A
26			Data Sheet for Spray Catcher/Gas Filter		A
27			Data Sheet for Centrifugal Blower including GA Drawing, Cross Sectional Drawing, Characteristic Curve.		A
28			Data Sheet for Caustic Recirculation Pump including GA Drawing, Cross Sectional Drawing, Characteristic Curve.		A
29			Data Sheet for Absorption Tower & Caustic Tank including GA Drawing, Mechanical Design Calculation & Sizing Calculation		A
30			Data Sheet for Chlorination Booster Pumping Set including GA Drawing, Cross Sectional Drawing, Characteristic Curve.		A
31			Data Sheet for Electrical Hoist including GA Drawing & Control Panel Drawing		A
32			Data Sheet for Load Indicator Crane Suspended/ Crane weigher		A

Sr. No.	BHEL_DRG_NO	VENDOR_DRG_NO.	DRAWING TITLE	SCH DATE OF SUBMISSION	CAT
33			Data Sheet for Platform Type Weighing Scale		A
34			Data Sheet for Tonner Lift Bar.		A
35			Data Sheet for Non Return Valve		A
36			GA Drg for FRP Hood		A
37			Data Sheet for Strainer		A
38			Self contained breathing apparatus		A
39			cannister type gas mask		A
40			GA Drg of Emergency shower & Eye Wash.		A
41			Emmergency repair kit for tonner		A
42			Valve Schedule		A
43			Process write - up & Control philosopy		A
44			O&M Manual.		A
45			Data Sheet for Agitator		A
46			Data Sheet for Diffuser		A
47			Performance Guarantee test procedure		A
48			Control Write-up Valve Sequence Charts		A
49			Electrical Load List For Stage 1 & Stage 2 for CW, Common RW & Common PW system		A
50			Technical Datasheet for valves (Auto changeover valve, auto shutoff valve, suction/discharge valves of pumps & blowers) with actuator scheme, rating		A
51			Technical Datasheet for Instruments(GAUGES/SWITCHES/TRANSMITTERS/ANALYSERS)of Gas chlorination		A
52			Technical datasheet, GAD for Heater		A
53			Technical datasheet, GAD, performance curves for motors		A
54			Technical datasheet for Chlorine Leak detector		A
55			Instrument Schedule for PT plant		A
56			Block Logic Diagram		A
57			HMI Pages Overview		A
58			Instrument Cable Schedule & Interconnection Chart		A
59			ENGINEERING BOQ OF CW RW PW Chlorination PLANT-MAIN SUPPLY AND SPARES BBU		A
60			PLC INPUT / OUTPUT SIGNAL LIST FOR STAGE 1 PLC & STAGE 2 PLC		A
61			INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS		A
62			FIELD JB TERMINATIONS /GROUPING DOCUMENT		A

Sr. No.	BHEL_DRG_NO	VENDOR_DRG_NO.	DRAWING TITLE	SCH DATE OF SUBMISSION	CAT
63			PLC DRAWINGS CONSISTING OF: PLC CONFIGURATION DIAGRAM PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING PLC WIRING DIAGRAM BACKUP PANEL MIMIC DRAWING PLC POWER SUPPLY CALCULATION CONTROL SCHEMES (BLOCK LOGIC) CONTROL DESK LAYOUT / GA DRAWING PLC-OWS/PRINTER, FURNITURE, Optic fiber cable datasheet & BOM PLC CATALOGUE ,BOI CATALOG PLC QUALITY PLAN & FAT PROCEDURE PROCESS GRAPHIC MANUSCRIPTS PANEL & ELECTRONIC EARTHING REQUIREMENT PANEL HEAT DISSIPATION DATA PLC EARTHING SCHEME		A
64			UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD CONSISTING OF; UPS SIZING CALCULATIONS BATTERY SIZING CALCULATIONS UPS QUALITY PLAN		A

Performance Guarantee Test Procedure

a. GAS CHLORINATION plant outlet water guarantee shall be as per approved attached Design memorandum document
b. The duration of the test shall not be less than 72 hours on continuous basis. These tests will be carried out within a reasonable period from the date of commissioning of the plant. The tests shall be conducted by the Bidder to prove beyond doubt the guaranteed performance of the plant to the satisfaction of the Purchaser
c. Chlorination:
    i. Each evaporator shall have a normal capacity not less than that specified in approved design memorandum.
    ii. Each chlorinator shall be of vacuum solution feed type
    iii. Emergency Leaked Chlorine Absorption System
        a) The outlet air from the Leaked Chlorine Absorption System must not have free residual chlorine more than 0.1 ppm
        b) The caustic solution flow rate through the absorber shall be such that chlorine from one leaked chlorine ton container (completely filled) can be absorbed within one hour maximum
        c) The capacity of Blowers shall be sufficient to suit the above requirement.
        d) Each pump shall be guaranteed for capacity, total dynamic head and power consumption.
        e) All blowers shall be guaranteed for head and power consumption
        f) The test procedures shall be as per relevant equivalent standards from recognized origins.

Water system packages fall under Category - B of this Performance Guarantee document. Bidder to refer below document in specific correlation w.r.t water system package only.

PERFORMANCE GUARANTEES

1.00.00 **PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE**

1.01.00 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

a) Those which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.

b) Those which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.02.00 The guaranteed parameters shall be without any tolerance values. The Bidder shall demonstrate all the guarantees covered in various volumes and sections of this specification during Performance/Acceptance test. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modification to make the equipment/system comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications within ninety (90) days of notification by the Owner, the Owner will at his discretion :

i. reject the equipment and recover the payment already made or accept the equipment only after levying liquidated damages as identified in this section for those guarantees which are covered under category "A".

OR

ii. reject the equipment and recover the payment already made or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

1.03.00 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, accuracies of various instruments used for the performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements

specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 **Performance/Acceptance Tests**

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 **START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS**

For the purpose of Taking over of the Plant, the following activities shall have to be completed successfully.

i) Mechanical Completion
ii) Preliminary Operation
iii) Initial Operation
iv) Reliability Operation
v) Trial Operation
vi) Performance Guarantee Tests

2.01.00 **Mechanical Completion**

(a) Mechanical completion is defined as the state of readiness of works and completeness of Field Quality checks under the scope of contract to undergo the pre-commissioning checks, followed immediately thereafter by commissioning including preliminary operation, initial operation, reliability operation, performance tests including unit characteristics tests for functional or operational occupation of the

works.

(b) Mechanical completion shall be deemed to occur when the contract erection/installation/construction and Field Quality check works are completed as per specifications for all equipment / systems including standby. It also include but not limited to the following:

(i) all installation/erection and Field Quality checks duly carried out and individual protocol viz. erection, FQA (Field Quality Assurance) and commissioning protocol to be signed.

(ii) all defects/deficiencies notified by the Purchaser during installation/erection rectified to the satisfaction of Purchaser which, in the opinion of the Purchaser, will not affect the safe operability and maintainability of the works, and

(iii) the contract works, in the opinion of Purchaser, subject to sub-clause (ii) above, being fit, sound, safe and operable for undertaking the pre-commissioning checks, preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests followed by subsequent commercial operation without interruption for reason of defect/deficiency or unfulfilled obligations of the Contractor in the erection/installation work.

2.02.00 **Specific Requirements of Mechanical Completion**

(a) Mechanical completion in different disciplines shall be determined based on the following characteristics, signifying the readiness of the works/plants and systems for undertaking the pre-commissioning checks and subsequent preliminary operation, initial operation, reliability operation and performance tests including unit characteristics tests as applicable to the contract works:

(i) All plant construction/installation in various disciplines, as detailed under (b) below and as applicable to the contract are completed including aesthetic and workmanship and safety aspects, with all installation/construction checks as per specification, relevant codes, standards and practices ensuring conformity to contract and meeting any applicable statutory requirements.

(ii) All contractual obligations up to the stage of completion of construction / installation are fulfilled to the satisfaction of the Purchaser.

(b) All contract works or otherwise ready to be taken into service, or for functional or operational occupation save pre-commissioning/ commissioning checks, preliminary operation, initial operation, reliability operation, performance tests, unit characteristics tests are to be carried out as per approved commissioning procedure submitted by the contractor including but not limited to the following:

(i) Areas inclusive of all roads, accesses, structures, housings, platforms, walkways, stairs, ladders, safe approach to equipments, safety/ protective guards, covers, hand rails and such items of work are constructed as per specification and approved for use.

(ii) Drains, sewers, waste disposal channels, vents, chutes, ducts and such works are constructed and connected to treatment and other disposal systems.

(iii) Equipment and piping in different systems/disciplines with all appurtenances, auxiliaries and accessories along with supporting structures, hangers, mounts, etc., are erected/ installed, supported, anchored, aligned, grouted and adjusted for operating conditions.

(iv) Electrical power supply, control, communication and lighting equipment along with control panels, control desks, switchgear, local starters and such accessories along with protective systems, interlocks and integral and auxiliary systems are permanently installed, aligned and adjusted, with megger, continuity and specified installation checks duly carried out.

(v) Cables are laid, routed, supported, dressed, clamped, tagged, ferruled and terminated with clamp terminals designated and all continuity and megger checks duly carried out.

(vi) Safety/relief valves are calibrated and set to operating conditions and tried out. All safety systems are installed, calibrated, checked and accepted.

(vii) Plant identification numbers, colour codes, tags, nameplates are duly mounted / painted/affixed.

(viii) All painting, lining and insulation works are completed with specified checks to the satisfaction of the Purchaser.

2.03.00 **Other Prerequisites for Mechanical Completion**

The Contractor shall also meet the following prerequisites for mechanical completion:

(a) Submit a compilation of all reports of shop tests, material tests and various stage inspection establishing total compliance to contract specification in manufacturing items of supply of contract.

(b) Submission of a certificate by the Contractor in a format agreed by the Purchaser that the contract works have been designed, selected, manufactured, furnished and installed under the full responsibility of the Contractor.

(c) All erected plants, structures, equipment and systems are maintained and preserved in sound condition and are fit and sound to undertake

pre-commissioning checks and 'tests before commercial operation' for operational and functional occupation immediately thereafter.

(d) All areas and constructed works are cleared daily upto the satisfaction of the Owner of all construction materials, temporary works, debris, rubbish water and all such impediments to render the contract works safe, sound and operable.

(e) All safety features and safety equipment are functional.

(f) Fire prevention and fire extinguishing system in all fire prone areas are to be made functional.

(g) Any specific statutory approvals pre-requisite to commissioning of the plant are duly obtained.

2.04.00 **Preliminary Operation**

Preliminary operation shall mean all activities undertaken as part of commissioning after mechanical completion upto commencement of initial operation and shall include mechanical and electrical checkouts, calibration of instruments and protection devices, commissioning of sub/supporting systems covered under the contract.

2.05.00 **Initial Operation**

Initial operation shall include all operations undertaken as part of commissioning after completion of preliminary operation upto commencement of reliability operation. It shall be the first integral operation of the complete BOP integrated with Boiler, Turbine Generator package covered under the contract and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out no-load / partial load /full loads runs for mechanical / electrical tryout and gathering of operational data, calibration, setting and commissioning of controls systems; and shutdown inspection and adjustment after running trails of the plant under the contract.

During initial operation each and every activity wise commissioning protocols are to be jointly signed by the Purchaser and Contractor commissioning team.

The auto loop control tuning shall continue upto the commencement of 72 hour full load operation of trial run.

The initial operations shall include operation of unit as a whole under normal operating conditions for twenty four (24) consecutive hours at the 100% TGMCR load or twelve (12) consecutive hours for two (2) consecutive days at the 100% TGMCR load unless otherwise agreed to by the Purchaser or restricted by system load conditions. The completion of initial operation will be certified in writing by the Purchaser.

2.06.00 **Reliability Operation**

(a) After the initial operations, the plant shall be on reliability operation. During the reliability operation, the Contractor will be allowed to make

minor adjustments as may be necessary, provided that such adjustments do not interfere with or prevent the commercial use of the plant or result in significant reduction of output. The duration of the reliability operation of plant shall be spread over a period of thirty (30) days. The maximum number of interruption attributable to Contractor shall be of four (4) numbers each not exceeding four (4) hours duration. In case either the number of interruptions, attributable to the Contractor, exceeds four (4) or the duration of any of the four (4) interruptions exceeds four (4) hours the reliability test shall be repeated.

(b) For the period of reliability operation, the time of actual operation shall be counted. In case the duration of actual continuous operation of any of the above modes is discontinued for reasons, which are not due to Contractor's fault or negligence, that particular test would be deemed to have satisfied the reliability operation test. However, should the test be discontinued due to Contractor fault, the test shall be restarted for that particular case.

(c) Should any failure (other than of an entirely minor nature) due to or arising out of faulty design, materials, or workmanship (but not otherwise) occur in any item of the plant, sufficient to prevent commercial use of the plant, the reliability test period of thirty (30) days shall recommence for that item after the defect has been remedied by the manufacturer/Contractor. The onus of proving that any failure is not due to faulty design, materials and workmanship will lie with the Contractor.

(d) A 'reliability operation' report comprising observations and recordings of various parameters measured in respect of the 'reliability operation' shall be prepared and submitted to the Purchaser. This report, besides recording the details of various observations during 'reliability operation' shall also include the dates of start and finish of the reliability operation and shall be signed by the representatives of both the parties. The report shall have recordings of all details of interruptions that occurred, adjustments made and any repairs carried out during the 'reliability operation'.

Also a punch list is to be prepared during the reliability test and the defects are to be rectified by the contractor before commencement of 72 hour operation at full load during trial operation.

(e) Should any failure or interruption occur in any portion of the tests due to or arising from faulty design, materials, workmanship, omissions, incorrect erection, or inadequate instructions by the Contractor's supervisors, sufficient to prevent safe commercial use of the plant, the reliability operation test at the particular load shall be considered void and the reliability test shall recommence after the Contractor has remedied the cause of the defect.

(f) During the reliability operation all the equipments, Raw/ DM water system and sub-systems, control loops, interlocks and protection including switchyard installations will be in service and change over to standby equipments are to be done on running condition of the unit.

(g) The 'reliability operations' shall be considered successful, provided that each item of plant can meet the above requirements.

(h) Upon the completion of 'reliability operations', as soon as practicable, or at such time as may be otherwise agreed to by the parties concerned, the Contractor shall notify in writing to the Purchaser that the Plant is ready for performance tests.

2.07.00 **TRIAL OPERATION:**

1. On completion of erection of any major items along with its auxiliaries, the same shall be thoroughly inspected by the Contractor together with the TSGENCO's Engineers for correctness and completeness and acceptability for pre-commissioning tests. Though the TSGENCO's Engineers associate themselves with such inspection, the responsibility for declaration for correctness, completeness and acceptability shall rest with the Contractor and the pre-commissioning tests and inspections shall be carried out after such declaration. The pre-commissioning tests to be performed at site as well as necessary documentation and formats for the protocols to be signed during and after the tests shall be prepared by the Contractor taking into account relevant Indian/International/ Manufacturers standard as applicable and finalized by the TSGENCO sufficiently in advance through mutual discussions. On conclusion of satisfactory pre-commissioning tests of each individual equipment, the trial operation of the unit shall start consistent with parameters of the technical specifications.

2. The duration of trial operation shall be for 14 days during which period the unit shall be run from half to full load or any other load cycle mutually agreed to during which period the unit shall run at full load for 72 hours continuously. However, if required, the Purchaser and the Contractor may mutually agree for economical load operation for 48 hours continuously. Any interruption caused by the Contractor up to 24 hours will not effect the period of 14 days indicated above. In case of such interruption occurring for more than 24 hours, the above period shall be extended correspondingly. During the above trial operation the standby auxiliary equipment shall also be run for a minimum period of more than 72 hours during which period the equipment shall run at its rated capacity for a minimum period of 24 hours. Further the above trial operation shall be carried out in full fledged manner with the associated instruments and controls. The unit is deemed to be commissioned on successful completion of the above trial operation.

3. A document shall be prepared on the results of trial operation. This document besides recording of the details of the various observations during the trial run will also include the date of start and finish of the trial operation and will be signed by the representative of both the parties. The document of the trial operation shall have log sheets and all adjustments, repairs, interruptions etc., shall be recorded therein. If any major adjustment is carried out which has been changed from the initial operation value, then the reason for it is to be furnished in the

report in detail.

The Purchaser and the Contractor will observe the plant overall reliability and shall test the equipment runback, rundown, auto start of equipments, CMC function and its reliability, complete automation of the plant system etc.

4. The readiness of the unit for the trial operation shall be intimated by written notice to the TSGENCO after mutual discussions. After receipt of such notice if the trial operation could not be performed or could not be completed due to any reasons not attributable to the Contractor and if the situation continues, the Contractor shall be absolved of the responsibility for the delay and the plant shall be deemed to have been taken over by the TSGENCO at the end of 60 days after the Contractor's notifications of readiness of the same.

5. The trial operation shall be carried out in compliance with relevant manufacturer's standards and/or relevant Indian/International standards and manufacturer's operation directions before starting them.

6. Defects which are minor in nature and do not endanger the safe operation of the plant, shall not be considered as reasons for not taking over the plant by the TSGENCO. These defects shall be listed in the above mentioned documents and shall be rectified by the Contractor in accordance with the agreement made in this respect.

2.08.00 **Performance Tests**

(a) PG test notification to be given by the contractor to the purchaser after COD. The performance tests shall be conducted at site on all major systems by the Contractor. The Contractor's commissioning Engineers shall make the entire plant ready for such tests and assist the Purchaser in operation during the tests. The test shall be commenced after the 'Plant/Equipment' has attained stable operation at the end of 'reliability operation'. The date of commencement of the performance tests shall be as soon as practicable on completion of the 'reliability operation' or as may be mutually agreed upon between the Contractor and Purchaser.

Final trail operation shall be carried out for a period of seventy two (72) hours at 100% TGMCR before 'taking over'.

(b) **Independent Inspector**

The Purchaser reserves his right to appoint an independent inspector at his own cost as his representative to discuss the test programme, to approve the instrumentation, to witness the tests and to analyze the test results.

(c) The tests shall be binding on both the parties of the contract to determine compliance of the 'plant'/'equipment' with the performance

guarantees.

(d) The performance tests shall be carried out to prove the guarantees. The purpose of the performance tests is to check whether the plant meets the guaranteed performances.

(e) The performance test procedure, the instrumentation to be installed, the instrument accuracy classes, including the definition of the calculation method to be used, the areas of responsibility and the items which specifically require preparation and agreement shall be submitted by the Contractor for review and approval during detail engineering phase. The schematics identifying the guarantee test instrumentation shall be submitted along with procedure. It shall be ensured that necessary test points and spool pieces are installed during the detail-engineering phase and also identified in process and instrumentation drawings. Code of the PG test is to be fixed up during detail engineering stage. The Contractor shall furnish detail test programme during detail engineering stage.

(f) The performance test instruments shall be of precision type with instrument accuracy limits as required and defined in the applicable performance test codes such that measurement uncertainty does not exceed the values agreed to by the Contractor in the Schedule of Performance Guarantees.

(g) All test instrumentation for the performance tests as required shall be supplied by the Contractor on loan basis. All costs associated with the supply, calibration, installation and return of the test instrumentation are deemed to have been included in the contract price. The test shall be in accordance with those specified or as per agreed performance test codes. Batch calibration shall not be accepted.

(h) Any special equipment, tools and tackle required for successful completion of the performance tests shall be provided by the Contractor.

(i) It is Contractor's responsibility to co-ordinate for carrying out the performance tests. The duration of the test shall be in accordance with the agreed test codes. All other tests to prove the guarantees as indicated in the Contractor's offer shall also be conducted.

(j) The plant parameters during the performance test shall be adjusted as far as practicable to the guaranteed performance test conditions. The tests shall be conducted to provide guaranteed parameters as defined in the contract.

(k) Category-B tests are to be completed before Category-A PG test. Protocols are to be signed jointly by the Purchaser and Contractor for each Category-B test.

(l) **Reporting of Test Results**

(a) Within two weeks after the conclusion of the performance test,

the Contractor shall submit ten (10) copies of test reports to the Purchaser stating whether the plant passed or failed such test(s), accompanied by sufficient test data and calculations to demonstrate the level of performance attained with respect to each of the tested parameters.

