ANNEXURE

Sl.No	Package Name	Vendor Sl. No	Vendor proposed for approval	TSGENCO Remarks for YTPS (5x800MW)
1.	FLOW ELEMENT-ORIFICE	1	ASIAN INDUSTRIAL VALVES & INSTRUMENTS, TAMILNADU	Approved.
		2	GENERAL INSTRUMENTS CONSORTIUM, TAMILNADU	Approved.
		3	INSTRUMENTATION LTD., KERALA	Approved.
		4	INSTRUMENTATION ENGINEERS PVT LTD., HYDERABAD	Approved.
		5	MICRO PRECISION PRODUCTS PVT. LTD., HARYANA	Approved.
		6	STAR-MECH CONTROLS (I) PVT.LTD., PUNE	Approved.
		7	CHEMTROLS INDUSTRIES PVT. LTD., MUMBAI	Not Approved.
		8	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD., KARNATAKA	Not Approved.
		9	TANSA EQUIPMENTS PVT. LTD., MUMBAI	Approved.

		10	HYDROPNEUMATICS PVT. LTD., GOA	Approved.
		~~11~~	~~MINCO (INDIA) PRIVATE LIMITED, GOA~~	~~Not Approved.~~
		~~12~~	~~MINCO (INDIA) FLOW ELEMENTS PVT. LTD., GOA~~	~~Not Approved.~~
		~~13~~	~~SCIENTIFIC DEVICES (BOMBAY) PVT LTD, MUMBAI~~	~~Not Approved.~~
		14	FLOW STAR ENGINEERING PVT. LTD., FARIDABAD	Approved.
2.	FLOW ELEMENT-NOZZLE	1	ASIAN INDUSTRIAL VALVES & INSTRUMENTS,TAMILNADU	Approved.
		2	BOPP & RUETHER HEINRICHS MESSTECHNI,GERMANY	Approved.
		3	GENERAL INSTRUMENTS CONSORTIUM,NEWDELHI	Approved.
		4	HYDROPNEUMATICS PVT. LTD., GOA	Approved.
		5	INSTRUMENTATION LTD., KERALA	Approved.
		6	MICRO PRECISION PRODUCTS PVT. LTD., HARYANA	Approved.
		7	STAR-MECH CONTROLS (I) PVT.LTD., PUNE	Approved.
		8	TECHNOMATIC ITALY	Approved.

		9	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD., KARNATAKA	Not Approved.
		10	MINCO (INDIA) FLOW ELEMENTS PVT. LTD., GOA	Approved.
		11	MINCO (INDIA) PRIVATE LIMITED, GOA	Not Approved.
3.	CONTROL VALVE	1	BTG KALLE INVENTING, SWEDEN	Approved.
		2	CONTROL COMPONENT INC.,NEW DELHI	Approved.
		3	DAUME REGELARMATUREN GMBH,	Approved.
		4	DRESSER VALVE INDIA PVT. LTD, TAMIL NADU	Approved.
		5	DRESSER PRODUITS INDUSTRIELS, FRANCE	Approved.
		6	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	Approved.
		7	FORBES MARSHALL ARCA PVT.LTD., PUNE	Approved.
		8	FISHER SANMAR LTD., NEWDELHI	Approved.

9	FLOWSERVE INDIA CONTROLS PVT. LTD.,KOLKATA	Approved.
10	INSTRUMENTATION LTD., KERALA	Approved.
11	KSB MIL CONTROLS LTD., KERALA	Approved.
12	KOSOFLUID CONTROLS PALAKKAD, KERALA	Approved.
13	KOSO INDIA PRIVATE LIMITED, MAHARASHTRA	Approved.
14	LESLIE CONTROLS, INC, USA	Approved.
15	SEVERN GLOCON INDIA PVT. LTD., TAMIL NADU	Approved.
16	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD., GUJARAT	Approved.
17	MASCOT VALVES PVT. LTD., GUJARAT	Approved.
18	R.K.CONTROL INSTRUMENTS PVT. LTD., MAHARASHTRA	Approved.
19	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD., CHINA	Not Approved.

		20	VALVITALIA S.P.A. , ITALY	Not Approved.
		21	WALDEMAR PRUSS ARMATURENFABRIK GMBH, GERMANY	Not Approved.
4.	ULTRASONIC FLOWMETER	1	CHEMTROLS INDUSTRIES LTD, MUMBAI	Approved.
		2	FLASH FORGE MUMBAI	Approved.
		3	ADEPT FLUIDYNE PVT. LTD., MAHARASHTRA	Approved.
		4	ELECTRONET EQUIPMENTS PVT LTD., PUNE	Approved.
		5	FLEXIM FLEXIBLE INDUSTRIEMESSTECHNIK GMBH, GERMANY	Not Approved.
		6	NIVUS GMBH, GERMANY	Not Approved.
		7	ROCKWIN FLOWMETER INDIA PVT. LTD., GHAZIABAD (UP)	Not Approved.

Sl No.	Package Name	Vendor Name	LOCATION
1	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	New Delhi
		PYROTECH ELECTRONICS PVT. LTD.	Udaipur
		PROCON INSTRUMENTATION PVT. LTD.	Chennai
		INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	Mumbai
2	ANALYSERS (ALL TYPES)	ABB INDUSTRIES AG	SWITZERLAND.
		ROSEMOUNT ANALYTICAL INC	IRVINE
		ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI
		HACH LANGE S.A.R.L CH-1222,	VESENAZ
		SWAN Analytische Instrumente AG, CH-8340	Hinwii
		METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI
		THERMO ORION INC	BEVERLY
3	UPS	EMERSON NETWORK POWER,	AMBERNATH
		EMERSON NETWORK POWER	PUNE
		HITACHI-HIREL,	GANDHINAGAR
		KELTRON,	TRIVANDRUM
		CONSUL NEOWATT POWER SOLUTIONS,	PUNE
5	MOTORISED ACTUATOR	ROTARK	UK
		AUMA	Bengaluru
		WEIR BDK VALVES	Hubli
		LIMITORQUE	Faridabad
6	AIR FILTER REGULATOR	PLACKA	Chennai
		SHAVO-NORGREN	Mumbai
		SCHRADER SCHORILL DUNCAN LTD.	Mumbai
		FAIRCHILD	USA
		SMC PNEUMATICS	Noida
7	SOLENOID VALVE	ASCO	USA
		ROTEX	Vadodra
		SCHRADER	Pune
		AVCON	Mumbai
		HERION-NORGREN	Germany
		IMI-NORGREN	Germany
		JAFFERSON	Argentina

Notes :-

1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/ delivery implication.