(b) The report(s) shall include as a minimum, the following:-

(i) Scope

(ii) Various guaranteed parameters & tests as per the contract.

(iii) Codes/standards used

(iv) . Description of the test procedures

(v) Full schematic diagrams with indication of test instruments locations and identification tags of same.

(vi) Instrumentation details and calibration.

(vii) Duration of test, frequency of readings and number of test runs

(viii) Test logs and summary of test readings used for performance calculations.

(ix) Full set of correction curves.

(x) Computation of test results.

(xi) Sample calculation

(xii) Performance calculation

(xiii) Computations to prove measurement uncertainty is within acceptable limits.

(xiv) Acceptance criteria

(xv) Any other information required for conducting the test

(xvi) Conclusions of performance tests.

(m) Within fifteen (15) days of receipt of such test report(s), the Purchaser shall submit a notice to the Contractor stating either:-

(i) That Purchaser concurs with the information provided in the test report(s), or

(ii) That Purchaser disputes some or all of the information provided

in the Contractor's test report(s), the areas being disputed, and the levels of performance being disputed.

(n) If Purchaser concurs with the information in the Contractor's test report(s), the Purchaser shall, within fifteen (15) days of receipt of the test report, provide a written notice to the Contractor accepting the results of the tests.

(o) If Purchaser disputes any or all of the results contained in the Contractor's test report(s), the Contractor and Purchaser shall meet within fifteen (15) days of the receipt of the Purchaser notice at a mutually acceptable location to review and discuss the dispute.

All the category-B test results are to be computed and to be submitted along with the PG test report for detail study by the Purchaser.

2.08.00 **Notice of Tests**

The Contractor shall issue 21 days notice to the Purchaser of the date after which he will be ready to commence the tests and the Contractor shall commence the tests promptly thereafter.

2.09.00 **Delayed Tests**

(a) If the tests could be carried out but are being unduly delayed by the Contractor, the Purchaser may by notice inform the Contractor to conduct the tests within 14 days after the receipt of such notice. The Contractor shall conduct the tests on such days within that period as the Contractor may fix and of which he shall issue notice to the Purchaser.

(b) If the Contractor fails to conduct the tests within such notice period, the Purchaser may himself proceed with the tests. All tests so conducted by the Purchaser shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the contract price or charged to the Contractor. The tests shall then be deemed to have been conducted by the Contractor and the test results shall be binding on the Contractor.

(c) **Facilities for Tests on Completion**

Except where otherwise specified, the Contractor shall provide and bear costs for these items, as may be required to carry out the tests on completion.

(d) **Retesting**

If the plant fails to pass the test (which in the case of performance tests means not achieving the acceptable limits), the Purchaser may require such tests to be repeated on the same terms and conditions save that only reasonable notice of the date and time of such tests shall be required to be given by the Contractor to the Purchaser.

(e) **Disagreement as a Result of Tests**

If the Purchaser and the Contractor disagree on the interpretation of the test results, each shall give a statement of his views to other within 14 days after such disagreement arises. The statement shall be accompanied by all relevant evidence.

ANNEXURE -6

DRAWINGS & DOCUMENTS ATTACHED

The following drawing/document are enclosed as a part of the specification:

1. Design Memorandum : 4-WT-040-01042 , Rev:04
2. P&ID For CW Gas Chlorination(Unit 1 & 2) : 2-WT-040-00262 , Rev:01
3. P&ID For CW Gas Chlorination(Unit 3,4&5) : 2-WT-040-00263 , Rev:01
4. P&ID For RW Gas Chlorination : 3-WT-040-00843 , Rev:01
5. P&ID For PW Gas Chlorination : 3-WT-040-00844, Rev:01
6. Layout For CW Gas Chlorination(Unit 1 & 2) : 1-WT-080-01845
7. Layout For CW Gas Chlorination(Unit 3,4&5) : 1-WT-080-01846
8. Layout For RW Gas Chlorination : 1-WT-040-01865
9. Layout for PT plant : 1-WT-025-01848
10. Layout For DM plant : 1-WT-500-01859

TATA CONSULTING ENGINEERS LIMITED
VENDOR DOCUMENT REVIEW STATUS

- ☑ A Drawing/Document approved as submitted. Proceed with fabrication/construction.
- ☐ B Drawing/Document approved subjected to comments noted. Proceed with fabrication/ construction considering our commnets.
- ☐ C Our comments are noted on this marked up print.
- ☐ D Our commnets are noted in memo attached to the forwarding transmittal letter No. .....Dated.....
- ☐ E Correct original of this drawing/document to reflect our comments and resubmit for approval.
- ☐ F Correct original of this drawing/document to reflect our comments and resubmit for records.
- ☐ G Drawings/Documents of this category are for information only and not for approval. Information furnished on the drawing/document is noted.
- ☑ H Drawing/Document reviewed against our previous comments and resolutions highlighted and identified by the vendor.
- ☐ I Drawing/Document returned without review.
- ☐ J Print not enclosed.

Approval conveyed herein neither relieves the Vendor/Contractor of his contractual obligations and his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance requirements and conformity of the supplies with the Indian Statutory Laws as may be applicable, nor does it limit the purchasers rights under the contract.

Reviewed by..... MB ..... Date 24-02-2020

Rev.No	Date	Prepared	Checked	Approved	Remarks
04	22.02.20	Sd/- ABH	Sd/- SS	Sd/- MSM	Comments resolutions dt.04.02.20
03	28.01.20	Sd/- ABH	Sd/- SS	Sd/- MSM	Resolutions dt.25.01.20
02	10.09.19	Sd/- ABH	Sd/- SS	Sd/- MSM	Comments dt.06.09.19
01	20.07.19	Sd/- ABH	Sd/- SS	Sd/- MSM	Comments dt.21.08.18
00	22.12.17	Sd/- ABH	Sd/- SS	Sd/- MSM	Fresh Issue

TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA STATE, INDIA
5 X 800 MW YADADRI - NALGONDA THERMAL POWER STATION

OWNER's CONSULTANT

TATA CONSULTING ENGINEERS LIMITED
BANGALORE

BHARAT HEAVY ELECTRICALS LTD
BOILER AUXILIARIES PLANT
RANIPET – 632 406.

DEPT CODE		NAME	SIGN	DATE
9776	PRPD	ABH	Sd/-	22.12.17
	CHD	SS	Sd/-	22.12.17
	APPD	MSM	Sd/-	22.12.17

TITLE

DESIGN MEMORANDUM FOR CW, RW & PW CHLORINATION PLANT FOR UNIT 1,2,3,4 & 5

DOCUMENT NO. **4-WT-040-01042**

REV.NO **04**

INDEX

1.0 SCOPE

The scope of this design memorandum covers the basis of design, system philosophy, equipment selection and layout aspects and Control Philosophy of Gas Chlorination Plant for CW, RW & PW Chlorination plant and Chlorine Absorption System for **5X800 MW YADADRI - NALGONDA TPS.**

2.0 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.

2.1 CALCULATION FOR CW-1 CHLORINATION PLANT CAPACITY

A. STAGE-1 (UNIT-1&2)

△4

CW & ACW Flow Capacity	=	2 x [CW:84210 + ACW:3451.2] m^3/hr = 175322.4 m^3/hr
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose	=	(175322.4X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	876.6 Kg./hr
Chlorinator selected based on shock dosing	=	5 @ 225 kg/hr (4W +1S)
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs.
Daily Chlorine requirement as per shock dose	=	1.5X 876.6 Kg./hr
	=	1314.9 Kg/Day
Chlorine requirement as per continuous dose		(175322.4 X 1)/1000 Kg/hr
	=	175.3 Kg/hr
Daily Chlorine requirement as per continuous dose	=	175.3 X 22.5 = 3944.25 Kg/Day.
Total Chlorine requirement	=	(1314.9+3944.25) Kg/Day.
	=	5259.15 Kg/Day.
Chlorine consumption for 15 days	=	78887.25 Kg
Filled Chlorine tonners required (@900 Kg)	=	87.65 nos.

Filled Chlorine tonners that shall be supplied (@900 Kg)	=	**90.0 NOS.**

B. STAGE-2 (UNIT-3,4&5) ④

CW & ACW Flow Capacity	=	3 x [CW:84210 + ACW:3451.2] m^3/hr = 262983.6 m^3/hr
Chlorine dosing rate (shock)	=	5 ppm
Total Chlorine consumption rate as per shock dose	=	(262983.6X 5)/1000 Kg./hr
Chlorine requirement as per shock dose	=	1314.92 Kg./hr
Chlorinator selected based on shock dosing	=	7 @ 225 kg/hr (6W +1S)
Frequency and Period of shock dosing	=	0.5 hr in 8 hrs.
Daily Chlorine requirement as per shock dose	=	1.5X 1314.92 Kg./hr
	=	1972.38 Kg/Day
Chlorine requirement as per continuous dose		(262983.6 X 1)/1000 Kg/hr
	=	262.98 Kg/hr
Daily Chlorine requirement as per continuous dose	=	262.98 X 22.5 = 5917.05 Kg/Day.
Total Chlorine requirement	=	(1972.36+5917.05) Kg/Day.
	=	7889.41 Kg/Day.
Chlorine consumption for 15 days	=	118341.15 Kg
Filled Chlorine tonners required (@900 Kg)	=	131.49 nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	135 nos.

2.2 EQUIPMENT DESIGN CRITERIA

Gas chlorination systems for Stage-1 and for Stage-2 have been provided. The chlorination plant shall consist of the following main equipment & accessories

- Chlorine ton containers,
- Pipe manifold with accessories
- Evaporator
- Chlorinator
- CW booster pumps
- Basket Strainers

- Chlorine gas leak detector & safety equipment
- Chlorine gas absorption system
- Lifting & handling devices
- Associated piping, instrumentations & necessary controls. 4

2.2.1. Chlorine Ton Container

Chlorine Ton Containers are provided with isolation valves, educator tubes, two (2) numbers Roller Supports, safety accessories and Automatic Switch Over facility for each Stage. Details on number of Ton containers are specified in datasheet.

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

10Nos. of Chlorine Manifolds each with all accessories for Stage-1 & 14Nos. of Chlorine manifolds each will all accessories for Stage-2 are considered. However, the total number of Manifolds will be decided based on recommendations of Gas chlorination vendor. 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.

2.2.3. Evaporator

5Nos. of electrically heated water bath type Chlorine Evaporators, each with all accessories for Stage-1 and 7Nos. of electrically heated water bath type Chlorine Evaporators, each with all accessories for Stage-2 are provided.

2.2.4. Chlorinator

5Nos. of Chlorinators for Stage-1 & 7Nos. of Chlorinators for Stage-2, each vacuum operated aqueous solution feed type complete with all accessories are provided. Each Chlorinator have the items as follows:

1) Remote Vacuum Regulator.
2) Cabinet with:
   a) Chlorine Gas Flow meter.
   b) Differential Pressure Regulator.
   c) Flow Control Valve.

3) Fixed throat type Remote Ejector

2.2.5. Booster water pumps

Water Supply Booster Pumps, each complete with electrical drive motor and all other accessories to supply water to the Evaporators and Chlorinators.

2.2.6. Basket strainers

Two (2) numbers (1W+1S) at upstream of Suction Header of each booster water pump.

2.2.7. Diffuser

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. 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.

2.2.8. Hoist mono-rails

Electrically operated monorail hoist shall be provided for lifting the ton container in each of the CW chlorination building. 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.

2.2.9. 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. 1No. weighing scale for Stage-1 CW Chlorination building, 1No. weighing scale for Stage-2 CW Chlorination building shall be provided.

2.2.10. 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.

2.2.11. 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 detector.
Refer Datasheet Cl.7.0

Emergency kit
Four (4) numbers with all accessories shall be provided to seal off Chlorine Ton-Containers in each of Stage-1 & Stage-2 CW Chlorination building.

2.3 CHLORINE LEAK ABSORPTION SYSTEM FOR CW CHLORINATION OF UNIT 1 &2 & UNIT 3,4&5

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, dual redundant level transmitter, water filling connection etc.

The absorption system shall mainly comprise of:

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

1a) 40 numbers of full FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for Stage-1 (Unit 1 & 2). 56 numbers of full FRP hoods to enclose Chlorine Ton Containers connected to the manifolds for 3 Units (Unit 3, 4 & 5) each with flexible hose arrangement for connection to FRP Duct Work.

1b) Half hood shall be provided for rest of the cylinder (which are not connected).

1c) One (1) number of Ventilation Fans with one (1) number additional ventilation fan as stand by, each complete with electrical drive motor and all other accessories for each of the leak absorption system

1d) Two (2) numbers Blowers, each complete with electrical drive motor and all other accessories for each leak absorption system.

1e) One (1) number Chlorine Absorption Tower complete with all accessories for each leak absorption system.

1f) One (1) number Caustic Solution preparation cum Recirculation Tank, complete with agitator as well as its drive motor & all other accessories for each leak absorption system.

1g) Two (2) numbers Caustic Solution Preparation cum Recirculation Pumps, each complete with electrical drive motor and all other accessories for each leak absorption system.

1h) FRP Duct Work to Absorption System with all accessories as required for each leak absorption system.

1i) Interconnecting piping valves, ducts, control and instrumentation.

1j) Two (2) sets of Safety & Supervisory Equipment & instruments as per requirements for each Gas Chlorination plant for Unit 1 &2 & Unit 3, 4 &5.

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

3.0 DESIGN PHILOSOPHY FOR RAW WATER (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.

3.1 CALCULATION FOR RAW WATER CHLORINATION PLANT CAPACITY

Total RW Flow	=	10457 m^3/hr
Chlorine dosing rate (Continuous dosing)	=	5 ppm
Total Chlorine consumption rate for	=	(10457x5)/1000

Continuous dosing		
Chlorine requirement	=	52.29 Kg./hr
Chlorinator selected	=	2 nos @ 60 Kg/Hr (1W+1S)
Chlorine requirement as per continuous dose	=	52.29x24=1254.96 Kg./day
Chlorine consumption for 15 days	=	18824.4kg
Filled Chlorine tonners required (@900 Kg)	=	20.92nos.
Filled Chlorine tonners that shall be supplied (@900 Kg)	=	**21.0 NOS.**

3.2. EQUIPMENT DESIGN CRITERIA

Gas chlorination systems for Stage-1 and for Stage-2 have been provided. The chlorination plant shall consist of the following main equipment & accessories

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

3.2.1. Chlorine Ton Container

Chlorine Ton Containers are provided with isolation valves, educator tubes, two (2) numbers Roller Supports, safety accessories and Automatic Switch Over facility for each Stage. Details on number of Ton containers are specified in datasheet.

The design, fabrication and testing of ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur

3.2.2. Pipe manifold with accessories

2Nos. of Chlorine Manifolds each with all accessories are considered. However, the total number of Manifolds will be decided based on recommendations of Gas chlorination vendor.

3.2.3. Evaporator

2Nos. of electrically heated water bath type Chlorine Evaporators, each with all accessories are provided.

3.2.4. Chlorinator

2Nos. of Chlorinators, each vacuum operated aqueous solution feed type complete with all accessories are provided. Each Chlorinator have the items as follows:

1) Remote Vacuum Regulator.
2) Cabinet with:
   a) Chlorine Gas Flow meter.
   b) Differential Pressure Regulator.
   c) Flow Control Valve.
3) Fixed throat type Remote Ejector

3.2.5. Booster water pumps

Water Supply Booster Pumps, each complete with electrical drive motor and all other accessories to supply water to the Evaporators and Chlorinators.

3.2.6. Basket strainers

Two (2) numbers (1W+1S) at upstream of Suction Header of each booster water pump.

3.2.7. Diffuser

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. 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.

3.2.8. Hoist mono-rails

Electrically operated monorail hoist shall be provided for lifting the ton container in RW chlorination building. 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.

3.2.9. 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. 1No. weighing scale for RW Chlorination building shall be provided.

3.2.10. 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.

3.2.11. 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 detector.
Refer Datasheet Cl.7.0

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

3.3 CHLORINE LEAK ABSORPTION SYSTEM FOR RW CHLORINATION OF UNIT 1, 2, 3, 4&5

An automatic chlorine leak absorption system has been provided for Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralization of about one-ton chlorine leakage in one hour.
Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, dual redundant level transmitter, water filling connection etc.
The absorption system shall mainly comprise of:

- 8 Nos. of FRP Hood covering full portion of the tonner in service and duct.
- 2 Nos. (1 working + 1 stand-by) Blowers.
- One (1) no. absorption tower (FRP) with packing.

- One (1) no. alkali storage tank.
- 2x 100% (1 working + 1 standby) alkali solutions cum recirculation pumps.
- Adequate numbers of Ventilation Fans with one (1) number additional Ventilation Fan as stand by, each complete with electrical drive motor and all other accessories
- Interconnecting piping valves, ducts, control and instrumentation.

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

4.0 DESIGN PHILOSOPHY FOR POTABLE WATER CHLORINATION

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

4.1 CALCULATION FOR PW CHLORINATION PLANT CAPACITY

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

4.2. EQUIPMENT DESIGN CRITERIA

There will be two (2) streams each of capacity 50 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:

4.2.1. Chlorine cylinder

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

4.2.2. 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 equipped with necessary instrumentation for safe & reliable operation. 4

Each chlorinator consists of the following

- Vacuum regulator
- Chlorine gas flow meter
- Differential pressure regulator
- Manual flow control valve
- Fixed throat type remote ejector

4.2.3. 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 has one basket strainer.

4.2.4. Diffuser

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. 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

4.3. CHLORINE LEAK ABSORPTION FOR PW CHLORINATION

Chlorine gas cylinders are envisaged for Potable water chlorination. All safety equipment required for leak detection, protection is considered for Potable water chlorination system. Additionally, a Caustic pit of capacity 200 litres is provided for neutralization of chlorine in case of leakage.

5.0 LAYOUT CONSIDERATION FOR CW, RW & 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 RW Chlorination building. 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.

6.0 OPERATION CONTROL PHILOSOPHY & INSTRUMENTATION

4 6.1. RW CHLORINATION

The operation of RW chlorination system shall be semi-automatic and envisaged through the RIO panel linked to CW Chlorination Stage 1 PLC.

Each manifold shall have triple redundant pressure switch which shall be interlocked with auto changeover valve. The pressure switch shall immediately send a signal to the Auto Changeover Valve 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 provided indicates 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 related Booster Pumps reaches below the set point set point value.
The dual redundant Vacuum Switch along with 1 No Vacuum transmitter will give signal to PLC if the system fails to create specified vacuum. At the same time the dual redundant Pressure transmitter 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 always be kept open manually.

Chlorine Tonner Storage Area and Chlorination Room will be properly ventilated by intermittent 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, ventilation fans and drive motors as required, ammeters for drive motors wherever required shall be displayed in PLC Operator work station.

All drive motors & valves shall be connected to PLC and signal exchange as described in Drive Control Philosophy (PE-DM-417-145-I002) shall be implemented

in respective PLC/DCS as per Control Philosophy for Mechanical Auxiliary packages (PE-DM-417-145-I900). Tripping of different motors, level alarms etc. shall also be annunciated. Reading of residual chlorine shall be indicated in Chlorination System PLC for monitoring dosing rate of RW chlorination stream.

6.2. CW CHLORINATION

4 The operation of the Circulating Water Chlorination System shall be semi-automatic through the PLC based control system with LCD screen based Operator Work Station located in Control Room inside CW treatment plant building of respective stages.

Each manifold shall have triple redundant pressure switch which shall be interlocked with auto changeover valve. The pressure switch shall immediately send a signal to the Auto Changeover Valve 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 provided indicates 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 related Booster Pumps reaches below the set point set point value.
The dual redundant Vacuum Switch along with 1 No Vacuum transmitter will give signal to PLC if the system fails to create specified vacuum. At the same time the dual redundant Pressure transmitter 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 always be kept open manually. Reading of residual chlorine shall be indicated in Chlorination System PLC for monitoring dosing rate of CW chlorination stream. During shock dosing, 4 booster pumps will be in operation in Stage-1 and 6 booster pumps will be in operation in Stage-2. During continuous dosing, 1 booster pump in stage 1 and 2 booster pumps in stage 2 will be in operation.

Chlorine Tonner Storage Area and Chlorination Room will be properly ventilated by intermittent 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, ventilation fans and drive motors as required, ammeters for drive motors wherever required shall be displayed in PLC Operator work station.

All drive motors & valves shall be connected to PLC and signal exchange as described in Drive Control Philosophy (PE-DM-417-145-I002) shall be implemented in respective PLC/DCS as per Control Philosophy for Mechanical Auxiliary packages (PE-DM-417-145-I900).
Tripping of different motors, level alarms etc. shall also be annunciated. Reading of residual chlorine shall be indicated in respective Chlorination System PLC provided stage wise for monitoring dosing rate of Chlorination stream.

6.3. PW CHLORINATION

The operation of PW chlorination system shall be semi-automatic and envisaged through the RIO panel linked to CW Chlorination Stage 1 PLC.

4 Each manifold shall have triple redundant pressure switch which shall be interlocked with 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.
The PW chlorinator consists of Vacuum regulator, Chlorine gas flowmeter rotameter, flow control valve.
The dual redundant Vacuum Switch along with 1 No Vacuum transmitter will give signal to PLC if the system fails to create specified vacuum. At the same time the 2 nos Pressure transmitter provided at the discharge of Booster Pumps will give header pressure signal to PLC**.** In the event of chlorine leakage, the Chlorine Leak Detector shall give signal to PLC for alarm and shall stop the running PW booster pump. The suction pressure transmitters provided at common suction header shall function as interlock for start of PW booster pumps and shall trip in case the suction header pressure is low. The motorized valve provided at the discharge of booster pump shall open for the pump selected for working. The motorized valve provided at the inlet of ejector shall remain open for the selected ejector. Flow indicating transmitter shall indicate the ejector flow reading in PLC for monitoring of dosing inlet flow.
Reading of residual chlorine shall be indicated in Chlorination System PLC for monitoring dosing rate of Potable Water chlorination stream.
PW chlorination area shall be properly ventilated by continuously running of ventilation fans.

ON/OFF/TRIP status of booster pumps and ventilation fans, ammeters for drive motors wherever required shall be displayed in PLC Operator work station.

All drive motors shall be connected to PLC and signal exchange as described in Drive Control Philosophy (PE-DM-417-145-I002) shall be implemented in respective PLC/DCS as per Control Philosophy for Mechanical Auxiliary packages (PE-DM-417-145-I900).

Tripping of different motors, level alarms etc. shall also be annunciated. Reading of residual chlorine shall be indicated in Stage 1 Chlorination PLC provided for monitoring dosing rate of Chlorination stream.

7.0 DATA SHEETS FOR VARIOUS CHLORINATION SYSTSEMS

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

1.0	**CHLORINE TON-CONTAINERS**	**Stage 1**	**Stage 2**
1.1	Number	Ninety (90) [Forty (40) numbers Ton Containers will be connected to manifolds and other Fifty (50) numbers Ton Containers will be kept as storage].	One Hundred Thirty Five (135) [Fifty six (56) numbers Ton Containers will be connected to manifolds and other Seventy nine (79) 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		
1.12.1	Container valves		
1.12.1.1	Number	One set for each Chlorine Ton-Container.	
1.12.1.1	Design Standard	IS-3224 or Equivalent.	
1.12.2	Eductor Tubes		
	Number	Two (2) numbers educator pipes shall be provided for each, each terminating into an isolating valve.	
	Purpose	One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine.	
1.13	Instrumentation and Control	Shall be provided as per specification and Approved P&ID	
1.14	Changeover Module	As per requirement to complete the system in all respects. (Chlorine automatic changeover facility with manifolds, valves, instruments & fittings etc.)	
2.0	**EVAPORATORS**	**Stage 1**	**Stage 2**
2.1	Number	Five (4W+1S) numbers	Seven (6W+1S) numbers
2.2	Description for each Evaporator		
2.3	Location	Indoor.	
2.4	Capacity	Not less than 225 Kg/Hr.	
2.5	Type	Electrically heated constant temperature immersion water bath type.	
2.6	Material of construction		
2.6.1	Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless	
2.6.2	Bottom flange(inlet chamber)	SA 105	
2.6.3	Counter Flange	IS 2062 Gr.B	
2.6.4	Flange: Outlet Chamber	IS 2062 Gr.B	
2.6.5	Outlet Chamber Pipe	IS: 3589 2001 ERW pipe	
2.6.6	Gas outlet pipe	SA 106 Gr. B Seamless	
2.6.7	Top Flange (Inner Chamber)	SA 105	
2.6.8	Gasket	Asbestos free gasket as per ISO 14001	
2.6.8.1	Inner chamber pipe	SA 106 Gr. B	
2.6.9	Super heat baffle pipe	SA 106 Gr. B	
2.6.10	Base plate	IS 2062 Gr.B	
2.6.11	Inlet and outlet pipe flange	SA 105	

2.6.12	Overflow and drain piping	MS IS: 1239 Heavy (Galv)
2.7	Corrosion Allowance	3 mm (minimum)
2.8	Radiography	100 %.
2.9	Heat treatment	Fully stress-relieved.
2.9	Accessories	
2.9.1	Rupture Disc	
2.9.1.1	Number	One (1) for each Evaporator.
2.9.1.2	Type	Bellow/Diaphragm type with local facility for adjustment of set point.
2.9.1.3	Size	Suitable.
2.9.1.4	Allowable Pressure	28 kg/cm^2 (approx)
2.9.1.5	Material of construction	Body – Silver coated Carbon Steel.
2.9.2	Expansion Chamber	
2.9.2.1	Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
2.9.2.2	Size	Will be provided after finalization of Vendor
2.9.2.3	Thickness	Sch 80
2.9.2.4	Design code	ASME SEC VIII Div 1
2.9.2.5	Fluid Handled	Chlorine Gas/ Chlorine Liquid
2.9.2.6	Design Pressure	40 Kg/cm^2 (g).
2.9.2.7	Radiography	100% on all butt weld joints
2.9.2.8	Hydro Test Pressure	60 Kg/cm^2 (g).
2.9.3	Heating element.	
2.9.3.1	Number/ Unit	As per manufacturer standard
2.9.3.2	Capacity	As per manufacturer standard
2.9.3.3	Type	Immersion type, 3-phase, 415 V, 50 Hz.
2.9.3.4	MOC	SS 304 Coil Body MS IS: 2062 Gr. B
2.9.4	Pressure Relief Valve	
2.9.4.1	Number	One (1) for each stream.
2.9.4.2	Type	Screwed end full port.
2.9.4.3	Size	Suitable
2.9.4.4	Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
2.9.4.5	Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
2.9.4.6	Body Test Pressure	60 Kg/cm^2.
2.9.5	Water Chamber	
2.9.5.1	Size and thickness	Will be provided after finalization of vendor.

2.9.5.2	Insulation Material	Glass Wool Aluminum Sheet	
2.9.5.3	Temp of water bath	80 ^{0} C	
2.9.5.4	Fluid handled	Water	
2.9.5.5	Design pressure	Water	
2.9.5.6	Hydro-test pressure	Water fill test	
2.9.5.7	Joint efficiency	0.7	
2.9.5.8	Radiography	Nil	
2.9.5.9	Corrosion allowance	1.5 mm	
2.9.6	Electrically interlocked shut-off valve at the gas discharge line from Evaporator	Shall be provided.	
2.9.7	Cathodic protection system		
2.9.7.1	Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided with Ammeter	
2.9.7.2	Purpose	Shall be provided to protect Water Bath and outside of Evaporator.	
2.9.8	One (1) number Control Cubicle complete with necessary contactors, fuses, push buttons, indication lamps, ammeters and other instruments for each Evaporator	Shall be provided.	
2.9.9	Instrumentation and Control	Will be provided as per the specification and approved P&ID	
3.0	**CHLORINE STRAINERS**	**Stage 1**	**Stage 2**
3.1	Number	Two (2) for each Chlorinator	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	
3.7	Instrumentation and Control	Will be provided as per the specification and approved P&ID	
4.0	**PRESSURE REGULATING VALVE**	**Stage 1**	**Stage 2**
4.1	Number	One (1) for each stream.	One (1) for each stream.
4.2	Description for each Valve		
4.3	Type	Spring loaded silver diaphragm	
4.4	Material of construction		

4.4.1	Body	Carbon Steel as per ASTM A 105.	
4.4.2	Diaphragm	PTFE.	
4.4.3	Trim	Monel.	
4.5	Size	Suitable	
4.6	Location and mounting	Gas line from evaporator to chlorinator to Subject chlorinators to less pressure during operation.	
4.7	Spring range	0-10 Kg/cm^2.	
4.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.	
4.9	Body Test Pressure	60 Kg/cm^2.	
5.0	**CHLORINATORS**	**Stage 1**	**Stage 2**
5.1	Number	Five (4W+1S) numbers	Seven (6W+1S) numbers
5.2	Description for each Chlorinator		
5.3	Location	Indoor.	
5.4	Capacity, Kg/hr	225 Kg/hr.	
5.5	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self-colored, resistant to corrosion by chlorine gas and chlorinated water solution.	
5.6	Design Standard	IS: 10553 Part 2	
5.7	Accessories for each chlorinator		
5.7.1	Vacuum Stabilizing valve		
5.7.1.1	Number	1 number	
5.7.1.2	Type	Diaphragm Type	
5.7.1.3	Material		
5.7.1.3.1	Body	PVC	
5.7.1.3.2	Diaphragm	PTFE	
5.7.1.3.3	Seat	PTFE	
5.7.1.3.4	Spring	Hastealloy ‘C’	
5.7.1.3.5.	Trim & Fasteners	Monel	
5.7.2	Flow rate valve		
5.7.2.1	Number/ Unit	1 number	
5.7.2.2	Type	Manual	
5.7.2.3	Material		
5.7.2.3.1	Body	PVC	
5.7.2.3.2	Plug	Silver	
5.7.2.3.3	Seat	PTFE	
5.7.2.3.4	Spring / ‘O’ ring	Hastealloy ‘C’	

5.7.3	Pressure relief valve	
5.7.3.1	Number/Unit	1 number
5.7.3.2.	Type	Spring loaded type
5.7.3.3	Material	
5.7.3.3.1.	Body	PVC
5.7.3.3.2.	Loading Bolt	PVC
5.7.3.3.3.	Seat	PTFE
5.7.3.3.4	Spring	Hastealloy ‘C’
5.7.3.3.5.	Trim & Fasteners	Monel
5.7.3.3.6.	‘O’ ring	Viton
5.7.4	Vacuum regulating valve	Shall be provided..
5.7.4.1.	Number/Unit	1 number/ unit with each set
5.7.4.2.	Type	Diaphragm type
5.7.4.3.	Material	
5.7.4.3.1.	Body	Ebonite
5.7.4.3.2.	Diaphragm and seat	PTFE
5.7.4.3.3.	Spring	Hastealloy ‘C’
5.7.4.3.4.	Trim	Monel
5.7.4.3.5.	Fasteners	Monel
5.7.5	Flow rate indicator	
5.7.5.1	Number/Unit	1 number
5.7.5.2	Type	Rota meter
5.7.5.3	Material	Borosilicate Glass & Float: PTFE
5.7.6	Ejector with in-built check valve	
5.7.6.1	Number/Unit	1 number/unit
5.7.6.2	Type	Fixed type
5.7.6.3	Material	
5.7.6.3.1.	Body	CI with FRP lining inside
5.7.6.3.2.	Jet & Throat	Ebonite
5.7.6.3.3.	Fasteners	SS304
5.7.6.3.4.	Gasket	Neoprene rubber
5.7.7	Porous filter at gas inlet	
5.7.7.1	Number	1 number
5.7.7.2	Material	
5.7.7.2.1	Body	CS SA 105
5.7.7.2.2.	Filter Media	Glass wool
5.7.8	Vent Piping	
5.7.8.1	Size	As per specification/ code.
5.7.8.2	Pressure Standard	10 kg/sq.cm
5.7.8.3	Total length	As required
5.7.8.4	Material	PVC

5.7.9	Drain relief valve		
5.7.9.1	Number/ Unit	1 number	
5.7.9.2	Type	Spring loaded type	
5.7.9.3	Material		
5.7.9.3.1	Body	PVC	
5.7.9.3.2	Diaphragm	PTFE	
5.7.9.3.3.	Spring	Hastealloy 'C'	
5.7.9.3.4.	Trim & Fasteners/ 'O' rings	Monel	
5.7.10	Injector	Details will be provided after finalization of Vendor	
5.7.11	Chlorine Detector	Details will be provided after finalization of Vendor	
5.7.12	Diffuser	Details will be provided after finalization of Vendor	
5.7.13	Instrumentation and Control	Will be provided as per the specification and approved P&ID	
6.0	**CHLORINATOR WATER SUPPLY BOOSTER PUMPS**	**Stage 1**	**Stage 2**
6.1	Number	Five (4W+1S) numbers	Seven (6W+1S) numbers
6.2	Description for each Pump		
6.3	Type of Pump	Horizontal Centrifugal	
6.4	Location	Indoor.	
6.5	Fluid to be handled	Circulating Water	
6.6	Service	To supply motive water for Chlorinator.	
6.7	Duty	Continuous and to be suitable for parallel operation.	
6.8	Suction Condition	Flooded.	
6.9	Type of Pump	Horizontal Centrifugal Non Clog type	
6.10	Type of Impeller	Semi Open or Open	
6.11	Design standard	As per IS-5659 & IS-5120.	
6.12	Service temperature, in ^{o}C	60 maximum.	
6.13	Rated Capacity, m^3/hr	To suit the requirement of the each Chlorinator and shall be decided as per supplier recommendation during detailed engineering & as per codal requirement.	
6.14	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.	
6.15	Range of operation	20 % - 120 %.	
6.16	Suction Condition	Flooded.	
6.17	Tentative head to be developed at rated capacity	Each pump should have adequate head to meet the requirements of Chlorination	

		System.	
6.18	Material of construction		
6.18.1	Casing	CI as per IS 210 FG 260	
6.18.2	Impeller	SS 316	
6.18.3	Shaft	EN 8 as per BS 970	
6.18.4	Stuffing Box and Gland	C.I.	
6.18.5	Gland Packing	Graphite free Teflon.	
6.18.6	Common Base plate	Fabricated Steel as per IS 2062.	
6.18.7	Nuts and bolts	SS-316	
6.19	Type of drive	Electrical Motor	
6.20	Rated speed (RPM)	1500 (Sync.) maximum.	
6.21	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to –5%).	
6.22	Type of coupling between Pump & Motor	Flexible Spacer.	
6.23	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).	
6.24	Painting for complete set of Pump & Motor		
	a) Primer	As per Painting Specification	
	b) Finish paint	As per Painting Specification	
	c) Shade	As per Painting Specification	
6.25	Tests and Inspection		
	a) Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.	
	b) Hydro-test.	As per IS-5120	
	c) Dynamic Balancing Test	Will be provided	
6.26	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	Will be provided	
6.27	Instrumentation & Control	Shall be provided as per specification and approved P&ID	
6.28	Start and stop facility provided both at local and Room	Will be provided.	
6.29	Trip interlock	Provided.	
6.30	Accessories Shall be provided.		
6.30.1	Basket Strainers	Stage-1	Stage-2

6.30.1.1	Numbers	Ten (10) numbers (1W+1S per stream)	Fourteen (14) numbers (1W+1S per stream)
6.30.1.2	Capacity	100% each.	
6.30.1.3	Location	At suction of Booster Pump.	
6.30.1.4	Mesh	40	
6.30.1.5	Body MOC	IS 1239	
7.0	**CHLORINATED WATER DIFFUSER AND MIXING SYSTEM**	**Stage 1**	**Stage 2**
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	Rubber Lined Perforated Steel Tubes/ Polypropylene Diffusers	
7.5	Number	Required number to achieve proper mixing.	
7.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec	
8.0	**LIFTING AND HANDLING DEVICES**	**Stage 1**	**Stage 2**
8.1	Monorail hoist		
8.1.1	Number	One (1) number	One (1) number
8.1.2	Type	Electrically operated.	
8.1.3	Duty	To handle Chlorine Ton-Container.	
8.1.4	Safe working load	3000 kg maximum.	
8.2	Weighting Scale		
8.2.1	Number	One (1) number	One (1) number
8.2.2	Type	Platform Dial Type.	
8.2.3	Duty	To handle Chlorine Ton-Container.	
8.2.4	Range	0 - 3000 kg	
9.0	**SAFETY AND SUPERVISORY EQUIPMENT**	**Stage 1**	**Stage 2**
9.1	Gas Mask and Oxygen Breathing equipment along with Breathing Apparatus		
9.1.1	Number	Two (2) numbers	Two (2) numbers
9.1.2	Capacity	One (1) hour minimum.	
9.1.3	Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.	
9.2	Canister Type Breathing Apparatus		

9.2.1	Number	Two (2) numbers	Two (2) numbers
9.2.2	Type	The moisture content from exhaled air of the User should react with granular chemical in Breathing Apparatus and liberates oxygen. The released Oxygen should enter a breathing bag from which the User can inhale.	
9.3	Orthotolidine Impregnated Leak Detectors		
9.3.1	Number	Four (4) numbers (min.). Will be provided based on layout	Four (4) numbers (min.) Will be provided based on layout
9.4	Ammonia bottles		
9.4.1	Number	Four (4) numbers (min.) Will be provided based on layout	Four (4) numbers (min.) Will be provided based on layout
9.4.2	Capacity	500 ml each.	
9.4.3	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 degree Be) to detect leakage of chlorine.	
9.5	Moisture Absorbing Breathing Bottles		
9.5.1	Number	One (1) number for each Chlorine Ton Container	One (1) number for each Chlorine Ton Container
9.5.2	Capacity	Two (2) 2000 ml silica gel for each bottle.	
9.5.3	Type	The moisture absorber shall be fitted to the connection pipe to the Chlorine Ton Container, as soon as the container detached from the system. The breather shall absorb the moisture and allow dry air in the system to prevent corrosion of pipes and system.	
9.5.4	Material of construction	Glass body.	
9.6	Chlorine Residual Test Kit		
9.6.1	Number	Two (2) numbers	Two (2) numbers
9.6.2	Type	Colorimetric Test Comparator	
9.6.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.	
10.0	**CHLORINE LEAK DETECTOR**	**Stage 1**	**Stage 2**

10.0.1	Number	Twenty two (22) numbers [10 for connected tonners, 10 for storage tonners and 2 at chlorinator room] each having two sensors for redundancy.	Thirty Three (33) numbers [14 for connected tonners, 16 for storage tonners and 3 at chlorinator room] each having two sensors for redundancy.
10.0.2	Type	Electronic type.	
10.0.3	Alarm	Shall be provided. in case of leakage of Chlorine.	
10.0.4	Interlock	Shall be provided.	
10.1	Emergency Kit		
10.1.1	Number	Four (4) numbers	Four (4) numbers
10.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.	
10.2	Weather Cock		
10.2.1	Number	One (1) number	One (1) number
10.3	Safety Helmet		
10.3.1	Number	Two (2) numbers	Two (2) numbers
10.4	Goggles		
10.4.1	Number	Two (2) numbers	Two (2) numbers
10.5	Rubber Boots		
10.5.1	Number	Two (2) numbers	Two (2) numbers
10.6	Gloves		
10.6.1	Number	Two (2) numbers	Two (2) numbers
10.7	Colored Vest		
10.7.1	Number	Two (2) numbers	Two (2) numbers
11.0	**LEAKED CHLORINE ABSORPTION SYSTEM**	**Stage 1**	**Stage 2**
11.1	**EXHAUST FANS**		
11.2	Number	Shall be as per requirement & as per manufacturer standard	
11.3	Description for each Fan		
11.4	Location	Indoor.	
11.5	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container.	
11.6	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Ton Container, to suction of Blowers of Chlorine Absorption System.	