2) New subvendor, if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

   BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.

3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

ANNEXURE-III

PERFORMANCE GUARANTEES

VOLUME : X

SECTION-I

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.

3.00.00 SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]

Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.01.00	**Plant**		
3.01.01	Efficiency of steam generator	Efficiency of the steam generator at 100% & 80% TMCR while firing the Design coal at rated steam parameters, rated coal fineness and rated excess air. **(Refer Note-1 for estimation of weightage factor.)** Design coal shall be blended coal (50% imported coal + 50% indigenous coal).	As per Volume-I.
3.01.02	Steam generating capacity	Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working) with the coal being fired from within the range specified.	As per Volume-I.
3.01.03	Turbine Cycle Heat rate	Turbine Cycle Heat rate in kcal/kWh under rated steam conditions, design condenser pressure with zero make up at 100% & 80% of rated load **(Refer Note-1 for estimation of weightage factor.)**	As per Volume-I.
3.01.04	Output	Continuous output (MW) of 100% TMCR at Generator terminals under rated steam conditions at Turbine Inlet (247 kg/cm^2(a), 565°C, 593°C) and CW temperature of 33°C with 0% make-up with excitation power deducted	As per Volume-I.
3.01.05	Condenser Pressure	Condenser pressure in mm Hg (abs) under VWO conditions, 3% make up, design CW temperature and CW flow.	As per Volume-I.

1.01.00 SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]

NOT APPLICABLE

1.02.00 SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:

1.02.00 CONDENSATE POLISHING UNIT (CATEGORY-B)

1.02.01 The design flow (through working vessels) for each condensate polishing plant shall be the corresponding condensate flow of TG unit at VWO (Valve wide open) condition at 1% cycle make-up (Flow through each service vessel indicated in the data sheet).

1.02.02 During Normal Operation, the following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system. The ionic concentrations indicated below are as such.

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	250	Below detectable limit.
Total dissolved solids (TDS, ammonia excluded)	ppb	110	< 25
Conductivity (at 25^{O}C) (After removal of all amines)	Micro S/cm	As actual	< 0.1 (after hydrogen column at 25 ^{O} C)
Silica (as SiO_2)	ppb	30	< 5 (Refer note # 1)
Total Ferric Iron	ppb	50	< 2
Sodium(as Na)	ppb	10	< 2
Chloride (as Cl)	ppb	20	< 2
pH (polisher runs at 25^{O}C with H/OH mode)		8.5-9.0	6.5-7.5
Crud (mostly black oxide of iron)	ppb	50	< 5

Note: 1. For temperature 50˚C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

Under the Normal Condition, each Condensate Polisher Mixed Bed shall be designed to operate in hydrogen cycle for not less than 240 hours of continuous operation, while maintaining the above treated condensate quality.

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

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	1500	Below detectable limit.
Total dissolved solids (TDS, ammonia excluded)	ppb	*As actual*	< 50
Conductivity(at 25^{O}C)	Micro S/cm	*As actual*	< 0.2 (after hydrogen column at 25 ^{O} C)
Silica (as SiO_2)	ppb	500	< 20 (Refer note # 1)
Crud (mostly black oxide of iron)	ppb	1000	< 100
pH(polisher runs at 25^{O}C with H/OH mode)		9.0-9.6	6.5-7.5
Total Ferric Iron	ppb	1000	< 10
Sodium(as Na)	ppb	20	< 5
Chloride (as Cl)	ppb	100	< 10

Note-1: For temperature 50°C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

Useful service run under this condition shall be 48 hours before regeneration.

1.02.04 CONDENSER TUBE LEAKAGE CONDITION:

During condenser tube conditions, quality of the influent may deteriorate to:

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Total dissolved solids (TDS, ammonia excluded) (In addition to normal influent contaminants stated in clause 1.02.02 above	ppb	2000	---
Silica (as SiO_2)	ppb	*As actual*	< 20 (Refer note # 1)
Sodium(as Na)	ppb	*As actual*	< 20

Note-1: For temperature 50˚C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

Useful service run between regeneration under the Startup conditions and under condenser tube leakage condition shall not be less than 48 hours each.

1.02.05 Influent water quality as indicated in the above clauses is minimum only. Bidder to check the same and higher values, if felt by them, shall be considered in the design so as to meet the specified effluent quality.

1.02.06 The bed cross section in the service vessels shall be such that the average velocity of condensate through it shall not exceed 1.75 meters/min (105 M3/hr/M^2) at the design flow rate for spherical vessel. Internal diameter of the service vessels (excluding the rubber lining) of spherical type shall be selected meeting the above mentioned velocity criteria. The effective depth of mixed bed in condensate polisher service vessel shall be not less than 1100 mm.

1.02.07 At the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.0 bar. This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drop under dirty conditions will be restricted to 3.5 bar including the pressure drop across effluent resin traps.

1.02.08 Cation resins shall be regenerated by technical grade hydrochloric acid to IS:265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS:252 available as 40-48% lye or as flakes. For calculations regeneration temperature should be taken as 25 Deg. C.

In no case, the regeneration levels cannot be lower than the values indicated below:

a) Cation resin: 125 kg of 100% HCl per cubic meter of resin

b) Anion resin: 160 kg of 100% NaOH per cubic meter of resin.

1.02.09 Each rinse water outlet header of condensate polishing unit shall be provided with a pressure reducing station with isolating valves, suitably designed to enable the water entry to the both condenser's hot well which is operating under vacuum. Each pressure reducing station shall consist of either a pressure reducing valve from design pressure of service vessel to condenser vacuum or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm2 and a pressure reducing valve from 2 kg/cm2 to condenser vacuum.