11.7	Duty	Intermittent.	
11.8	Type	Bifurcated type.	
11.9	Rated Capacity	Will be provided after finalization of Vendor	
11.10	Head to be developed at rated capacity	Will be provided after finalization of Vendor	
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	As per painting specification	
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**	**Stage 1**	**Stage 2**
12.1	Number	Two (2) [One (1) number to be under operation and the other as standby].	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	IS 4894
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	Will be provided after finalization of Vendor
12.14	Permissible tolerance in efficiency at rated capacity, in %	As per IS-4894.
12.15	Material of construction	
12.15.1	Casing	Polypropylene or FRP.
12.15.2	Impeller	Polypropylene or FRP.
12.15.3	Shaft	EN-8 to BS-970.
12.15.4	Common Base plate	Fabricated Steel as per IS 2062.
12.15.5	Coupling Guard	Carbon Steel.
12.15.6	Nuts and bolts	Haste Alloy -C
12.16	Type of drive	Electrical Motor
12.17	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.
12.18	Rated speed (RPM)	1500 (Sync.) maximum.
12.19	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to –5%).
12.20	Type of coupling between Blower & Motor	Direct.
12.21	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).

12.22	Painting for complete set of Blower & Motor		
12.23	Tests and Inspection		
12.24	Material Test required for	Casing, Impeller and Shaft.	
12.25	Hydro-test	As per IS-4894.	
12.26	Dynamic Balancing Test	Shall be provided.	
12.27	Performance Test		
12.28	Test Code	As per IS-4894.	
12.29	Tests to be done for determination of	Head-Capacity Curve and BHP-Capacity Curve.	
12.30	Test to be carried out	On prototype model at rated speed.	
12.31	Test for satisfactory operation of Blower at site	Required.	
12.32	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.	
12.33	Start interlock	Shall be provided.	
12.34	Accessories Shall be provided.	Common Base Frame, Suction Filter, Suction Silencer, Discharge Silencer, Discharge Damper.	
13.0	**CHLORINE ABSORPTION TOWER**	**Stage 1**	**Stage 2**
13.1	Numbers Shall be provided.	One (1).	One (1).
13.2	Description		
13.3	Type	Packed Tower	
13.4	Type of fluid to be handled	20% w/w (maximum) caustic solution and chlorine gas.	
13.5	Rated Absorption Capacity, kg of chlorine/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).	
13.6	Fill	Polypropylene Raschig / Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.	
13.7	Caustic Flow Rate, m^3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).	
13.8	Cl_2 content at outlet of Chlorine Absorption Tower	Free residual chlorine shall not be more than 0.1 ppm.	
13.9	Design Temperature, °C	80	
13.10	Location	The absorber shall be mounted on the	

		caustic solution preparation-cum recirculation tank.	
13.11	Design Code	As per manufacturer standard	
13.12	Material of Construction	FRP	
13.13	Fill	Polypropylene Raschig /Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.	
13.14	Protection		
13.14.1	Internal	Not required.	
13.14.2	External	Not required.	
13.15	Provided with accessories as follows:		
13.15.1	Dissolving Basket	Not required.	
13.15.2	Inlet	Shall be provided.	
13.15.3	Outlet	Shall be provided.	
13.15.4	Drain	Shall be provided.	
13.15.5	Overflow	Not required.	
13.15.6	Vent	Shall be provided.	
13.15.7	Manhole	Shall be provided.	
13.15.8	Rain protection	Necessary arrangement in order to prevent rain water entry needs Shall be provided.	
14.0	**CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION TANK**	**Stage 1**	**Stage 2**
14.1	Numbers Shall be provided.	One (1).	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.	
14.5	Effective capacity, in m3	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container +20% margin	
14.6	Minimum Free Board, in mm	300.	
14.7	Size	Bidder need to specify	
14.8	Design Pressure kg/cm2	Atmospheric	
14.9	Design Temperature, °C	80	
14.10	Design Code	IS803	
14.11	Code for Tests and inspections	IS803	

14.12	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.	
14.13	Protection		
14.13.1	Internal	As per approved painting specification	
14.13.2	External	As per approved painting specification	
14.14	Provided with accessories as follows:		
14.14.1	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.	
14.14.2	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.	
14.14.3	Inlet	Shall be provided.	
14.14.4	Outlet	Shall be provided.	
14.14.5	Drain	Shall be provided.	
14.14.6	Overflow	Shall be provided.	
14.14.7	Vent	Shall be provided.	
14.14.8	Manhole	Shall be provided.	
14.14.9	Sample Collection Point	Shall be provided..	
14.14.10	Isolation Gates	Not required.	
14.14.11	Platform complete with handrails for operation	Shall be provided..	
14.14.12	Staircase	Shall be provided. for access from finished ground level to top of Operation Platform.	
14.14.13	Instrumentation and Control	Shall be provided as per Specification and approved P&ID	
15.0	**CAUSTIC SOLUTION PREPARATION-CUM-RECIRCULATION PUMPS**	**Stage 1**	**Stage 2**
15.1	Number	Two (2) [One (1) number to be under operation and the other as standby].	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	
15.19.1	Casing	Polypropylene
15.19.2	Impeller	Polypropylene
15.19.3	Shaft	EN-8 as per BS-970 / SS 316.
15.19.4	Mechanical Seal	SS-316.
15.19.5	Common Base plate	Fabricated Steel as per IS 2062.
15.19.6	Nuts and bolts	SS-316
15.20	Type of drive	Electrical Motor
15.21	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
15.22	Rated speed (RPM)	1500 (Sync.) maximum.
15.23	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to –5%).
15.24	Type of coupling between Pump & Motor	Flexible Spacer.
15.25	Noise level (for complete set of Pump & Motor)	Not more than 85 dB (At a distance of 1.0 m from the outer surface of Motor).
15.26	Painting for complete set of Pump & Motor	Shall be as per tender specification

15.27	Suction Strainer along with flushing connection	Shall be provided.
15.28	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.
15.29	Trip interlock	Shall be provided.
15.30	Testing	Shall be provided to meet the specification
15.31	Instrumentation and Control	To be given as per the requirements of the Bid Specification

7.2 DATA SHEET FOR RAW WATER CHLORINATION WITH LEAK ABSORPTION SYSTEM FOR UNIT 1,2,3,4&5

1.0	**CHLORINE TON-CONTAINERS**	
1.1	Type of container	Chlorine Ton Container
1.2	Number required	Twenty one (21) [Eight (8) will be connected to manifold and other Thirteen (13) 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	
1.13.1	Container valves	
1.13.1.1	Number	One set for each Chlorine Ton-Container.
1.13.1.2	Design Standard	IS-3224 or Equivalent.
1.13.2	Eductor Tubes	
1.13.2.1	Number	Two (2) numbers eductor pipes shall be provided for each, each terminating into an

		isolating valve.
1.13.2.2	Purpose	One eductor tube will be used for chlorine gas withdrawal while the other shall deliver liquid chlorine
1.14	Instrumentation and Control	Shall be provided as per specification and approved P&ID.
1.15	Changeover Module	As per requirement to complete the system in all respects. (Chlorine automatic changeover facility with manifolds, valves, instruments & fittings etc.)
2.0	**EVAPORATORS**	
2.1	Number	Two (2) numbers
2.2	Description for each Evaporator	
2.3	Location	Indoor.
2.4	Capacity	Not less than 60 Kg/Hr.
2.5	Type	Electrically heated constant temperature immersion water bath type.
2.6	Material of construction	
2.6.1	Liquid Chlorine inlet pipe	SA 106 Gr. B Seamless
2.6.2	Bottom flange(inlet chamber)	SA 105
2.6.3	Counter Flange	IS 2062 Gr.B
2.6.4	Flange: Outlet Chamber	IS 2062 Gr.B
2.6.5	Outlet Chamber Pipe	IS: 3589 2001 ERW pipe
2.6.6	Gas outlet pipe	SA 106 Gr. B Seamless
2.6.7	Top Flange (Inner Chamber)	SA 105
2.6.8	Gasket	Asbestos free gasket as per ISO 14001
2.6.8.1	Inner chamber pipe	SA 106 Gr. B
2.6.9	Super heat baffle pipe	SA 106 Gr. B
2.6.10	Base plate	IS 2062 Gr.B
2.6.11	Inlet and outlet pipe flange	SA 105
2.6.12	Overflow and drain piping	MS IS: 1239 Heavy (Galv)
2.7	Corrosion Allowance	3 mm (minimum)
2.8	Radiography	100 %.
2.9	Heat treatment	Fully stress-relieved.
2.9	Accessories	
2.9.1	Rupture Disc	
2.9.1 1	Number	One (1) for each Evaporator.
2.9.1.2	Type	Bellow/Diaphragm type with local facility for adjustment of set point.
2.9.1.3	Size	Suitable.
2.9.1.4	Allowable Pressure	28 kg/cm^2 (approx)

2.9.1.5	Material of construction	Body – Silver coated Carbon Steel.
2.9.2	Expansion Chamber	
2.9.2.1	Number	One (1) for each Evaporator complete with pipe works, unions, isolation valve, nuts and bolts, support brackets and all other accessories.
2.9.2.2	Size	Will be provided during detailed engg.
2.9.2.3	Thickness	Sch 80
2.9.2.4	Design code	ASME SEC VIII Div 1
2.9.2.5	Fluid Handled	Chlorine Gas/ Chlorine Liquid
2.9.2.6	Design Pressure	40 Kg/cm^2 (g).
2.9.2.7	Radiography	100% on all butt weld joints
2.9.2.8	Hydro Test Pressure	60 Kg/cm^2 (g).
2.9.3	Heating element.	
2.9.3.1	Number/ Unit	As per manufacturer standard
2.9.3.2	Capacity	As per manufacturer standard
2.9.3.3	Type	Immersion type, 3-phase, 415 V, 50 Hz.
2.9.3.4	MOC	SS 304 Coil Body MS IS: 2062 Gr. B
2.9.4	Pressure Relief Valve	
2.9.4.1	Number	One (1) for each stream.
2.9.4.2	Type	Screwed end full port.
2.9.4.3	Size	Suitable
2.9.4.4	Vent Line	The chlorine gas vented from Pressure Relief Valve shall be led to a suitable point through PVC pipe.
2.9.4.5	Material of construction	Body - Carbon Steel as per ASTM A 105. Diaphragm - PTFE. Trim - Monel.
2.9.4.6	Body Test Pressure	60 Kg/cm^2.
2.9.5	Water Chamber	
2.9.5.1	Size and thickness	As per manufacturer standard
2.9.5.2	Insulation Material	Glass Wool Aluminum Sheet
2.9.5.3	Temp of water bath	80 ^{0}C
2.9.5.4	Fluid handled	Water
2.9.5.5	Design pressure	Water
2.9.5.6	Hydro-test pressure	Water fill test
2.9.5.7	Joint efficiency	0.7
2.9.5.8	Radiography	Nil
2.9.5.9	Corrosion allowance	1.5 mm
2.9.6	Electrically interlocked shut-off valve at the gas discharge line	Shall be provided.

	from Evaporator	
2.9.7	Cathodic protection system	
2.9.7.1	Type	One set Sacrificial type Magnesium anode rod / Unit Shall be provided. with Ammeter
2.9.7.2	Purpose	Shall be provided. to protect Water Bath and outside of Evaporator.
2.9.8	One (1) number Control Cubicle complete with necessary contactors, fuses, push buttons, indication lamps, ammeters and other instruments for each Evaporator	Shall be provided.
2.9.9	Instrumentation and Control	Will be provided as per the specification and approved P&ID
3.0	**CHLORINE GAS STRAINERS**	
3.1	Number	Two (2) for each Chlorinator [One in operation and other as stand-by].
3.2	Application	To trap any liquid chlorine "Mist" and solid impurities from reaching the chlorinator.
3.3	Description for each Strainer	
3.3.1	Capacity	100 % for each Chlorinator.
3.3.2	Material of construction	Carbon steel SA 105
3.3.3	Filter Media	Spun Fibre Glass Wool
3.4	Instrumentation and Control	Will be provided as per the specification and approved P&ID
4.0	**PRESSURE REGULATING VALVE**	
4.1	Number	One (1) number for each stream
4.2	Type	Spring loaded silver diaphragm
4.3	Description for each Valve	
4.4	Material of construction	
4.4.1	Lower Body	EN8
4.4.2	Upper Body	IS 210 FG0200
4.4.3	Diaphragm	Teflon
4.4.4	Main spring	Hastealloy Silver Plated
4.4.5	Loading spring	Carbon Steel
4.4.6	Valve seat	Teflon
4.4.7	Valve plug	Silver
4.5	Size	
4.6	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.

4.7	Spring range	0-10 Kg/cm2.
4.8	Flange	Ends shall be flanged and flange sealing done by lead gasket.
4.9	Body Test Pressure	60 Kg/cm2.
5.0	**CHLORINATORS**	
5.1	Number	Two (2) (one working + one standby)
5.2	Description for each Chlorinator	
5.3	Location	Indoor.
5.4	Design Standard	IS: 10553 Part 2
5.5	Capacity Kg/hr	60
5.6	Type	Vacuum solution feed type. Each Chlorinator Cabinet shall be fiberglass, self colored, resistant to corrosion by chlorine gas and chlorinated water solution.
5.7	Accessories	
5.7.1	Vacuum Stabilizing valve	
5.7.1.1	Number	1 number
5.7.1.2	Type	Diaphragm Type
5.7.1.3	Material	
5.7.1.4	Body	PVC
5.7.1.5	Diaphragm	PTFE
5.7.1.6	Seat	PTFE
5.7.1.7	Spring	Hastealloy ‘C’
5.7.1 8	Trim & Fasteners	Monel
5.7.2	Flow rate valve	
5.7.2.1	Number/ Unit	1 number
5.7.2.2	Type	Manual
5.7.2.3	Material	
5.7.2.4	Body	PVC
5.7.2.5	Plug	Silver
5.7.2.6	Seat	PTFE
5.7.2.7	Spring / ‘O’ ring	Viton
5.7.3	Pressure relief valve	
5.7.3.1	Number/Unit	1 number
5.7.3.2	Type	Spring loaded type
5.7.3.3	Material	
5.7.3.4	Body	PVC
5.7.3.5	Loading Bolt	PVC
5.7.3.6	Seat	PTFE
5.7.3.7	Spring	Hastealloy ‘C’
5.7.3.8	Trim & Fasteners	Monel
5.7.3.9	‘O’ ring	Viton

5.7.4	Vacuum regulating valve	
5.7.4.1	Number/Unit	1 number/ unit with each set
5.7.4.2	Type	Diaphragm type
5.7.4.3	Material	
5.7.4.4	Body	Ebonite
5.7.4.5	Trim	Monel
5.7.4.6	Fasteners	Monel
5.7.5	Flow rate indicator	
5.7.5.1	Number/Unit	1 number
5.7.5.2	Type	Rota meter
5.7.5.3	Material	Borosilicate Glass & Float: PTFE
5.7.6	Ejector with in-built check valve	
5.7.6.1	Number/Unit	1 number/unit
5.7.6.2	Type	Fixed type
5.7.6.3	Material	
5.7.6.4	Body	Ebonite
5.7.7	Porous filter at gas inlet	
5.7.7.1	Number	1 number
5.7.7.2	Material	
5.7.7.3	Body	Monel
5.7.7.4	Filter Media	Spun Fibre Glass Wool
5.7.8	Vent Piping	
5.7.8.1	Size	As per system requirment
5.7.8.2	Pressure Standard	10 kg/sq.cm
5.7.8.3	Total length	As required
5.7.8.4	Material	PVC
5.7.9	Drain relief valve	
5.7.9.1	Number/ Unit	1 number
5.7.9.2	Type	Spring loaded type
5.7.9.3	Material	
5.7.9.4	Body	PVC
5.7.9.5	Diaphragm	PTFE
5.7.9.6	Trim & Fasteners/ ‘O’ rings	Viton
5.7.9.7	Injector	Details will be provided after finalization of Vendor
5.7.9.8	Chlorine Detector	Details will be provided after finalization of Vendor
5.7.9.9	Diffuser	Details will be provided after finalization of Vendor
5.7.10	Instrumentation and Control	Will be provided as per the specification and approved P&ID
6.0	**CHLORINATOR WATER SUPPLY BOOSTER PUMPS**	

6.1	Number	Two (2) [One in operation and other as stand-by].
6.2	Description for each Pump	
6.3	Type	Horizontal Centrifugal Non Clog type
6.4	Location	Indoor.
6.5	Fluid to be handled	Service Water.
6.6	Type of Impeller	Semi Open or Open
6.7	Design standard	As per IS-5659 & IS-5120.
6.8	Service temperature, in oC	60 maximum.
6.9	Duty	Continuous and to be suitable for parallel operation.
6.10	Suction Condition	Flooded.
6.11	Range of operation	20 % - 120 %.
6.12	Rated Capacity, m3/hr	To suit the requirement of each Chlorinator.
6.13	Tentative head to be developed at rated capacity, MLC	Each pump shall have adequate head to meet the requirements of respective Chlorination System
6.14	Pump speed (RPM)	1500 preferred.
6.15	Material of construction	
6.15.1	Casing	CI as per IS 210 FG 260
6.15.2	Impeller	Bronze as per IS 318
6.15.3	Shaft	EN 8 as per BS 970
6.15.3	Shaft sleeve	SS 410
6.15.3	Stuffing Box and Gland	C.I.
6.16	Gland Packing	Graphite free Teflon.
6.17	Common Base plate	Fabricated Steel as per IS 2062.
6.17.1	Nuts and bolts	SS-316
6.18	Type of drive	Electrical Motor
6.19	Rated speed (RPM)	1500 (Sync.) maximum.
6.20	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), Phase, 50 HZ (+3 to –5%).
6.21	Type of coupling between Pump & Motor	Flexible Spacer.
6.22	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.5 m from the outer surface of Motor).
6.23	Start and stop facility provided both at local and panel	Shall be provided.
6.24	Trip interlock	
6.25	Accessories Shall be provided.	
6.26	Basket Strainers	
6.27	Number	Two (2) numbers per pump 4
6.28	Capacity	100% each.

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

9.3.2	Type	Electronic type.
9.3.3	Alarm	Shall be provided. in case of leakage of Chlorine.
9.3.4	Interlock	Shall be provided.
9.4	Emergency Kit	
9.4.1	Number	Two (2) numbers
9.4.2	Breathing Apparatus	Four (4) numbers
9.4.3	Oxygen Cylinders	Four (4) numbers
9.4.4	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
9.5	Weather Cock	
9.5.1	Number	One (1) number
9.6	Safety shower	
9.6.1	Number	One (1) number
9.7	Moisture Absorbing Breathing Apparatus	
9.7.1	Number	One (1)
9.8	Safety Helmet	
9.8.1	Number	Two (2) numbers
9.9	Goggles	
9.9.1	Number	Two (2) numbers
9.10	Rubber Boots	
9.10.1	Number	Two (2) numbers
9.11	Gloves	
9.11.1	Number	Two (2) numbers
9.12	Colored Vest	
9.12.1	Number	Two (2) numbers
10.0	**CHLORINE LEAK DETECTOR**	
10.0.1	Number 	Six (6) numbers [2 for connected tonners, 3 for storage tonners and 1 at chlorinator room] each having two sensors for redundancy
10.0.2	Type	Electronic type.
10.0.3	Alarm	Shall be provided. in case of leakage of Chlorine
10.0.4	Interlock	Shall be provided.
10.1	Emergency Kit	
10.1.1	Number	Four (4) numbers
10.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Ton-Containers.
10.2	Weather Cock	
10.2.1	Number	One (1) number
10.3	Safety Helmet	

10.3.1	Number	Two (2) numbers
10.4	Goggles	
10.4.1	Number	Two (2) numbers
10.5	Rubber Boots	
10.5.1	Number	Two (2) numbers
10.6	Gloves	
10.6.1	Number	Two (2) numbers
10.7	Colored Vest	
10.7.1	Number	Two (2) numbers
11.0	**LEAKED CHLORINE ABSORPTION SYSTEM**	
11.1	EXHAUST FANS	
11.2	Number	As per system requirement.
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 system requirement.
11.10	Head to be developed at rated capacity	As per system requirement.
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	As per painting specification
11.18	Start and stop facility provided both at local and panel	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) number (1W+1S)
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	Horizontal, rotary oil free, motor driven, preferably bifurcated type.
12.8	Type of Impeller	Fan Blade.
12.9	Design standard	IS 4894
12.10	Service temperature, in 0C	60 maximum.
12.11	Rated Capacity	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	
12.15.1	Casing	Polypropylene or FRP.