1.02.10 While calculating pump head, 10% margin (minimum) shall be considered of the value of friction losses. Pipe friction loss shall be calculated as per Willam-Hazen formula and "C" value to be adopted shall be as below:-

1. Carbon Steel pipe : 100
2. CI pipe/ductile Iron : 100
3. Rubber lines steel pipe : 120
4. Stainless steel pipe : 100
5. PVC/HDPE pipe : 140

1.02.11 Each Pump shall be guaranteed for capacity, total dynamic head and power consumption for CPU package.

1.02.12 All blowers shall be guaranteed for head and power consumption for CPU package.

1.02.13 Each Condensate Polisher Mixed Bed will have a rated continuous treated water output capacity of not less than design value. Each Condensate Polisher Mixed Bed Unit shall be regenerated once after every 240 hours of continuous service run during normal operation.

1.02.14 Net output from each of Condensate Polisher Mixed Beds shall be not less than design volume of treated water for the design water analysis as exhibited in cl. no. 1.02.02, 1.02.03 & 1.02.04. In case water analysis is different from the design values, guaranteed quantity shall be calculated as indicated elsewhere in this Specification and guarantee shall be applicable on this calculated quantity.

1.02.15 Chemical consumption of the Condensate Polisher Mixed Bed as indicated by the Bidder shall be guaranteed against the regeneration level employed and resin volume provided without any tolerance.

1.02.16 Qualities of treated water from Condensate Polisher Mixed Bed shall be as per treated water analysis as exhibited in cl. no. 1.02.02, 1.02.03 & 1.02.04.

1.02.17 Noise level of all pumps and blowers at the rated duty point shall be demonstrated at site.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central Pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Bidder shall comply with the requirement.

1.02.18 Liquidate Damages (LD) for Non Achievement of Specific Performance:

The performance Guarantee parameters for Condensate Polishing System have been indicated in above clauses.

No negative tolerance in respect flow, head and other performance guarantee parameters are acceptable to the Purchaser. In case, any equipment of Condensate Polishing System is not able to achieve the performance guarantee parameters during the Performance Guarantee Tests, Bidder shall make necessary modifications or replace the Equipment/ Plant or any part. If even after rectification, the Equipment/Plant is not able to achieve the guaranteed performance parameters, the Purchaser shall have right to reject the Equipment/Plant. In such case, the Bidder shall pay back the total amount paid to them with reference to the Equipment/Plant (with all taxes and duties as applicable) to the Purchaser.

PROCEDURE FOR CONDUCTING PG TESTS

design C W flow and CW i nlet temperature corresponding to guranteed vacuum. T he c leanliness f actor s hall be det ermined in ac cordance with t he latest edition of ASME PTC-12.2.

4.07.00 Feed Water Heaters and Drain Cooler

Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.

4.08.00 Deaerator

Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.

The di ssolved o xygen c ontent i n f eed water at outlet of deaer ator s hall be determined b y A SME-D 888. R eference Method A an d an y r ecognised modification thereof.

Free c arbondioxide c ontent of deaerator e ffluent shall be measured by APHA method.

1.00.00 STATUTORY REQUIREMENTS

All par ameters of pl ant, eq uipment & facilities which ar e under j urisdiction of Statutory A uthorities, l ike M OEF, TPCB etc., s hall be g uaranteed. Conformance to the performance parameters under statutory requirement is mandatory.

2.00.00 CONDENSATE POLISHING UNIT

For Condensate polishing plant, the performance test shall be carried out as per the respective equipment specification and the applicable codes.

ANNEXURE IV

DRAWING DOCUMENTS SUBMISSION/DISTRIBUTION PROCEDURE

DRAWING DOCUMNTS SUBMISSION/DISTRIBUTION PROCEDURE

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- Editable copy of all the drawings and documents shall be provided.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copes whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.
  - P&IDs.
  - Equipment lay out of the service vessel area and regeneration area.
  - Equipment Cable tray layout for service vessel area and regeneration area
  - Equipment earthing layout service vessel area and regeneration area
  - Civil scope drawings.
  - Piping lay out drawing for Service vessel area, regenerative area and yard piping layout.
  - Valve schedule
  - Instrument schedule
  - Cable Schedule

ii) Other requirements

- Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account

DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO								M/S DCPL, KOLKATA			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS		
A	**Letter Of Intent or Contract Documents**	1	1	1	S	1	2	2	1	1	1	1	2	
B	**Vendor Drawings**													
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S	
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1	
3.	Final and any revision thereof													
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S	
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S	
C.	**Design Drawings**													
1.	Preliminary													
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S	
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S	
2.	Released for construction													
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S	
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S	
3.	Return marked 'As built'													
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1	
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1	
4.	As built drawings													
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S	
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S	

S. No	Description	TSGENCO								M/S DCPL, KOLKATA			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS		
D	Progress Report Monthly													
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1	Nil	
E	Test & Inspection Reports													
1.	Equipment manufacturer													
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1	-	
F	Instruction Manuals/Data Books													
1.	Equipment manufacturer													
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil	
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	

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

TSGENCO : Telangana State Power Generation Corporation Limited

Director, Projects, Hyd : Director/ Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082

NOTES:
The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.
All documents & drawings shall be in English and in metric units.

ANNEXURE V

PAINTING SPECIFICATION

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

SECTION-XIII

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

C O N T E N T S

SECTION-XIII

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

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

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

2.00.00 CODES & STANDARDS

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

a)	SSPC SP 10 / NACE 2 / Sa 2½	:	Near White Blast Cleaning
b)	SSPC PA 2	:	Measurement of dry film Coating Thickness with magnetic gauges.
c)	ASTM D 4541	:	Method for pull off strength using portable Adhesion Tester.
d)	NACE RP 0274 – 2004	:	High-Voltage Electrical Inspection of Pipeline Coatings
e)	NACE SP 0188 – 2006	:	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

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

3.00.00 GENERAL REQUIREMENTS

3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.

3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.

3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.

3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.

3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.

3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.

3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.

3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.

3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

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

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

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MAT ERIAL A ND SERVICES TO B E F URNISHED BY TH E BIDDER

4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :

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

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

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

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

e) Total DFT of paint system shall not be less than 150 microns.

4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :

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

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

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

d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.

e) Total DFT of paint system shall not be less than 300 microns.