12.15.2	Impeller	Polypropylene or FRP.
12.15.3	Shaft	EN-8 to BS-970.
12.15.4	Common Base plate	Fabricated Steel as per IS 2062.
12.15.5	Coupling Guard	Carbon Steel.
12.15.6	Nuts and bolts	Haste Alloy C
12.16	Type of drive	Electrical Motor
12.17	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.
12.18	Rated speed (RPM)	1500 (Sync.) maximum.
12.19	Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to –5%).
12.20	Type of coupling between Blower & Motor	Direct.
12.21	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).
12.22	Painting for complete set of Blower & Motor	
12.23	Tests and Inspection	
12.24	Material Test required for	Casing, Impeller and Shaft.
12.25	Hydro-test	As per IS-4894.
12.26	Dynamic Balancing Test	Shall be provided.
12.27	Performance Test	
12.28	Test Code	As per IS-4894.
12.29	Tests to be done for determination of	Head-Capacity Curve and BHP-Capacity Curve.
12.30	Test to be carried out	On prototype model at rated speed.
12.31	Test for satisfactory operation of Blower at site	Required.
12.32	Start and stop facility provided both at local and panel	Shall be provided. in conjunction with Auto Start Facility.
12.33	Start interlock	Shall be provided.
12.34	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	Vertical Cylindrical Packed Absorption

		Tower. The Absorption Tower shall be mounted on the Caustic Solution Preparation cum Recirculation Tank (Described hereinafter).
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, m3/hr	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container within one hour (maximum).
13.8	Cl2 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 system requirement.
13.12	Material of Construction	FRP
13.13	Fill	Polypropylene Raschig/Pall rings along with baffle plates to keep entrainment loss less than 0.1% of circulating liquid flow rate.
13.14	Protection	
13.14.1	Internal	Not required.
13.14.2	External	Not required.
13.15	Provided with accessories as follows:	
13.15.1	Dissolving Basket	Not required.
13.15.2	Inlet	Shall be provided.
13.15.3	Outlet	Shall be provided.
13.15.4	Drain	Shall be provided.
13.15.5	Overflow	Not required.
13.15.6	Vent	Shall be provided.
13.15.7	Manhole	Shall be provided.
13.15.8	Rain protection	Necessary arrangement in order to prevent rain water entry needs Shall be 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.
14.5	Effective capacity, in m3	Adequate for absorption of chlorine leaked from one (1) number completely filled Chlorine Ton Container +20% margin
14.6	Minimum Free Board, in mm	300.
14.7	Size	Bidder need to specify
14.8	Design Pressure kg/cm2	Atmospheric
14.9	Design Temperature, °C	80
14.10	Design Code	IS803
14.11	Code for Tests and inspections	IS803
14.12	Material of Construction	Carbon steel as per IS 2062 or ASTM A 515 Gr.70.
14.13	Protection	
14.13.1	Internal	As per approved painting specification
14.13.2	External	As per approved painting specification
14.14	Provided with accessories as follows:	
14.14.1	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.
14.14.2	Dissolving Basket	Shall be provided.. Dissolving Basket shall be of SS-316 construction.
14.14.3	Inlet	Shall be provided.
14.14.4	Outlet	Shall be provided.
14.14.5	Drain	Shall be provided.
14.14.6	Overflow	Shall be provided.
14.14.7	Vent	Shall be provided.
14.14.8	Manhole	Shall be provided.
14.14.9	Sample Collection Point	Shall be provided..
14.14.10	Isolation Gates	Not required.
14.14.11	Platform complete with handrails for operation	Shall be provided..
14.14.12	Staircase	Shall be provided. for access from finished ground level to top of Operation Platform.
14.14.13	Instrumentation and Control	Shall be provided as per Specification and approved P&ID

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	
15.19.1	Casing	Polypropylene
15.19.2	Impeller	Polypropylene
15.19.3	Shaft	EN-8 as per BS-970 / SS 316.
15.19.4	Mechanical Seal	SS-316.
15.19.5	Common Base plate	Fabricated Steel as per IS 2062.
15.19.6	Nuts and bolts	SS-316
15.20	Type of drive	Electrical Motor
15.21	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be

		selected. This shall in no way be less than the maximum power required by the Pump.
15.22	Rated speed (RPM)	1500 (Sync.) maximum.
15.23	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to –5%).
15.24	Type of coupling between Pump & Motor	Flexible Spacer.
15.25	Noise level (for complete set of Pump & Motor)	Not more than 85 dB (At a distance of 1.0 m from the outer surface of Motor).
15.26	Painting for complete set of Pump & Motor	Shall be as per tender specification
15.27	Suction Strainer along with flushing connection	Shall be provided.
15.28	Start and stop facility provided both at local and Room	Shall be provided. in conjunction with Auto Start Facility.
15.29	Trip interlock	Shall be provided.
15.30	Testing	Shall be provided to meet the specification
15.31	Instrumentation and Control	To be given as per the requirements of the Bid Specification

7.4 DATA SHEET FOR POTABLE WATER(PW) CHLORINATION FOR UNIT 1,2,3,4&5.

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	
1.12.1	Cylinder Valve valves	
1.12.1.1	Number	One set for each Chlorine Cylinder

1.12.1.2	Design Standard	IS-3224 or Equivalent.
1.12.2	Instruments along with alarms, interlocks and accessories	Shall be provided as per specification & approved P&ID.
1.12.3	Changeover Module	One (1) chlorine automatic changeover facility with manifolds, valves, instruments & fittings
2.0	**CHLORINE GAS PIPE LINE**	
2.1	Material of Construction	PVC (sch 80)
3.0	**PRESSURE REGULATING VALVE**	
3.1	Number	One (1) for each stream.
3.2	Description for each Valve	
3.2.1	Material of construction	
3.2.1.1	a) Body	Carbon Steel as per ASTM A 105.
3.2.1.2	b) Diaphragm	PTFE
3.2.1.3	c) Trim	Monel
3.3	Size	
3.4	Location and mounting	Gas line from evaporator to chlorinator to subject chlorinators to less pressure during operation.
3.5	Spring range	0-10 Kg/cm^2.
3.6	Flange	Ends shall be flanged and flange sealing done by lead gasket.
3.7	Body Test Pressure	60 Kg/cm^2.
4.0	**CHLORINATOR**	
4.1	Number	Two (2) [One in operation and other as stand-by].
4.2	Description for each Chlorinator	
4.2.1	Location	Indoor.
4.2.2	Design Standard	IS: 10553 Part 2
4.2.3	Capacity	50 gm /hr.
4.2.4	Type	Vacuum solution feed type.
4.2.5	Accessories	
4.2.5.1	Inlet Chlorine Pressure Reducing Valve.	Details will be provided after finalization of Vendor.
4.2.5.2	Chlorine Feed Rate Adjuster	Details will be provided after finalization of Vendor
4.2.5.3	Automatic pressure vacuum relief valve	Details will be provided after finalization of Vendor
4.2.5.4	Vacuum Controller	
4.2.5.5	Number	One (1) for each Chlorinator.
4.2.5.6	Material	ABS (Acryl nitrile Butadiene Styrene) Plastic

		Chamber and Teflon diaphragm with inlet valve having tantalum seat and special alloy spring of tantalum.
4.2.5.7	Injector	
4.2.5.7.1	Number	One (1) for each Chlorinator.
4.2.5.7.2	Material	CI (IS-210 grade) with FRP/RL inside. The injector shall include ebonite jet. The throat studs shall be SS-316 and gasket shall be of rubber.
4.2.5.8	Diffuser	Shall be provided.
4.2.5.9	Instruments along with alarms, interlocks and accessories	Shall be provided as per specification & approved P&ID.
5.0	**CHLORINATOR WATER BOOSTER PUMPS**	
5.1	Number	Two (2) [One in operation and other as stand-by].
5.2	Description for each Pump	
5.2.1	Location	Indoor.
5.2.2	Fluid to be handled	Filtered Water
5.2.3	Service	To supply motive water for Chlorinator.
5.2.4	Duty	Intermittent and suitable for parallel operation
5.2.5	Type of Pump	Horizontal Centrifugal Non Clog type
5.2.6	Type of Impeller	Semi Open or Open
5.2.7	Design standard	As per IS-5659 & IS-5120.
5.2.8	Service temperature, in deg. C	60 maximum.
5.2.9	Rated Capacity, in m3/hr	To suit the requirement of the each Chlorinator and shall be decided as per supplier recommendation during detailed engineering and as per codal requirement
5.2.10	Permissible tolerance in rated capacity, in %	As per IS-5659 & IS-5120.
5.2.11	Range of operation	20 % - 120 %.
5.2.12	Suction Condition	Flooded.
5.2.13	Head to be developed at rated capacity	To suit the requirement of the each Chlorinator. (C should be considered as 120 to calculate the frictional loss in pipe as per Hagen Williams Equation).
5.2.14	Shut Off Head	To be suitable for stable operation at rated duty point.
5.2.15	Permissible tolerance in efficiency at rated capacity, in %	As per IS-5659 & IS-5120.

5.2.16	Material of construction	
5.2.16.1	Casing	CI as per IS 210 FG 260
5.2.16.2	Impeller	Bronze as per IS 318
5.2.16.3	Shaft	EN 8 as per BS 970
5.2.16.4	Stuffing Box and Gland	C.I.
5.2.16.5	Gland Packing	Graphite free Teflon.
5.2.16.6	Common Base plate	Fabricated Steel as per IS 2062.
5.2.16.7	Nuts and bolts	SS-316
5.2.17	Type of drive	Electrical Motor
5.2.18	Noise level (for complete set of Pump & Motor)	Not more than 85 db. (At a distance of 1.0 m from the outer surface of Motor).
5.2.19	Painting for complete set of Pump & Motor	As per painting specification.
5.2.20	Tests and Inspection	
5.2.20.1	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
5.2.20.2	Hydro-test	As per IS-5118.
5.2.20.3	Dynamic Balancing Test	Shall be provided.
5.2.21	Performance Test	
5.2.21.1	Test Code	Hydraulic Institute Standard.
5.2.21.2	Tests to be done for determination of	Head-Capacity Curve, BHP-Capacity Curve and Efficiency-Capacity Curve and NPSH-Capacity Curve.
5.2.21.3	Test to be carried out	On prototype model at rated speed.
5.2.21.4	Test for satisfactory operation of pump at site	Required.
5.2.22	Instruments along with alarms, interlocks and accessories	Shall be provided. as per the requirements of the Tender Specification and approved P&ID
5.2.23	Accessories Shall be provided.	Two (2) numbers Suction Strainers at upstream of Suction Header - common for all the Pumps.
5.2.24	Start and stop facility provided both at local and panel	Shall be provided.
5.2.25	Trip interlock	Shall be provided.
5.2.26	Accessories Shall be provided.	
5.2.27	Chlorine Water Dosing	At the Discharge Header of the Feed pumps of potable water treatment system through Mixing Tee
6.0	**CHLORINATED WATER DIFFUSER AND MIXING SYSTEM (INJECTION**	

	QUILL)	
6.1	Location for injection of chlorinated water	Potable water transfer pump discharge
6.2	Device for injection of chlorinated water	Injection quill.
6.3	Location of diffusers	In potable water transfer pump discharge header
6.4	Material of construction	CPVC SCH80
6.5	Number	Require number to achieve proper mixing.
6.6	Dimensions	To maintain 4 to 7 lpm flow at a velocity 3 to 4 m/sec
7.0	**LIFTING AND HANDLING DEVICES**	
7.1	Weighting Scale	
7.1.1	a) Number	One (1) numbers
7.1.2	b) Type	Platform Dial Type.
7.1.3	c) Duty	To handle Chlorine Ton-Container.
7.1.4	d) Range	0 - 200 kg
8.0	**SAFETY AND SUPERVISORY EQUIPMENT**	
8.1	Gas Mask and Oxygen Breathing equipment along with Breathing Apparatus	
8.1.1	Number	Two (2) numbers
8.1.2	Capacity	One (1) hour minimum.
8.1.3	Accessories Shall be provided.	Full mask, full vision face pieces, flow regulating valves and all other accessories.
8.2	Canister Type Breathing Apparatus	
8.2.1	Number	Two (2) numbers
8.2.2	Type	The moisture content from exhaled air of the User should react with granular chemical in Breathing Apparatus and liberates oxygen. The released Oxygen should enter a breathing bag from which the User can inhale.
8.3	Orthotolidine Impregnated Leak Detectors	
8.3.1	Number	Four (4) numbers
8.4	Ammonia bottles	
8.4.1	Number	Four (4) numbers
8.4.2	Capacity	500 ml each.
8.4.3	Accessories Shall be provided.	Filled up with commercial grade ammonia solution (26 degree Be) to detect leakage of chlorine.

8.5	Moisture Absorbing Breathing Bottles	
8.1	Number	One (1) number for each Chlorine Cylinder.
8.5.2	Capacity	Two (2) 2000 ml silica gel for each bottle.
8.5.3	Type	The moisture absorber shall be fitted to the connection pipe to the Chlorine Cylinder, as soon as the container detached from the system. The breather shall absorb the moisture and allow dry air in the system to prevent corrosion of pipes and system.
8.5.4	Material of construction	Glass body.
8.6	Chlorine Residual Test Kit	
8.6.1	Number	Two (2) numbers
8.6.2	Type	Colorimetric Test Comparator
8.6.3	Range	One 0 to 0.5 ppm in steps of 0.05 ppm and second 0.5 to 6 ppm in steps of 0.5 ppm.
9.0	**CHLORINE LEAK DETECTOR**	
9.0.1	Number	Two (2) numbers [one for connected cylinder and one at chlorinator room] each having two sensors.
9.0.2	Type	Electronic type.
9.0.3	Alarm	Shall be provided. in case of leakage of Chlorine.
9.0.4	Interlock	Shall be provided.
9.1	Emergency Kit	
9.1.1	Number	Four (4) numbers
9.1.2	Accessories Shall be provided.	All accessories Shall be provided to seal off Chlorine Cylinders.
9.2	Weather Cock	
9.2.1	Number	One (1) number
9.3	Safety Helmet	
9.3.1	Number	Two (2) numbers
9.4	Goggles	
9.4.1	Number	Two (2) numbers
9.5	Rubber Boots	
9.5.1	Number	Two (2) numbers
9.6	Gloves	
9.6.1	Number	Two (2) numbers
9.7	Colored Vest	
9.7.1	Number	Two (2) numbers
10.0	**EXHAUST FANS**	

10.1	EXHAUST FANS	
10.2	Number	To meet the system requirements. As per manufacturer standard
10.3	Description for each Fan	
10.4	Location	Indoor.
10.5	Fluid to be handled	Ambient Air mixed with Chlorine Gas leaked from Chlorine Cylinder.
10.6	Service	To transfer Ambient Air mixed with Chlorine Gas leaked from Chlorine Cylinder, to atmosphere
10.7	Duty	Continuous 4
10.8	Type	Bifurcated type.
10.9	Rated Capacity	As per manufacturer standard
10.10	Head to be developed at rated capacity	As per manufacturer standard
10.11	Material of construction	Polypropylene or FRP.
10.12	Type of drive	Electrical Motor
10.13	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.
10.14	Rated speed (RPM)	1500 (Sync.) maximum.
10.15	Voltage, Phase & Frequency (± % Variation)	415 V (±10%), 3 Phase, 50 HZ (+3 to –5%).
10.16	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).
10.17	Painting for complete set of Fan & Motor	
10.18	Start and stop facility provided both at local and at Control Room	Shall be provided. in conjunction with Auto Start Facility.
10.19	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.
10.20	Accessories Shall be provided.	Each Exhaust Fan shall be provided. With motorized damper. The complete electrical wiring and interlock

		facility as mentioned above shall be provided for both Exhaust Fans as well as Atmosphere Ventilation Fans.
11.0	**Caustic Pit**	
11.1	Number	1
11.2	MOC	RCC
11.3	Capacity	200 litres.

DRAWING NO. 1-WT-040-00262

CHLORINATOR ROOM

EXPN. CHAMBER

CHLORINATOR
CAP : 225 KPH

QUANTITY 2 NOS

TOTAL NO. OF CYL = 90
IN OPERATION = 40 NOS.
IN STORAGE = 50 NOS.

QTY : 10 NOS.
(IN STORAGE AREA)

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

BLOWERS
QTY : 1W+1S

ABSORPTION TOWER QTY : 1W

ABSORPTION TANK
QTY : 1W

CAUSTIC RECIR. PUMPS
QTY : 1W+1S

ABSORPTION SYSTEM – OPEN TO SKY

300 NB GRP

150 NB CS

200 NB CS

350 NB CS

BOOSTER PUMPS
QTY : 4W+1S

BASKET STRAINER
QTY : 14 NOS.
(2 NOS. / PUMP)

VENTILATION FAN
QTY : 1W+1S

MAKE-UP WATER LINE
FROM CW DISCHARGE INCOMING WATER

C.W. FOREBAY FOR STAGE # 1

EACH CW/ACW PUMP PIT FOR SHOCK DOSING

CW FOREBAY (LEFT SIDE) FOR CONTINUOUS DOSING.

CW FOREBAY (RIGHT SIDE) FOR CONTINUOUS DOSING.

(THE DIFFUSERS & MOTORISED VALVE SHOWN IS TENTATIVE. FINAL QUANTITY WILL BE DECIDED DURING DETAIL ENGINEERING)

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

FOR TENDER PURPOSE ONLY

ALL DIMENSIONS ARE IN MILLIMETRES

LEGEND

- PRESSURE INDICATOR WITH DIAPHRAGM SEAL
- PRESSURE SWITCH WITH DIAPHRAGM SEAL
- TEMPERATURE INDICATOR
- DIFFERENTIAL PRESSURE SWITCH
- PRESSURE INDICATING TRANSMITTER
- PRESSURE INDICATOR
- DIFFERENTIAL PRESSURE REGULATOR
- VACUUM SWITCH WITH DIAPHRAGM SEAL
- VACUUM GAUGE WITH DIAPHRAGM SEAL
- FLOW INDICATING TRANSMITTER
- FLOW INDICATING SWITCH
- LEVEL INDICATOR
- LEVEL INDICATING TRANSMITTER
- CHLORINE LEAK DETECTOR WITH 2 SENSOR
- RESIDUAL CHLORINE ANALYSER
- TON VALVE WITH YOKE
- MANIFOLD (NEEDLE) VALVE
- FLOW CONTROL VALVE
- BALL VALVE
- ISOLATION (NEEDLE) VALVE
- BUTTER FLY VALVE
- ISOLATION (GLOBE/GATE)VALVE
- GATE VALVE
- PRESSURE INDICATING TRANSMITTER
- DIAPHRAGM VALVE
- DAMPER
- CHECK VALVE
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- (EMERGENCY) DRAIN RELIEF VALVE
- AUTO SHUT OFF VALVE
- AUTO CHANGE OVER VALVE
- SOLENOID VALVE
- MOTORISED BUTTERFLY VALVE
- STRAINER - (Y-TYPE)
- PRESSURE REDUCING VALVE
- AUTOMATIC VACUUM REGULATOR
- GAS FILTER
- RUPTURE DISC
- INJECTOR
- STRAINER (BASKET)
- HORIZONTAL CENTRIFUGAL PUMP
- BLOWER
- CHLORINE TONNER
- TONNER ROLLER SUPPORT
- DIFFUSER
- WATER LINE
- CHLORINE LINE
- CHLORINE SOLUTION
- INTER LOCK LINE
- DUCTING LINE

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	01	06.02.2020	ABHINAV	SRIVATSAN	SALAIMANALAN
	1. REVISED BASED ON RESOLUTION DT.06.02.2020				

PROJECT: YADADRI TPS -5x800 MW

OWNER: TELANGANA STATE POWER GEN. CORPN. LTD.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : CW GAS CHLORINATION FOR UNIT # 1,2

TITLE: P & ID FOR CW GAS CHLORINATION SYSTEM
(FOR UNIT # 1 & 2)

	NAME	SIGN.	DATE
DRAWN	ABHINAV	Sd /-	23.12.17
CHECKED	SRIVATSAN	Sd /-	23.12.17
APPROVED	SALAIMANALAN	Sd /-	23.12.17

ALL DIMENSIONS ARE IN MILLIMETRES | PROJECTION | SCALE N.T.S | BHEL DRAWING NO. 2-WT-040-00262 | REV 01

Size A2

DRAWING NO. 1-WT-040-00263

TOTAL NO. OF CYL = 135
IN OPERATION = 56 NOS.
IN STORAGE = 79 NOS.

QTY : 16 NOS.
(IN STORAGE AREA)

CHLORINATOR ROOM

EXPN. CHAMBER

EVAPORATOR

GAS FLTR.

CHLORINATOR
CAP : 225 KPH

QUANTITY 3 NOS

NO. OF STREAMS : 07 (6W+1S)

350 NB GRP

BLOWERS
QTY : 1W+1S

ABSORPTION TOWER QTY : 1W

ABSORPTION TANK
QTY : 1W

CAUSTIC RECIR. PUMPS
QTY : 1W+1S

ABSORPTION SYSTEM – OPEN TO SKY

SER. WATER

MAKE-UP WATER LINE
FROM CW DISCHARGE INCOMING WATER

BASKET STRAINER
QTY : 14 NOS.
(2 NOS. / PUMP)

400 NB CS

200 NB CS

150 NB CS

BOOSTER PUMPS
QTY : 6W+1S

C.W. FOREBAY FOR STAGE # 4

EACH CW/ACW PUMP PIT FOR SHOCK DOSING

CW FOREBAY (LEFT SIDE) FOR CONTINUOUS DOSING.

CW FOREBAY (RIGHT SIDE) FOR CONTINUOUS DOSING.

VENTILATION FAN
QTY : 1W+1S

(THE DIFFUSERS & MOTORISED VALVE SHOWN IS TENTATIVE.
FINAL QUANTITY WILL BE DECIDED DURING DETAIL ENGINEERING)

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

ZONE

FOR TENDER PURPOSE ONLY

REV	DATE	ALTD:	CHD:	APPD:
01	06.02.2020	MKV	SS	MSM

1. REVISED BASED ON RESOLUTION DT.06.02.2020.

PROJECT: YADADRI TPS -5x800 MW

OWNER: TELANGANA STATE POWER GEN. CORPN. LTD.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : CW GAS CHLORINATION FOR UNIT # 3,4 & 5

TITLE: P & ID FOR CW GAS CHLORINATION SYSTEM
(FOR UNIT # 3,4 & 5)

	NAME	SIGN.	DATE
DRAWN	ABHINAV	Sd /-	23.12.17
CHECKED	SRIVATSAN	Sd /-	23.12.17
APPROVED	SALAIMANALAN	Sd /-	23.12.17

ALL DIMENSIONS ARE IN MILLIMETRES

PROJECTION

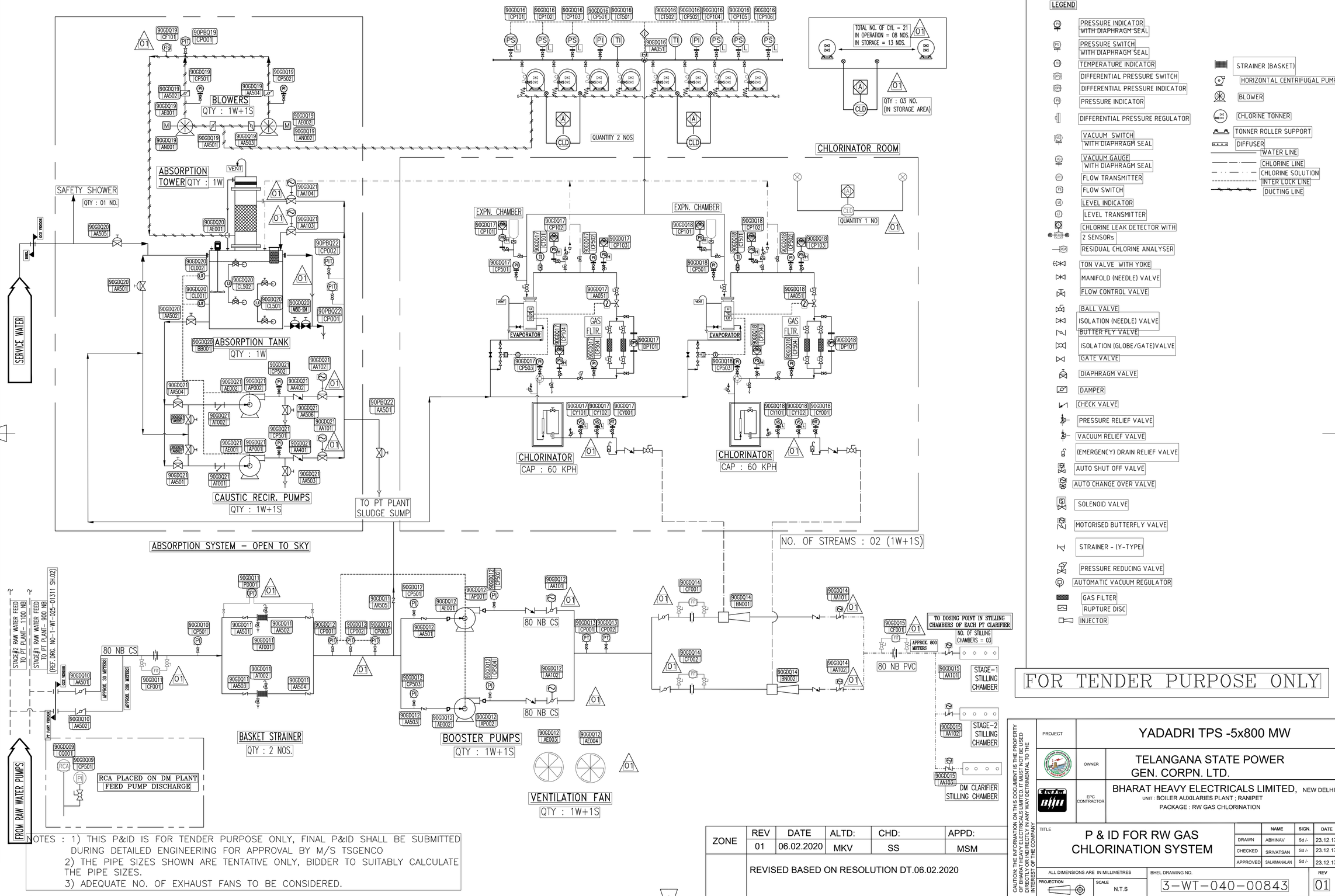
SCALE: N.T.S

BHEL DRAWING NO. 2-WT-040-00263

REV 01

Size A2

DRAWING NO. 3 - WT - 040 - 00843



LEGEND

- PRESSURE INDICATOR WITH DIAPHRAGM SEAL
- PRESSURE SWITCH WITH DIAPHRAGM SEAL
- TEMPERATURE INDICATOR
- DIFFERENTIAL PRESSURE SWITCH
- DIFFERENTIAL PRESSURE INDICATOR
- PRESSURE INDICATOR
- DIFFERENTIAL PRESSURE REGULATOR
- VACUUM SWITCH WITH DIAPHRAGM SEAL
- VACUUM GAUGE WITH DIAPHRAGM SEAL
- FLOW TRANSMITTER
- FLOW SWITCH
- LEVEL INDICATOR
- LEVEL TRANSMITTER
- CHLORINE LEAK DETECTOR WITH 2 SENSORS
- RESIDUAL CHLORINE ANALYSER
- TON VALVE WITH YOKE
- MANIFOLD (NEEDLE) VALVE
- FLOW CONTROL VALVE
- BALL VALVE
- ISOLATION (NEEDLE) VALVE
- BUTTER FLY VALVE
- ISOLATION (GLOBE/GATE)VALVE
- GATE VALVE
- DIAPHRAGM VALVE
- DAMPER
- CHECK VALVE
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- (EMERGENCY) DRAIN RELIEF VALVE
- AUTO SHUT OFF VALVE
- AUTO CHANGE OVER VALVE
- SOLENOID VALVE
- MOTORISED BUTTERFLY VALVE
- STRAINER - (Y-TYPE)
- PRESSURE REDUCING VALVE
- AUTOMATIC VACUUM REGULATOR
- GAS FILTER
- RUPTURE DISC
- INJECTOR

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

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

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	01	06.02.2020	MKV	SS	MSM
	REVISED BASED ON RESOLUTION DT.06.02.2020				

FOR TENDER PURPOSE ONLY

PROJECT: YADADRI TPS -5x800 MW

OWNER: TELANGANA STATE POWER GEN. CORPN. LTD.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : RW GAS CHLORINATION

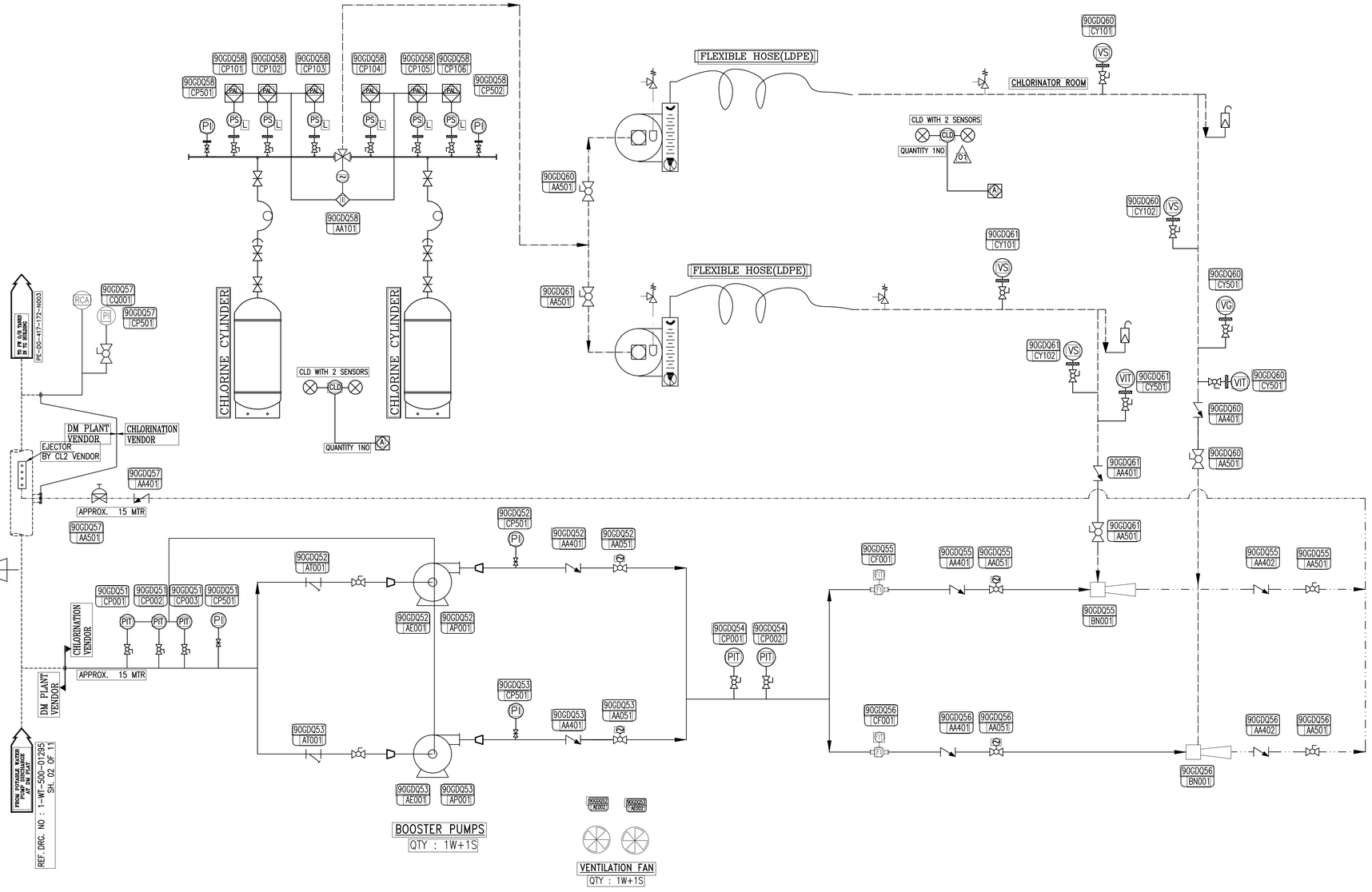
TITLE: P & ID FOR RW GAS CHLORINATION SYSTEM

	NAME	SIGN.	DATE
DRAWN	ABHINAV	Sd /-	23.12.17
CHECKED	SRIVATSAN	Sd /-	23.12.17
APPROVED	SALAIMANALAN	Sd /-	23.12.17

ALL DIMENSIONS ARE IN MILLIMETRES
PROJECTION
SCALE: N.T.S
BHEL DRAWING NO. 3-WT-040-00843
REV 01

Size A3

DRAWING NO. 3 - WT - 040 - 00844



LEGEND

- PRESSURE INDICATOR WITH DIAPHRAGM SEAL
- PRESSURE SWITCH WITH DIAPHRAGM SEAL
- TEMPERATURE INDICATOR
- DIFFERENTIAL PRESSURE SWITCH
- DIFFERENTIAL PRESSURE INDICATOR
- PRESSURE INDICATOR
- DIFFERENTIAL PRESSURE REGULATOR
- VACUUM SWITCH WITH DIAPHRAGM SEAL
- VACUUM GAUGE WITH DIAPHRAGM SEAL
- FLOW TRANSMITTER
- HORIZONTAL CENTRIFUGAL PUMP
- CHLORINE LEAK DETECTOR WITH 2 SENSOR
- RESIDUAL CHLORINE ANALYSER
- TON VALVE WITH YOKE
- MANIFOLD (NEEDLE) VALVE
- FLOW CONTROL VALVE
- BALL VALVE
- ISOLATION (NEEDLE) VALVE
- BUTTER FLY VALVE
- ISOLATION (GLOBE/GATE)VALVE
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- (EMERGENCY) DRAIN RELIEF VALVE
- AUTO CHANGE OVER VALVE
- PRESSURE REDUCING VALVE
- AUTOMATIC VACUUM REGULATOR
- VACUUM REGULATOR WITH ROTAMETER,FLOW CONTROL VALVE,
- GAS FILTER
- RUPTURE DISC
- INJECTOR
- SOLENOID VALVE
- DAMPER
- DIAPHRAGM VALVE
- CHECK VALVE
- STRAINER - (Y-TYPE)
- CHLORINE TONNER
- MOTORISED BALL VALVE
- FLOW SWITCH
- AUTO SHUT OFF VALVE
- DIFFUSER
- WATER LINE
- CHLORINE LINE
- CHLORINE SOLUTION
- INTER LOCK LINE

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

FOR TENDER PURPOSE ONLY

REV	DATE	ALTD:	CHD:	APPD:
01	06.02.2020	MKV	SS	MSM

REVISED BASED ON RESOLUTION DT.06.02.2020

PROJECT: YADADRI TPS -5x800 MW

OWNER: TELANGANA STATE POWER GEN. CORPN. LTD.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI
UNIT : BOILER AUXILARIES PLANT ; RANIPET
PACKAGE : PW GAS CHLORINATION

TITLE: P & ID FOR PW GAS CHLORINATION SYSTEM

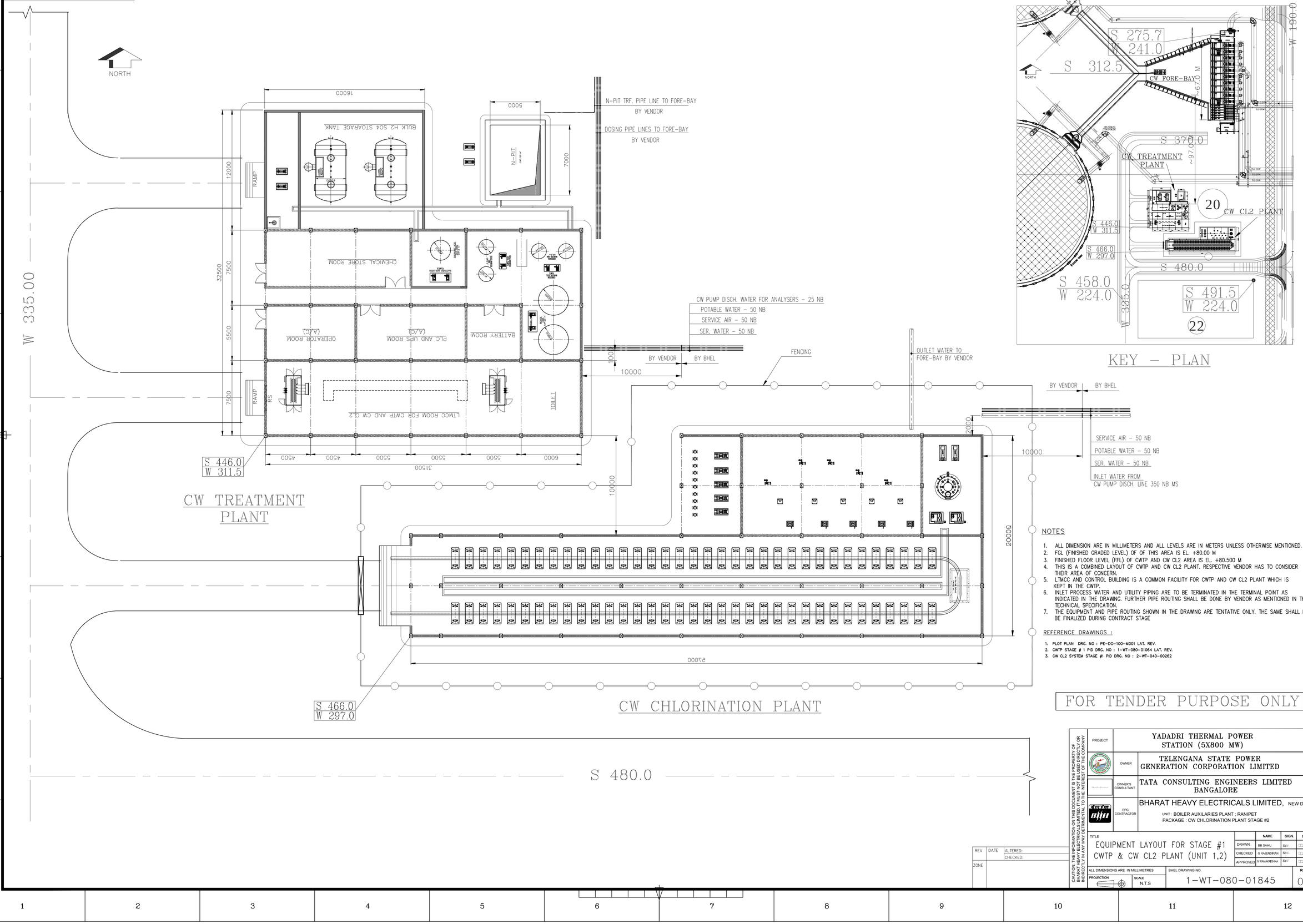
	NAME	SIGN.	DATE
DRAWN	ABHINAV	Sd/-	23.12.17
CHECKED	SRIVATSAN	Sd/-	23.12.17
APPROVED	SALAIMANALAN	Sd/-	23.12.17