4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid in side a hum e pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

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

4.03.04 Specification for application of paints for **internal surface protection of larg e diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.

b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.

c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.

b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.

c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

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

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

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

a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.

b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

a) Coating shall be applied when

i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater that 50°C.

b) Material preparation shall be in accordance with manufacturer's recommendations.

c) Application of epoxy coating system :

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

5.03.00 Application of PU Coating

a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).

b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

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

6.01.01 Apparatus / Instrument:-

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

6.01.02 Procedures:-

a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing Voltage V = 7900 $\sqrt{T}$ ± 10 percent where T is the average coating thickness in mm.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

6.03.00 Adhesion Pull off Test :

After holiday the coated surface is subjected to adhesion pull off test as per ASTMD 4541.

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “Jaw” at the bottom and also dollies.

6.03.02 Prepare the test surface :

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

6.03.03 Prepare Dolly (Test Pull Stub) :

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

6.03.04 Select an adhesive:

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

6.03.05 Attach the dolly to the surface.

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

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

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

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

6.03.06 Adhesion Test Procedure

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

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

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

d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

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

6.04.01 Surface Preparation:

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

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

6.04.03 Coating Application :

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

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

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

6.05.02 Electrical Inspection :

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

7.00.00 INFORMATI ON/DATA REQUIRED

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

NOTE-

Bidder to note that the paint shade shall be informed/finalized during detailed engineering. The same shall be complied by bidder without any price & delivery implication to BHEL & Customer.

ANNEXURE VI

MANDATORY SPARE LIST

MANDATORY SPARES LIST FOR CONDENSATE POLISHING UNIT

	Condensate Polishing Plant (Mandatory Spares List)	
S.No.	**Equipment**	**Spares Quantity for 5 Units**
1	**Spares for Horizontal Centrifugal Pumps**	
1.1	Shaft	2 Nos.
1.2	Shaft Sleeve	4 Nos.
1.3	Impeller	2 Nos.
1.4	Impeller locking nut and bolt	8 Nos.
1.5	Impeller wear ring	8 Nos.
1.6	Casing wear ring	8 Nos.
1.7	Oil Seal	8 Nos.
1.8	Oil Deflector	6 Nos.
1.9	Oil Ring	6 Nos.
1.1	Gland Packing	8 Nos.
1.11	Lantern Ring	6 Nos.
1.12	Mech Seal Assembly	2 Nos.
1.13	Stationary/Carbon Packing and O “Ring for Mechanical Seal"	6 Sets
1.14	Oil Level Gauge	6 Nos.
1.15	Coupling	4 Nos.
1.16	Rubber Bush for Coupling	4 Nos.
1.17	O " Rings "	4 Sets
1.18	Suction Strainers Element	6 Nos.
1.19	Bearing for Pump Motor	4 Sets
2	**Spares for Vertical Type Centrifugal Pumps (at Neutralising Pit)**	
2.1	Complete Bowl assembly	2 Sets
2.2	Impeller (s)	2 Sets
2.3	Shafts	2 Sets
2.4	Casing wearing (s)	2 Sets
2.5	Impeller wear ring (s)	2 Sets
2.6	Shaft Sleeves	4 Sets
2.7	Shaft Couplings	2 Sets
2.8	Shaft nuts & keys	2 Sets
2.9	Lantern rings	2 Sets
2.1	Bell mouth liner	2 Sets
2.11	Bearings	2 Sets
2.12	Pump motor coupling	2 Sets
3	**Spares for Agitators**	
3.1	Gear Box Unit Complete	2 Nos.
3.2	Bearing for Gear Box Unit	2 Sets
3.3	Coupling complete (Motor/Gear box and gear box/agitator)	2 Sets

3.4	Coupling Bolts	2 Sets
3.5	Coupling shim pack (if applicable)	8 Sets
3.6	Oil seals	8 Sets
4	**Spares for Valves**	
4.1	i) Manual Diaphragm valves	20% of total quantity used for each type and size with minimum no. four (4) for each type /size/rating.**(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
	ii) Spare Diaphragm for above	20% of total quantity used for each type and size with minimum no. four (4) for each type and size. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
4.2	i) Non return valves (NRV)	4 nos. of each size & type
	ii) Flaps for above NRV	4 nos. of each size
4.3	**Gate/Globe/Ball valves/plug valve/needle valve**	
	i) Up to 4”	20% of total quantity used for each type and size with minimum no. four (4) for each type, size. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
	ii) Above 4”	2 nos. each type and size.
4.4	**Butter fly valve**	
	i) Up to 4”	20% of total quantity used for each type and size with minimum no. four (4) for each type, size. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
	ii) Above 4”	2 nos. each type and size.
5	**Spares for Filter Media/ ION Exchange Resins**	
5.1	Media for Activated Carbon Filters	20% of total quantity.**(Total Quantity shall be calculated based on quantity of the item required for 1st set of complete regeneration system i.e. Quantity of activated carbon required for 1 complete ACF).**
5.2	Resins for each type of exchangers	20% of total quantity .**(Total Quantity shall be calculated based on quantity of the item**

		required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system i.e. 4 charge resins+ 1 resin injection hopper charge)
5.3	Ejectors	Four (4) nos. of each type
6	**Spares for Air Blowers**	
6.1	Impeller with shaft	2 Sets
6.2	Bearings	2 Sets
6.3	Oil seals	10 Sets
6.4	Filter	2 Sets
7	**Pneumatic Control Valve**	
7.1	Pneumatic Diaphragm for Diaphragm actuated valve	4 Nos. for each type of Actuator
7.2	Gland Packing	2 sets for each type of Control Valve
7.3	Plug, Seat, Cage, Stem etc.	2 sets for each type of Control Valve
7.4	Retainer Ring, Seal Ring etc.	2 sets for each type of Control Valve
7.5	Gasket	4 Sets for each type of Control Valve
7.6	Position Transmitter complete set	20% of total quantity used in the system for each type and model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
7.7	Control Valve E/P Positioner complete Set	20% of total quantity used in the system for each type and model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
7.8	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	4 Nos. for each type & ratings
7.9	Solenoid Coil for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
7.10	Position Limit Switch for Pneumatic type On/Off Valve	20 Nos. for each type & ratings
8	**C&I Items**	
8.1	Transmitters/ Gauges/Switches etc. along with relevant accessories	20% of total or at least four (whichever is higher) for each type along with accessories.**[Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection instruments].**
8.2	Temperature Element (RTD/Thermo-couple) with thermo well	20% of each type, range and immersion length. Minimum 10 nos. .**[Total Quantity**

		shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection instruments].
8.3	**Analysers**	
a)	Field sensor	4 nos.
b)	Field transmitter/ complete electronic unit	2 nos.
c)	Power supply card	2 nos.
d)	Instrumentation hardware	2 nos. each item
8.4	**Pneumatic Control Valves & Block Valves**	
a)	Plot Relay	2 sets for each valve
b)	Actuator Diaphragm	2 nos. for each valve
c)	Feedback Linkage	2 nos. for each valve
d)	Smart Positioners	20% of total quantity of each model/type. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
e)	I/P Converters (If any)	20% of total quantity or minimum 30 nos. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
f)	Complete Consumables for Valve Viz. O-ring, Gland Packing, Packing Ring, Bonnet Seal etc	4 Sets each size, rating, type
g)	Valve Disc	4 Sets each size, rating, type
h)	Valve Spindle	4 Sets each size, rating, type
i)	Valve Seat	4 Sets each size, rating, type
j)	Bush	4 Sets each size, rating, type
k)	Guide	4 Sets each size, rating, type
l)	Guide Bush	4 Sets each size, rating, type
m)	Coupling Nut	4 Sets each size, rating, type
n)	Actuator Piston with Rod & Seal	4 Sets each size, rating, type
o)	Control valve stem packing and spare operator moulded rubber diaphragms	2 sets for each size, rating, type
p)	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for each of the control valves as offered.	2 sets for each size, rating, type
q)	Solenoid valves, position transmitters, limit switches, I/P convertors, positioners etc of each type	20% of total quantity spare with minimum 2 nos. for each size, rating, type. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with**

		its interconnection valves).
8.5	**Solenoid Valves**	
a)	Solenoid Valve Coil	4 nos. of each rating & insulation
b)	Plunger	2 nos. of each type
c)	Seat	4 nos. of each type & size
d)	Gaskets	4 sets of each type & size
e)	O-Ring set	10 sets of each type & size
8.6	**Flow Elements**	
a)	Root valves	4 nos. for each flow element
b)	Gland packing for root valves	4 nos. for each flow element
c)	Gaskets	6 nos. for each flow element
8.7	**Process Connection Piping (Impulse piping/tubing, sampling piping / tubing & air supply piping as applicable)**	
a)	Valves of all types	20% of each type, class, size & model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection valves).**
b)	Valve Manifolds (2 way/3 way/5 way)	20% of each type, class, size & model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection).**
c)	Fittings	20% of each type, class, size & model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection).**
d)	Filter Regulators	40% of each model. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection).**
9	**Electrical Items**	
10	**Motor**	
10.1	**415 Volt Motor (above 30KW Rating up to 200KW)**	
10.1.1	End Shield Cover Driving & Non-Driving End	2 Sets for each type and rating of Motor
10.1.2	Driving End & Non-Driving End Bearing	2 Sets for each type and rating of Motor
10.1.3	Cooling Fan	2 Nos. for each type and rating of Motor
10.1.4	Motor Space Heater	2 Nos. for each type and rating of Motor
10.1.5	Motor Terminal Block	2 Nos. for each type and rating of Motor
10.1.6	Complete Set of Coupling	2 Sets for each Application
10.2	**415 Volt Motor (Up to 30KW Rating)**	

10.2.1	Driving End & Non-Driving End Bearing	6 Sets for each type and rating of Motor
10.2.2	Cooling Fan	4 Nos. for each type and rating of Motor
10.2.3	Motor Terminal Block	10 Nos. for each type and rating of Motor
10.2.4	Complete Set of Coupling	2 Sets for each Application
10.3	**Lugs & Glands**	
10.3.1	Glands & Lugs	40 % of each type, size & rating of cables. **(Total Quantity shall be calculated based on population of the item required for 1 CPU service vessel area of 1 TG hall & 1st set of complete regeneration system along with its interconnection).**

NOTE:	
1	Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.
2	***Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for 1 TG unit (CPU service vessel area) & 1st set of complete regeneration system along with the interconnection.***
3	In case of Bought Out items, itemised spares list may be vendor specific and may differ from the list of spares mentioned above. In such cases, The quoted price shall be considered for applicable items only without any change in the contract price.

NOTES:

i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.

ii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

iii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for station, as specified above.

iv) All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract.

v) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

vi) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

vii) Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment.

viii) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares.

ix) In case mandatory spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities in line with list of mandatory spares.

THE VENDOR WARRANTS:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:

2. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.

3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty-Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the

sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.

4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.

5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.

6. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.

7. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

8. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.

9. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

The number of drawing/documents to be submitted by the bidder shall be as per enclosed Sub-Section IA ANNEXURE-IV. The submission of soft copy or hard copy of the document whichever is later will be considered as final date of submission of the document. The bidder has to submit the revised drawing /document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

For the Drawings/Documents distribution Procedure, please refer attached Sub-Section IA Annexure-IV. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The numbers of soft copies & hard copies of drawing/documents to be submitted by the bidder shall be as per enclosed Sub-Section IA Annexure-IV.

After award of LOI/LOA, drawing/documents to be submitted by the bidder for BHEL/Customer approval has been indicated in Sub-Section IA Annexure VII. However, any additional drawing /document if found necessary for completion of the engineering, the same shall be submitted by bidder without any technical, commercial & delivery implication to BHEL. Bidder confirmed drawings submission schedule as follows:

a. Drawing/documents submission schedule: First submission of basic drawings/ documents – (Please refer MDL for list of basic drawing/documents & submission schedule).
b. Every revised document shall be submitted by bidder incorporating BHEL/customer comments – within 10 days.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder further confirmed that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

(a) List and schedule of drawings/documents to be submitted after award of contract: -

MASTER DRAWING LIST(MDL)

Sr.No.	Drawing/Document No.	Drawing/Document Title	No. of weeks for drawing/document submission after placing LOI/PO	Paper Size of Dwg/Docs.
1.0	PE-V0-417-155-A001	QAP FOR PRESSURE VESSELS FOR CONDENSATE POLISHING UNIT	10	A4
2.0	PE-V0-417-155-A002	QAP FOR SERVICE VESSEL FOR CONDENSATE POLISHING UNIT	10	A4
3.0	PE-V0-417-155-A003	QAP FOR ATMOSPHERIC TANKS FOR CONDENSATE POLISHING UNIT	10	A4

4.0	PE-V0-417-155-A004	QAP FOR BLOWERS WITH MOTOR FOR CONDENSATE POLISHING UNIT	10	A4
5.0	PE-V0-417-155-A005	QAP FOR METERING PUMPS WITH MOTOR FOR CONDENSATE POLISHING UNIT	10	A4
6.0	PE-V0-417-155-A006	QAP FOR HORIZONTAL / VERTICAL CENTRIFUGALPUMPS WITH MOTOR FOR CONDENSATE POLISHING UNIT	10	A4
7.0	PE-V0-417-155-A008	QAP FOR VALVES FOR CONDENSATE POLISHING UNIT	10	A4
8.0	PE-V0-417-155-A009 *	OPERATION & CONTROL PHILOSOPHY FOR CPU ALONG WITH CONTROL SYSTEM CONFIGURATION DIAGRAM	6	A4
9.0	PE-V0-417-155-A010 *	PROCESS DESIGN & SIZING CALCULATIONS, DS OF RESIN, VESSEL THICKNESS & PR. DROP CALCULATIONS FOR CPU	4	A4
10.0	PE-V0-417-155-A011	TECHNICAL DATA SHEET FOR HEATER FOR CONDENSATE POLISHING UNIT	10	A4
11.0	PE-V0-417-155-A012	TECHNICAL DATA SHEET OF BLOWERS FOR CONDENSATE POLISHING UNIT	10	A4
12.0	PE-V0-417-155-A013	TECHNICAL DATA SHEET FOR MOTOR FOR CONDENSATE POLISHING UNIT	10	A4
13.0	PE-V0-417-155-A014	TECHNICAL DATA SHEET FOR ANALYSERS FOR CONDENSATE POLISHING UNIT	10	A4
14.0	PE-V0-417-155-A015	TECHNICAL DATA SHEET FOR HIGH PRESSURE VALVES FOR CONDENSATE POLISHING UNIT	10	A4
15.0	PE-V0-417-155-A017	PAINTING SCHEDULE FOR CPU	10	A4
16.0	PE-V0-417-155-A018	TECHNICAL DATA SHEET FOR METERING PUMPS FOR CONDENSATE POLISHING UNIT	10	A4
17.0	PE-V0-417-155-A019	DATASHEET OF RESIN TRAP, CARBON TRAP, ACF, AGITATOR FOR CONDENSATE POLISHING UNIT	12	A4
18.0	PE-V0-417-155-A020	TECHNICAL DATA SHEET FOR INSTRUMENTS FOR CONDENSATE POLISHING UNIT	10	A4
19.0	PE-V0-417-155-A021	TECHNICAL DATA SHEET OF HORIZONTAL / VERTICAL CENTRIFUGALPUMPS FOR CONDENSATE POLISHING UNIT	10	A4
20.0	PE-V0-417-155-A022	TECHNICAL DATA SHEET FOR LOW PRESSURE VALVES FOR CONDENSATE POLISHING UNIT	10	A4
21.0	PE-V0-417-155-A023	QAP / ICL FOR CPU (FOR BALANCE OF ITEMS)	12	A4
22.0	PE-V0-417-155-A024	ELECTRICAL LOAD DATA FOR CONDENSATE POLISHING UNIT	10	A4
23.0	PE-V0-417-155-A025	GA DRAWING OF SERVICE VESSELS FOR CPU	10	A1
24.0	PE-V0-417-155-A026	GA DRAWING OF PRESSURE VESSELS FOR CPU	10	A1
25.0	PE-V0-417-155-A027	GA DRAWING OF ATMOSPHERIC TANKS FOR CPU	10	A1
26.0	PE-V0-417-155-A028	CONTROL SCHEME FOR CONDENSATE POLISHING UNIT	14	A4
27.0	PE-V0-417-155-A029	CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)	8	A1
28.0	PE-V0-417-155-A030	CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNITREGENERATION AREA)	8	A1
29.0	PE-V0-417-155-A031 *	P&I DIAGRAM FOR CONDENSATE POLISHING UNIT	4	A1

30.0	PE-V0-417-155-A032 *	EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)	4	A1
31.0	PE-V0-417-155-A033 *	EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (REGENERATION AREA)	4	A1
32.0	PE-V0-417-155-A034	PIPING LAYOUT (REGENERATION AREA) FOR CONDENSATE POLISHING UNIT	10	A1
33.0	PE-V0-417-155-A035	YARD PIPING LAYOUT FOR CONDENSATE POLISHING UNIT	16	A1
36.0	PE-V0-417-155-A036	PG test procedure for condensate polishing unit	20	A4
37.0	PE-V0-417-155-A037	PIPING LAYOUT (SERVICE VESSEL AREA) FOR CONDENSATE POLISHING UNIT	10	A1
38.0	PE-V0-417-155-A038	VALVE SCHEDULE FOR CONDENSATE POLISHING UNIT	12	A3
39.0	PE-V0-417-155-A039	INSTRUMENT SCHEDULE FOR CONDENSATE POLISHING UNIT	12	A3
40.0	PE-V0-417-155-A040	VALVE SEQUENCE CHART FOR CONDENSATE POLISHING UNIT	10	A3
41.0	PE-V0-417-155-A041 *	SUB-VENDOR LIST AND INSPECTION CRITERIA	4	A4
42.0	PE-V0-417-155-A042	I/O LIST FOR CONDENSATE POLISHING UNIT	10	A4
43.0	PE-V0-417-155-A043	DRIVE LIST FOR CONDENSATE POLISHING UNIT	12	A4
44.0	PE-V0-417-155-A044	CABLE TRAY/TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CPU(REGENERATION AREA)	12	A1
45.0	PE-V0-417-155-A045	CABLE TRAY/TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CPU(SERVICE VESSEL AREA)	12	A1
46.0	PE-V0-417-155-A046	CABLE SCHEDULE FOR CONDENSATE POLISHING UNIT	16	A3
47.0	PE-V0-417-155-A047	O&M MANUAL FOR CONDENSATE POLISHING UNIT	24	A4

Note-The drawing/document marked as (*) shall be considered as basic drawings/documents and payment as per suggested price format shall be made after approval of drawings/ documents marked as (*) in either CAT-I/II .