ALL DIMENSIONS ARE IN MILLIMETRES
PROJECTION
SCALE N.T.S
BHEL DRAWING NO. 3-WT-040-00844
REV 01

Size A3

DRAWING NO 1-WT-080-01845

ALL DIMENSIONS ARE IN MILLIMETRES



KEY – PLAN

NOTES

1. ALL DIMENSION ARE IN MILLIMETERS AND ALL LEVELS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. FGL (FINISHED GRADED LEVEL) OF OF THIS AREA IS EL. +80.00 M
3. FINISHED FLOOR LEVEL (FFL) OF CWTP AND CW CL2 AREA IS EL. +80.500 M
4. THIS IS A COMBINED LAYOUT OF CWTP AND CW CL2 PLANT. RESPECTIVE VENDOR HAS TO CONSIDER THEIR AREA OF CONCERN.
5. LTMCC AND CONTROL BUILDING IS A COMMON FACILITY FOR CWTP AND CW CL2 PLANT WHICH IS KEPT IN THE CWTP.
6. INLET PROCESS WATER AND UTILITY PIPING ARE TO BE TERMINATED IN THE TERMINAL POINT AS INDICATED IN THE DRAWING. FURTHER PIPE ROUTING SHALL BE DONE BY VENDOR AS MENTIONED IN THE TECHNICAL SPECIFICATION.
7. THE EQUIPMENT AND PIPE ROUTING SHOWN IN THE DRAWING ARE TENTATIVE ONLY. THE SAME SHALL BE BE FINALIZED DURING CONTRACT STAGE

REFERENCE DRAWINGS :

1. PLOT PLAN DRG. NO : PE-DG-100-M001 LAT. REV.
2. CWTP STAGE # 1 PID DRG. NO : 1-WT-080-01064 LAT. REV.
3. CW CL2 SYSTEM STAGE #1 PID DRG. NO : 2-WT-040-00262

FOR TENDER PURPOSE ONLY

REV	DATE	ALTERED:
ZONE		CHECKED:

PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : CW CHLORINATION PLANT STAGE #2

TITLE: EQUIPMENT LAYOUT FOR STAGE #1 CWTP & CW CL2 PLANT (UNIT 1,2)

	NAME	SIGN.	DATE
DRAWN	BB SAHU	Sd/-	□□.2.2□
CHECKED	G RAJENDRAN	Sd/-	□□.2.2□
APPROVED	M RAMAKRISHNA	Sd/-	□□.2.2□

ALL DIMENSIONS ARE IN MILLIMETRES | PROJECTION | SCALE N.T.S | BHEL DRAWING NO. 1-WT-080-01845 | REV 00

DRAWING NO. 1-WT-080-01846

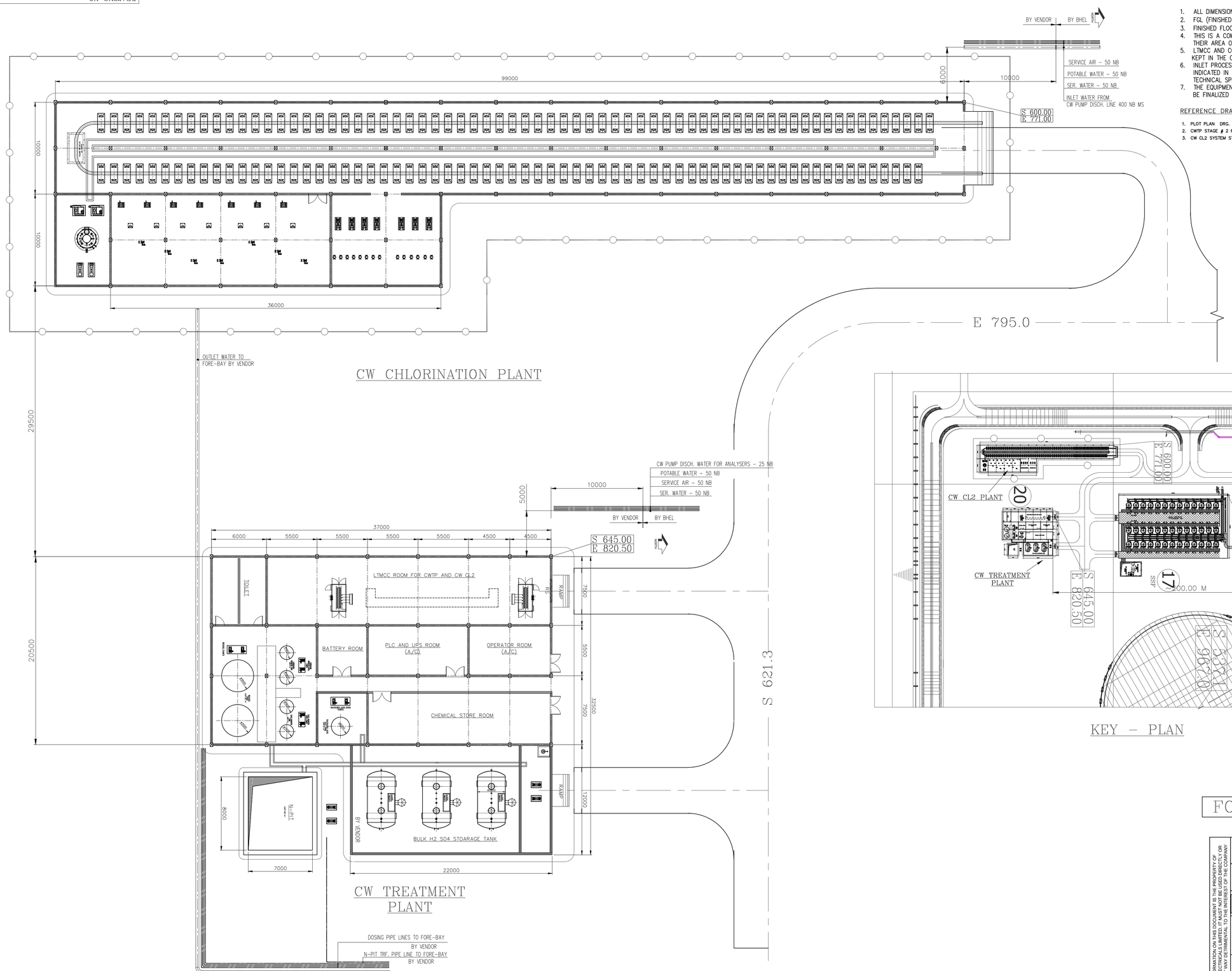
ALL DIMENSIONS ARE IN MILLIMETRES

NOTES

1. ALL DIMENSION ARE IN MILLIMETERS AND ALL LEVELS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. FGL (FINISHED GRADED LEVEL) OF OF THIS AREA IS EL. +83.00 M.
3. FINISHED FLOOR LEVEL (FFL) OF CWTP AND CW CL2 AREA IS EL. +83.500 M.
4. THIS IS A COMBINED LAYOUT OF CWTP AND CW CL2 PLANT. RESPECTIVE VENDOR HAS TO CONSIDER THEIR AREA OF CONCERN.
5. LTMCC AND CONTROL BUILDING IS A COMMON FACILITY FOR CWTP AND CW CL2 PLANT WHICH IS KEPT IN THE CWTP.
6. INLET PROCESS WATER AND UTILITY PIPING ARE TO BE TERMINATED IN THE TERMINAL POINT AS INDICATED IN THE DRAWING. FURTHER PIPE ROUTING SHALL BE DONE BY VENDOR AS MENTIONED IN THE TECHNICAL SPECIFICATION.
7. THE EQUIPMENT AND PIPE ROUTING SHOWN IN THE DRAWING ARE TENTATIVE ONLY. THE SAME SHALL BE BE FINALIZED DURING CONTRACT STAGE

REFERENCE DRAWINGS :

1. PLOT PLAN DRG. NO : PE-DG-100-M001 LAT. REV.
2. CWTP STAGE # 2 PID DRG. NO : 1-WT-080-01065 LAT. REV.
3. CW CL2 SYSTEM STAGE #1 PID DRG. NO : 2-WT-040-00263 LAT. REV.



FOR TENDER PURPOSE ONLY

PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : CW CHLORINATION PLANT STAGE #2

TITLE: EQUIPMENT LAYOUT FOR STAGE #2 CWTP & CW CL2 PLANT (UNIT 3,4&5)

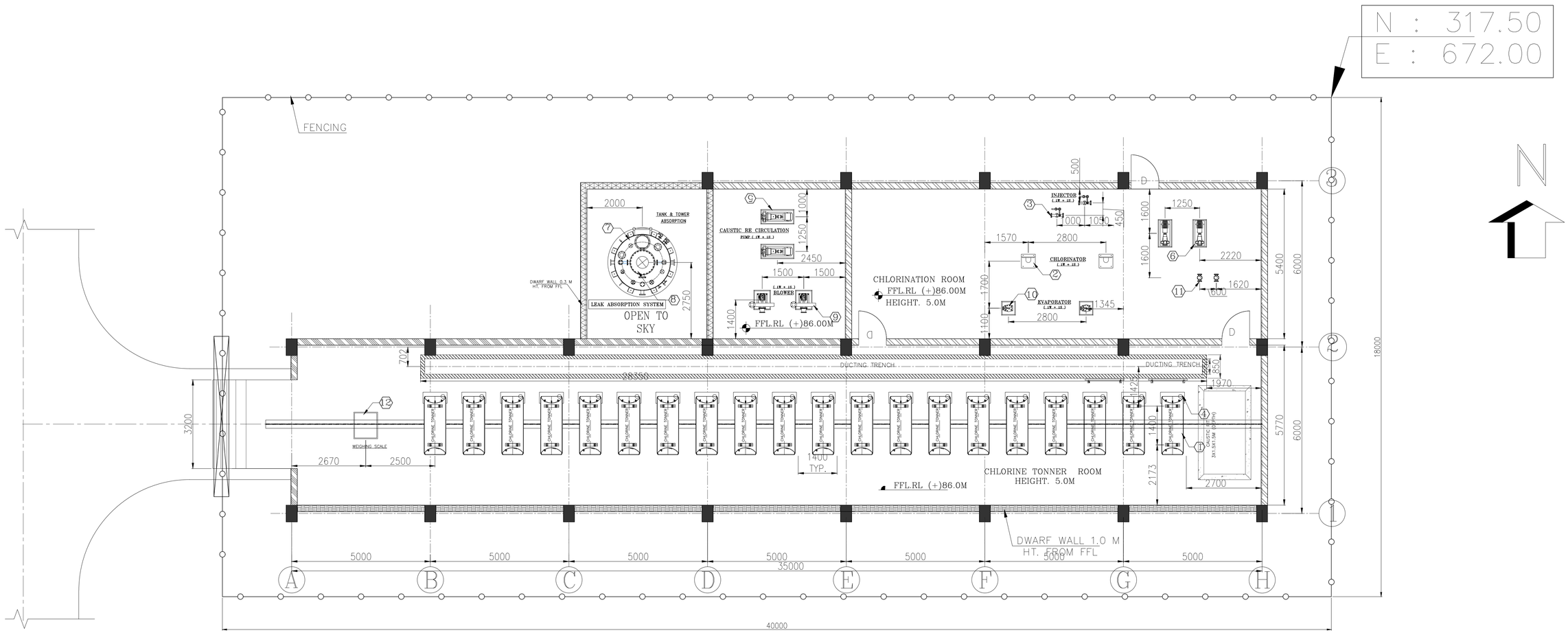
	NAME	SIGN.	DATE
DRAWN	BB SAHU	Sd/-	□□.2.2□
CHECKED	G RAJENDRAN	Sd/-	□□.2.2□
APPROVED	M RAMAKRISHNA	Sd/-	□□.2.2□

ALL DIMENSIONS ARE IN MILLIMETRES | PROJECTION | SCALE N.T.S | BHEL DRAWING NO. 1-WT-080-01846 | REV 00

REV	DATE	ALTERED:
ZONE		CHECKED:

DRAWING NO. 1-WT-040-01865

ALL DIMENSIONS ARE IN METRES



RW CHLORINATION PLANT

EQUIPMENT DETAILS.

S.No.	Description	Approx. dimension in mm	KKS Tag NO.	LOAD WEIGHT (EACH APPROX)	Qty
1.	CHLORINE TONNER				20(12w+4s)
2.	CHLORINATORS (CABINET)				
3.	INJECTOR				2(1w+1s)
4.	FRP – HOOD				
5.	CAUSTIC RE CIRCULATION PUMP				2(1w+1s)
6.	BLOWER (BLW)				2(1w+1s)
7.	ABSORPTION TANK(ABTK)		VENDOR TO PROVIDE		1
8.	ABSORPTION TOWER				1
9.	BOOSTER PUMP (BP)				2(1w+1s)
10.	EVAPORATOR				2(1w+1s)
11.	BASKET STRAINER				2
12.	WEIGHING SCALE				1
13.	ELECTRICAL HOIST (3 TONS)				1

NOTES

1. ALL DIMENSIONS ARE IN m.m AND ALL LEVELS ARE IN METRE.
2. THIS DRG. SHOULD NOT BE SCALED.
3. THIS AREA FINISHED GRADE LEVEL IS RL +85.5 M.
4. FOR TERMINAL POINTS REFER PT PLANT LAYOUT DRG. NO : 1-WT-025-01848
5. POWER SUPPLY FOR THESE EQUIPMENT IS FROM PT PLANT MCC LOCATED IN CHEMICAL BUILDING

LEGEND
F.G.L – FINISH GROUND LEVEL
T.W.L – TOP WATER LEVEL
I.L – INVERT LEVEL
WALK WAY

REFERENCE DRAWINGS :

1. PLOT PLAN : PE-DG-100-M001 LAT. REV.
2. RW CHLORINATION PID : 3-WT-040-00843
3. PT PLANT LAYOUT : 1-WT-025-01848

FOR TENDER PURPOSE ONLY

REV	DATE	ALTERED:
		CHECKED:
ZONE		

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : RW CHLORINATION PLANT

TITLE: EQUIPMENT LAYOUT FOR RW CHLORINATION

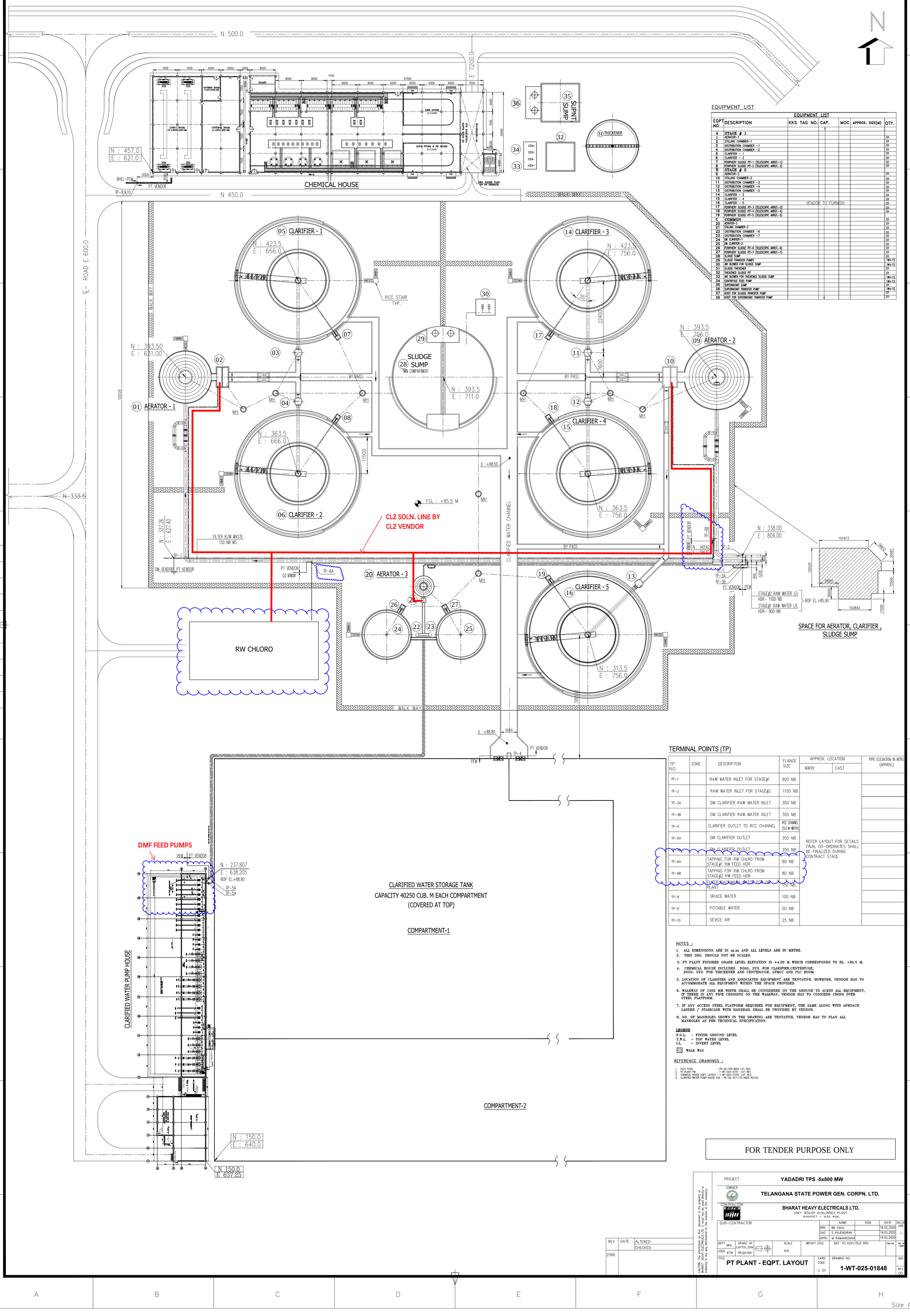
	NAME	SIGN.	DATE
DRAWN	BB SAHU	Sd/-	13.03.20
CHECKED	G RAJENDIRAN	Sd/-	13.03.20
APPROVED	M RAMAKRISHNA	Sd/-	13.03.20

ALL DIMENSIONS ARE IN MILLIMETRES | PROJECTION | SCALE N.T.S | BHEL DRAWING NO. 1-WT-040-01865 | REV 00

Size A2

DRAWING NO. 1 - WT - 025 - 01848

ALL DIMENSIONS ARE IN MILLIMETRES



EQUIPMENT LIST

EQPT NO	DESCRIPTION	KKS TAG NO.	CAP.	MOC	APPROX. SIZE(M)	QTY.
A	**STAGE # 1**					
1	AERATOR-1					01
2	STILLING CHAMBER-1					01
3	DISTRIBUTION CHAMBER -1					01
4	DISTRIBUTION CHAMBER -2					01
5	CLARIFIER - 1					01
6	CLARIFIER - 2					01
7	PERIPHERY SLUDGE PIT-1 (TELESCOPIC ARRGT.-1)					01
8	PERIPHERY SLUDGE PIT-2 (TELESCOPIC ARRGT.-2)					01
B	**STAGE # 2**					
9	AERATOR-2					01
10	STILLING CHAMBER-2					01
11	DISTRIBUTION CHAMBER -3					01
12	DISTRIBUTION CHAMBER -4					01
13	DISTRIBUTION CHAMBER -5					01
14	CLARIFIER - 3					01
15	CLARIFIER - 4					01
16	CLARIFIER - 5	VENDOR TO FURNISH				01
17	PERIPHERY SLUDGE PIT-3 (TELESCOPIC ARRGT.-3)					01
18	PERIPHERY SLUDGE PIT-4 (TELESCOPIC ARRGT.-4)					01
19	PERIPHERY SLUDGE PIT-5 (TELESCOPIC ARRGT.-5)					
C	**COMMON**					01
20	AERATOR-3					01
21	STILLING CHAMBER-3					01
22	DISTRIBUTION CHAMBER -6					01
23	DISTRIBUTION CHAMBER -7					01
24	DM CLARIFIER-1					01
25	DM CLARIFIER-2					01
26	PERIPHERY SLUDGE PIT-6 (TELESCOPIC ARRGT.-6)					01
27	PERIPHERY SLUDGE PIT-7 (TELESCOPIC ARRGT.-7)					01
28	SLUDGE SUMP					01
29	SLUDGE TRANSFER PUMPS					1W+1S
30	AIR BLOWER FOR SLUDGE SUMP					1W+1S
31	SLUDGE THICKENER					01
32	THICKENED SLUDGE PIT					01
33	AIR BLOWER FOR THICKENED SLUDGE SUMP					1W+1S
34	CENTRIFUGE FEED PUMP					1W+1S
35	SUPERNATANT SUMP					01
36	SUPERNATANT TRANSFER PUMP					1W+1S
37	HOIST FOR SLUDGE TRANSFER PUMP					01
38	HOIST FOR SUPERNATANT TRANSFER PUMP					01