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing no.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 10 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

5. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx)"
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

ANNEXURE VIII

WATER ANALYSIS

CLARIFIED WATER ANALYSIS

S.No.	CONSTITUENTS	As	CONTENT
1.	Calcium	$CaCO_3$	121.9 ppm
2.	Magnesium	$CaCO_3$	74.1 ppm
3.	Sodium	$CaCO_3$	184.4 ppm
4.	Potassium	$CaCO_3$	1.1 ppm
5.	Iron in Soln.	Fe	Nil
	TOTAL CATIONS	**$CaCO_3$**	**381.5 ppm**
6.	Bicarbonate	$CaCO_3$	134.8 ppm
7.	Sulphate	$CaCO_3$	80.9 ppm
8.	Chloride	$CaCO_3$	161.0 ppm
9.	Nitrate	$CaCO_3$	3.5 ppm
10.	Phosphate	$CaCO_3$	Nil
11.	Fluoride	$CaCO_3$	1.3 ppm
	TOTAL ANIONS	**$CaCO_3$**	**381.5 ppm**
12.	Reactive Silica	SiO_2	14.1 ppm
13.	Colloidal Silica	SiO_2	Nil
14.	Total Silica	SiO_2	14.1 ppm
15.	Nitrites	NO_2	Nil
16.	Total Hardness	$CaCO_3$	196 ppm
17.	Total Suspended Solid		15 ppm
18.	pH value at 25°C	-	8.0
19.	Turbidity		15 NTU

Note:

The analysis of the clarified water is exhibited here shall be multiplied with 6.5 COC to derive the circulating water analysis.

ANNEXURE IX

LIST OF TOOLS & TACKLES (AS APPLICABLE)

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition bidder to adhere relevant clauses of tender specification also.

ANNEXURE X

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	Commissioning Activities (if not covered in				

	separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				

6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centers ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

ANNEXURE XI

SITE STORAGE AND PRESERVATION

CONTENT

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) **GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –

   - Ingress of moisture and corrosion damages.
   - Damage to protective coating.
   - Open ends in pipes, vessels and equipment -
     - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

   - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
   - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere.** (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage.** (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

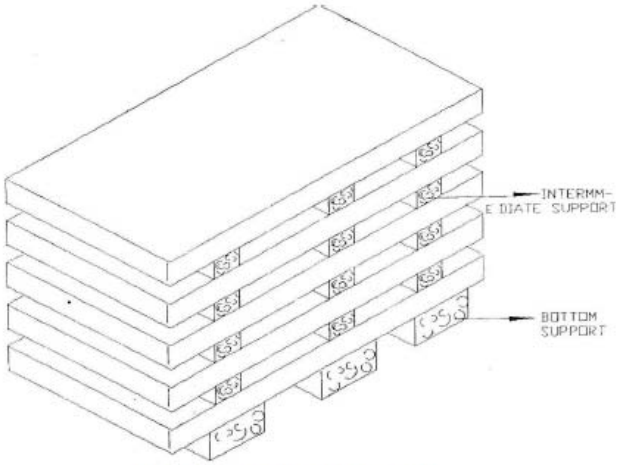

Figure – 1 – PLATE STACKING ARRANGEMENT

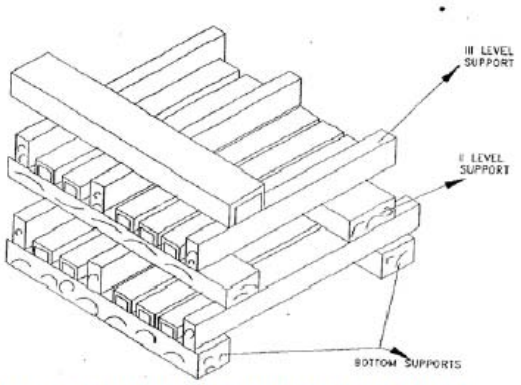

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

ANNEXURE XII

GENERAL TECHNICAL REQUIREMENTS (GTR)

CONTENT

SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.

2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.

2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.

2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 NAME PLATES (RATING PLATES)

3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.

3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.

4.00.00 SAFETY AND SECURITY

4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

a) The minimum width of clear access corridors around equipment shall be 1.2 meter.

b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.

c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.

g) Cubicle for operating personnel shall be located at safe place near the equipment.

h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.

i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.

10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 PLANT LIFE AND MODE OF OPERATION

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 **PROTECTION**

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

15.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.

b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm^3 (with worst coal and one field out at TMCR).

b) NO_x - 365 ppm Max. or 750 mg/Nm^3 (Equivalent NO_2).

c) SO_2 - Concentration based standard 2000 mg/Nm^3. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 **Noise Level Requirement**

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.

16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.

16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.

16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

16.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

16.02.00 **Performance Tests at Site**

16.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

17.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2

60 heads	60
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However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

2. Plant operation and systems training for operators including simulator training as applicable.

3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training

coordinator(s) during the tenure of the training programme.