TERMINAL POINTS (TP)

TP NO.	ZONE	DESCRIPTION	FLANGE SIZE	APPROX. LOCATION NORTH	APPROX. LOCATION EAST	PIPE ELEVATION IN MTRS (APPROX.)
TP-1		RAW WATER INLET FOR STAGE#1	900 NB	REFER LAYOUT FOR DETAILS FINAL CO-ORDINATES SHALL BE FINALIZED DURING CONTRACT STAGE		
TP-2		RAW WATER INLET FOR STAGE#2	1100 NB			
TP-3A		DM CLARIFIER RAW WATER INLET	300 NB			
TP-3B		DM CLARIFIER RAW WATER INLET	300 NB			
TP-4		CLARIFIER OUTLET TO RCC CHANNEL	RCC CHANNEL (5.0 M WIDTH)			
TP-5A		DM CLARIFIER OUTLET	350 NB			
TP-5B		DM CLARIFIER OUTLET	350 NB			
TP-6A		TAPPING FOR RW CHLRO FROM STAGE#1 RW FEED HDR	80 NB			
TP-6B		TAPPING FOR RW CHLRO FROM STAGE#2 RW FEED HDR	80 NB			
TP-7		FILTER BACKWASH WASTE FOR DM PLANT	150 NB			
TP-8		SRVICE WATER	100 NB			
TP-9		POTABLE WATER	50 NB			
TP-10		SEVICE AIR	25 NB			

NOTES :

1. ALL DIMENSIONS ARE IN m.m AND ALL LEVELS ARE IN METRE.
2. THIS DRG. SHOULD NOT BE SCALED.
3. PT PLANT FINISHED GRADE LEVEL ELEVATION IS +4.00 M WHICH CORRESPONDS TO RL. +85.5 M.
4. CHEMICAL HOUSE INCLUDES DOSG. SYS. FOR CLARIFIER,CENTRIFUGE, DOSG. SYS. FOR THICKENER AND CENTRIGUGE, LTMCC AND PLC ROOM.
5. LOCATION OF CLARIFIER AND ASSOCIATED EQUIPMENT ARE TENTATIVE. HOWEVER, VENDOR HAS TO ACCOMMODATE ALL EQUIPMENT WITHIN THE SPACE PROVIDED.
6. WALKWAY OF 1200 MM WIDTH SHALL BE CONSIDERED ON THE GROUND TO ACESS ALL EQUIPMENT, IF THERE IS ANY PIPE CROSSING ON THE WALKWAY, VENDOR HAS TO CONSIEDR CROSS OVER STEEL PLATFORM.
7. IF ANY ACCESS STEEL PLATFORM REQUIRED FOR EQUIPMENT, THE SAME ALONG WITH APROACH LADDER / STAIRCASE WITH HANDRAIL SHALL BE PROVIDED BY VENDOR.
8. NO. OF MANHOLES SHOWN IN THE DRAWING ARE TENTATIVE, VENDOR HAS TO PLAN ALL MANHOLES AS PER TECHNICAL SPECIFICATION.

LEGEND

F.G.L. – FINISH GROUND LEVEL
T.W.L. – TOP WATER LEVEL
I.L. – INVERT LEVEL
WALK WAY

REFERENCE DRAWINGS :

1. PLOT PLAN : PE-DG-100-M001 LAT. REV.
2. PT PLANT PID : 1-WT-025-01311 LAT. REV.
3. CHEMICAL HOUSE EQPT. LAYOUT : 1-WT-025-01319 LAT. REV.
4. CLARIFIED WATER PUMP HOUSE GAD : PE-DG-417-172-N005 REV.02

FOR TENDER PURPOSE ONLY

REV	DATE	ALTERED:
ZONE		CHECKED:

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any detrimental to the interest of the company.

PROJECT: YADADRI TPS -5x800 MW
OWNER: TELANGANA STATE POWER GEN. CORPN. LTD.
CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.
UNIT: BOILER AUXILIARIES PLANT. RANIPET – 632 406.
SUB–CONTRACTOR

	NAME	SIGN	DATE	NO.OF VAR.
DRN	BB SAHU		19.02.2020	
CHD	G RAJENDIRAN		19.02.2020	--
APPD	M RAMAKRISHNA		19.02.2020	

DEPT NPG | GRADE OF UNTOL..DIM | SCALE NTS | WEIGHT (KG). | REF. TO ASSY/OLD DRG. | ITEM NO. | NO. OF ITEMS
CODE 9776 | PR:QA:500

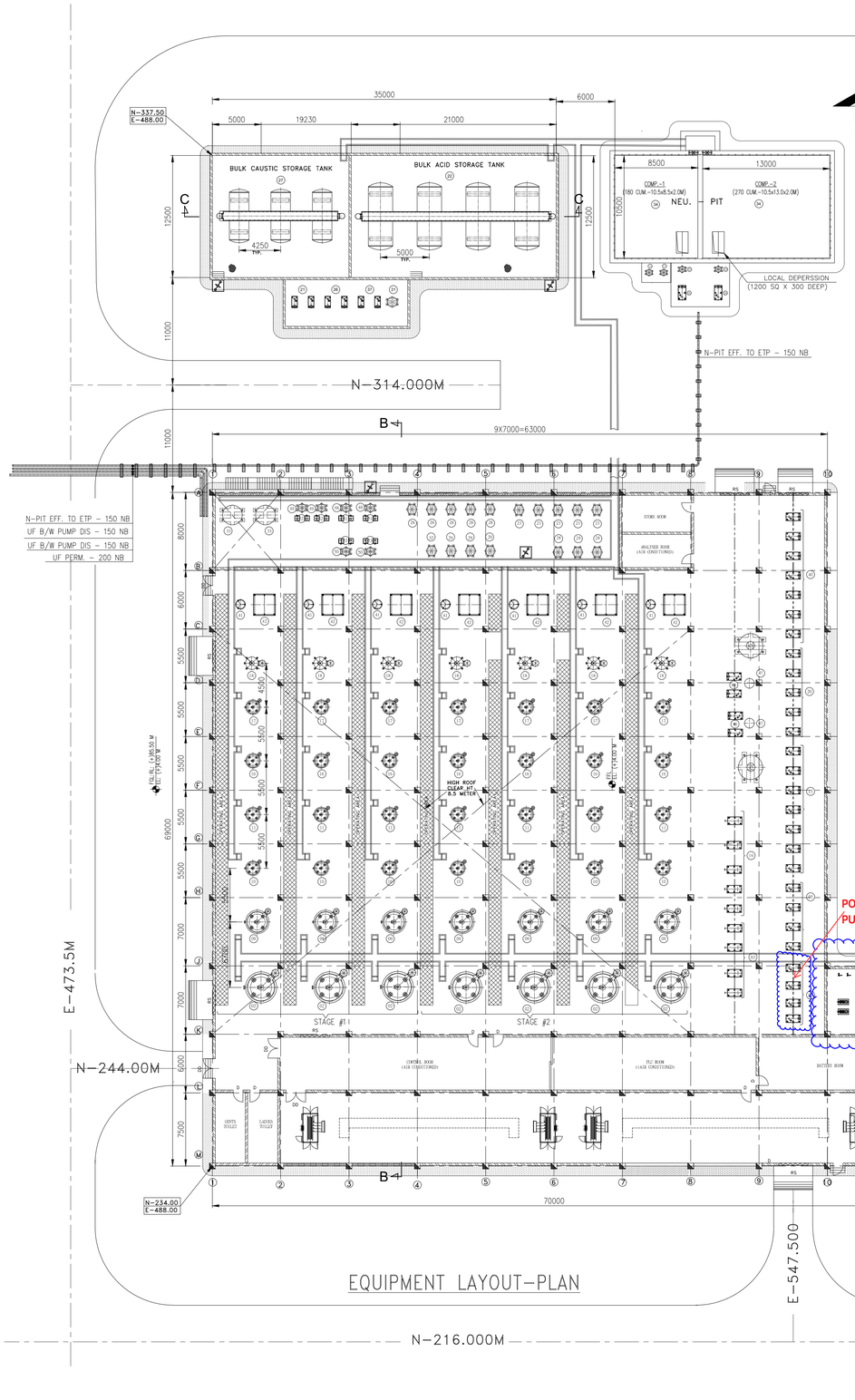
TITLE: PT PLANT - EQPT. LAYOUT
CARD CODE: U 01
DRAWING NO.: 1-WT-025-01848
VER
REV 00

Size A1

DRAWING NO. 1-WT-500-01859

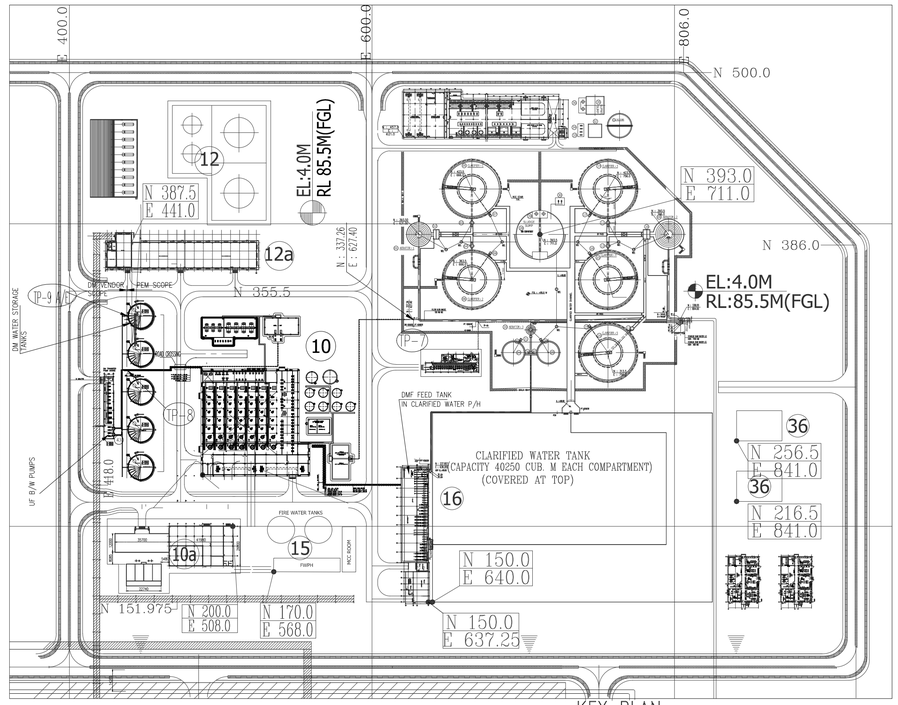
ALL DIMENSIONS ARE IN MILLIMETRES

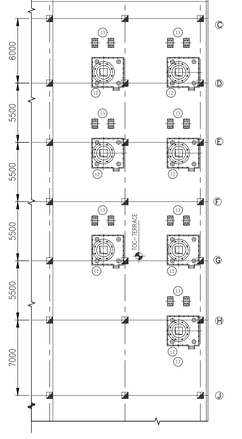
N-355.50M



TERMINAL POINTS (TP)

TP NO.	ZONE	DESCRIPTION	FLANGE SIZE	APPROX. LOCATION NORTH	APPROX. LOCATION EAST	PIPE ELEVATION IN MTRS (APPROX.)
TP-1		STAGE#1 DMF FEED PUMP SUC	---	REFER CLARIFIED WATER P/H CAD		---
TP-2		STAGE#2 DMF FEED PUMP SUC	---			---
TP-3		STAGE#1 DMF FEED PUMP R/C	150 NB			TOP OF DMF FEED TANK
TP-4		STAGE#2 DMF FEED PUMP R/C	200 NB			TOP OF DMF FEED TANK
TP-5A		TAPPING OUT FOR PW CHLORINATION	50 NB	POTABLE WATER PUMP DISCH		VENDOR TO PROVIDE
TP-5B		TAPPING IN FOR PW CHLORINATION	50 NB			VENDOR TO PROVIDE
TP-6		POTABLE WATER TO PWST	100 NB	REFER LAYOUT		BOP EL. +4.40 M
TP-7		FILTER B/W WASTE	150 NB	REFER KEY -PLAN APPROX. PIPE LENGTH-150 M		BOP EL. +4.40 M
TP-8		UF PERM. WATER TO DMWST	200 NB	REFER KEY -PLAN		BOP EL. +4.40 M
TP-9 A/E		UF B/W PUMP SUCTION	200 NB	DMWST NOZZLES		@ EL. +5.3 M
TP-10		N-PIT EFFLUENT DICH TO ETP	150 NB	APPROX. PIPE LENGTH-1500 M		
TP-11		INSTRUMENT AIR	50 NB	REFER LAYOUT		BOP EL. +4.40 M
TP-12		SEVCE AIR	25 NB	REFER LAYOUT		BOP EL. +4.40 M
TP-13		POTABLE WATER	50 NB	REFER LAYOUT		BOP EL. +4.40 M
TP-14		SERVICE WATER	50 NB	REFER LAYOUT		BOP EL. +4.40 M





DEGASSER AND BLOWER LAYOUT ON TERRACE

SL.NO	DESCRIPTION	QUANTITY	MOC	APPROX. SIZE
27	BULK CAUSTIC STORAGE TANK	3Nos		
28	CAUSTIC MEASURING TANK FOR SBA	5Nos		
29	CAUSTIC MEASURING TANK FOR MB	3Nos(2W+1S)		
30	CAUSTIC MEASURING TANK FOR N-PIT	1No		
31	ACTIVATE CARBON FILTER FOR ALKALI	1No		
32	BRINE SOLUTION PREPARATION TANK	1Nos		
33	HOT WATER TANK	2Nos		
34	NEUTRALIZATION PIT	2 Compartment		
35	PRIMING CHAMBER	2Nos(1W+1S)		
36	N-PIT EFFLUENT DISPOSAL PUMPS	2Nos(1W+1S)		
37	CAUSTIC TRANSFER CUM RECIRCULATION PUMP	2Nos(1W+1S)		
38	UF FEED TANK - A 240 CUM.	1No		
39	UF FEED TANK - B 360 CUM.	1No		
40	UF FEED PUMPS	7Nos(5W+2S)		
41	PRE FILTER	7Nos(5W+2S)		
42	UF SKIDS	7Nos(5W+2S)		
43	UF BACK WASH PUMPS	4Nos(2W+2S)		
44	-NOT USED-			
45	CIP TANK	2Nos		
46	UF (CIP) CLEANING PUMPS	4Nos(2W+2S)		
47	CARTIDGE FILTER	2Nos		
48	ACID (HCL) DOSING TANK FOR UF	2Nos		
49	CAUSTIC (NaOH) DOSING TANK FOR UF	2Nos		
50	HYPOCHLORITE (NaOCl) DOSING TANK FOR UF	2Nos		
51	ACID (HCL) DOSING PUMPS FOR UF	4Nos(2W+2S)		
52	CAUSTIC(NaOH) DOSING PUMPS FOR UF	4Nos(2W+2S)		
53	HYPOCHLORITE(NaOCl) DOSING PUMPS FOR UF	4Nos(2W+2S)		

VENDOR TO PROVIDE

SL.NO	DESCRIPTION	QUANTITY	MOC	APPROX. SIZE
01	DMF FEED PUMP	7Nos(5W+2S)		0.65MmX0.45MmX0.45M TP
02	DUAL MEDIA PRESSURE FILTER (DMF)	7Nos(5W+2S)		
03	DMF AIR BLOWER	4Nos(2W+2S)		
04	FILTERED BACKWASH WATER TANK	2 Compartment		
05	FILTER BACKWASH WATER PUMP	4Nos(2W+2S)		
06	POTABLE WATER TRANSFER PUMP	4Nos(2W+1S)		
07	FILTER BACKWASH WATER SUMP	2 Compartment		
08	BACKWASH WATER DISPOSAL PUMP	2Nos(1W+1S)		
09	ACTIVATE CARBON FILTER (ACF)	7Nos(5W+2S)		
10	WEAK ACID CATION EXCHANGER (WAC)	7Nos(5W+2S)		
11	STRONG ACID CATION EXCHANGER(SAC)	7Nos(5W+2S)		
12	DEGASER TOWER	7Nos		
13	DEGASSER AIR BLOWER	14Nos(7W+7S)		
14	DEGASSED WATER STORAGE TANK	7Nos		VENDOR TO PROVIDE
15	DEGASSED WATER TRANSFER PUMP	7Nos(5W+2S)		
16	WEAK BASE ANION EXCHANGER (WBA)	7Nos(5W+2S)		
17	STRONG BASE ANION (SBA)	7Nos(5W+2S)		
18	MIXED BED EXCHANGER (MB)	7Nos(5W+2S)		
19	AIR BLOWER FOR MB & N-PIT	5Nos(3W+2S)		
20	REGEN. WATER TRANSFER PUMP	5Nos(3W+2S)		
21	ACID UNLOADING PUMP	2Nos(1W+1S)		
22	BULK ACID STORAGE TANK	4Nos		
23	ACID MEASURING TANK FOR SAC	5 Nos(3W+2S)		
24	ACID MEASURING TANK FOR MB	3 Nos		
25	ACID MEASURING TANK FOR N-PIT	1No		
26	CAUSTIC UNLOADING PUMP	2Nos(1W+1S)		

FOR TENDER PURPOSE ONLY

NOTES:
1.ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN METER UNLESS OTHERWISE NOTED.
2.THE FINISHED FLOOR LEVEL (FFL) OF POWER HOUSE BUILDING GROUND FLOOR IS (+)0.00M WHICH CORRESPONDS TO RL (+)81.5M.
3.DM PLANT FINISHED GRADE LEVEL IS (+)4.0M AND FINISHED FLOOR LEVEL (FFL) IS (+)4.5M.
4. DMF FEED PUMPS ARE TO BE LOCATED IN CLARIFIED WATER PUMP HOUSE. REFER KEY-PLAN AND CLARIFIED WATER PUMP HOUSE GAD.
5. UF B/W PUMPS ARE TO BE LOCATED IN DM TRANSFER PUMP HOUSE. REFER KEY-PLAN
6.EQUIPMENT LOCATION ARE TENTATIVE AND SUBJECT TO MINOR CHANGES DURING DETAIL ENGINEERING.
7.EQUIPMENT SIZE ARE INDICATIVE AND WILL BE FINALIZED AFTER ORDERING OF EQUIPMENT.
8.PLC AND BATTERY ROOM SHALL BE AIR CONDITIONED (PEM SCOPE).
9.REFERENCES DRAWINGS:
i)PLOT PLAN: PE-DG-417-100-M001(LATEST REVISION).
ii)P&ID FOR DM PLANT: 1-WT-500-01295.

LEGEND:-
FGL :- FINISHED GROUND LEVEL.
FFL :- FINISHED FLOOR LEVEL.
EL :- ELEVATION.
IL :- INVERT LEVEL.
- CHEMICAL RESISTANT TILED FLOOR
- DWARF WALL - 1.0 M HT. FROM FFL
- DRAIN CHANNEL
- OPERATING AREA
- PLINTH PROTECTION
- FIRE BARRIER WALL

REV	DATE	ALTERED:
		CHECKED:
ZONE		

PROJECT	YADADRI THERMAL POWER STATION (5X800 MW)	
OWNER	TELENGANA STATE POWER GENERATION CORPORATION LIMITED	
OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BANGALORE	
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : DM PLANT	

TITLE: EQUIPMENT LAYOUT OF DM PLANT

	NAME	SIGN.	DATE
DRAWN	BB SAHU	Sd/-	06.03.20
CHECKED	G RAJENDRAN	Sd/-	06.03.20
APPROVED	M RAMAKRISHNA	Sd/-	06.03.20

ALL DIMENSIONS ARE IN MILLIMETRES
PROJECTION
SCALE N.T.S
BHEL DRAWING NO. 1-WT-500-01859
REV 00