17.02.00 **Operation and Maintenance Training at Site**

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

a) One (1) for Steam Generator and Auxiliaries ;

b) One (1) for Turbine Generator and Auxiliaries ;

c) One (1) for Electrical Works ;

d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;

e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

17.04.00 For detail C&I training refer to Volume-VI, Section-9.

18.00.00 **DEVIATIONS**

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission (IEC) Publications.

t) Power Test Code for Steam Turbines (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Dept. of Environment, Govt. of India

hh) Central Board of Irrigation and Power (CBIP) Publications.

ii) The Air Prevention and Control of Pollution Act.

jj) The Environmental Protection Act

kk) The Public Liability Insurance Act.

ll) The Forest Conservation Act

mm) The Wildlife protection Act.

nn) The EIA Notification, 1994.

oo) IS: 14665-Specification for Electric Traction Lift

pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

	ITEM	SPECIFICATION REQUIREMENT
A.	Site conditions to be considered	
1.	Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B.	Layout Requirements	
1.	Maximum permissible slope in	
a)	Rail track	1 in 400
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	Required road width	
a)	Main roads	Refer VII-A, B, C.
b)	Auxiliary interconnections	Refer VII-A, B, C.
c)	Road to the power house unloading bay :	
	• Only for entry to the unloading bay	Yes
	• To pass through the unloading bay	No
3.	Required minimum horizontal distance between the nearest points of	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other building/facility	As per the Tariff Advisory Committee/ LPA Rules
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee/ LPA Rules
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

	ITEM	SPECIFICATION REQUIREMENT
4.	Required minimum vertical clearance	
a)	Under pipes/cable racks at road crossings	8.0 Metres
b)	Soil coverage over underground pipes	1.0 Metre (minimum)
5.	Railway Wagon clearance	Rules of the Indian Railways
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7.	Required level, above the local developed grade level, of	
a)	top of all roads	150 mm above FGL
b)	all outdoor paved areas	100 mm above FGL
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d)	Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.
BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS		
A.	Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1.	Horizontal, in all directions	
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm
b)	Adjacent to any other plant facilities (including walls/structures)	1000 mm
2.	Vertical (head-room clearance)	
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.5 Metre
b)	Under any other plant facilities (including structures, pipes etc.)	2.5 Metre

	ITEM	SPECIFICATION REQUIREMENT
3.	For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4.	Minimum clear hand space required for	
a)	The application of thermal insulation	100 mm
b)	Welding work	150 mm
c)	Bolt tightening	150 mm
B.	Floors, platforms, staircase, ladders, walls, doors & windows	
1.	Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.	Operation & Maintenance Requirement	
a)	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b)	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3.	Plinth level of all buildings, above the finished grade level	500 mm
4.	Minimum access opening required (with rolling shutter) for transportation, wherever entry of truck for material handling is envisaged	3.5M wide x 4M high or, more depending upon the equipment size to be handled.

	ITEM	SPECIFICATION REQUIREMENT
C.	Other Maintenance Requirement	
1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismant-ling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	

	ITEM	SPECIFICATION REQUIREMENT
c)	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d)	No opening shall be provided from Boiler side.	
e)	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f)	Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g)	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h)	Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i)	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E.	Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

ANNEXURE-XIII

SCOPE MATRIX OF PRESSURE VESSELS & ATMOSPHERIC TANKS

ANNEXURE-XIII

SCOPE MATRIX OF PRESSURE VESSELS & ATMOSPHERIC TANKS

Following pressure vessels and atmospheric tanks shall be supplied by BHEL & bidder (Kindly refer the below table for the same). Erection and commissioning of all these pressure vessels and atmospheric tanks shall be in scope of Bidder. Further all the pressure vessels and atmospheric tanks for which internals, underdrain system or any other accessories required technically for functioning of the vessel and for the process and performance requirement shall be part of bidder scope. All the internals as required shall be supplied at BHEL Jagdishpur Fabrication Plant by the Bidder.

Sr. no.	Type of vessel	Description of the item with Nos.	Vessel/tank material supply and fabrication by	Vessel complete internals supply scope for all vessels	Integration of these internals with main tank/ vessel by	Relevant drawing supporting the installation of internals shall be provided by	Vessel GA drawing along with fabrication drawing including complete dimensioning shall be provided by	Rubber Lining & Painting	Inspection and Testing arranged by	Packing (as required and as applicable)
1.	Pressure vessel	Service Vessel (Spherical)-15 nos.	BHEL	All internals like (Inlet header, lateral distributor, top strainer plate of Service vessel, etc.) - By Bidder Sight glass– By Bidder Bottom strainer bed plate, nozzle/ strainer along with its accessories - By Bidder	BHEL	Bidder	Bidder	BHEL	BHEL	BHEL
2.	Pressure vessel (Regeneration Vessel)	Regeneration Vessel (as per Technical Specification requirement) a) Resin Separation Vessel- 2nos., b) Anion Resin Regeneration Vessel-2 nos., c) Cation Resin Regeneration Vessel / Mixed Resin Storage Vessel- 2nos.	Bidder	Bidder	Bidder	Bidder	Bidder	Bidder	Bidder	Bidder
3.	Atmospheric tank	Resin Make up/injection hopper - 2nos.	BHEL	Complete vessel internal (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL (as applicable)	BHEL	BHEL
4.	Atmospheric tank	Acid measuring tank for regeneration -2 nos. along with applicable seal pot and fume absorber	BHEL	Complete vessel internal (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
5.	Pressure vessel	Activated carbon filter for alkali -2 nos.	BHEL	Complete vessel internals (as applicable), under drain system including nozzle/ strainer and sight glass by bidder	BHEL	Bidder	Bidder	BHEL	BHEL	BHEL

Sr. no.	Type of vessel	Description of the item with Nos.	Vessel/tank material supply and fabrication by	Vessel complete internals supply scope for all vessels	Integration of these internals with main tank/ vessel by	Relevant drawing supporting the installation of internals shall be provided by	Vessel GA drawing along with fabrication drawing including complete dimensioning shall be provided by	Rubber Lining & Painting	Inspection and Testing arranged by	Packing (as required and as applicable)
6.	Atmospheric tank	Alkali measuring cum preparation tank- 2nos. along with Seal pot and CO2 absorber	BHEL	Complete vessel internals (as applicable) by Bidder Agitator with motor along with reduction gear arrangement and supporting structure shall be provided by bidder for fitting on the tanks.	BHEL	Bidder	Bidder	BHEL	BHEL	BHEL
7.	Pressure vessel	Hot water tank-2 nos.	BHEL	Complete vessel internals (as applicable) by Bidder Heaters as required as per the technical specification by bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
8.	Atmospheric tank	Bulk Acid storage tanks for Stage –I – 2nos. along with applicable seal pot and fume absorber	BHEL	Complete vessel internals (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
9.	Atmospheric tank	Bulk Acid storage tanks for Stage –II – 2nos. along with applicable seal pot and fume absorber	BHEL	Complete vessel internals (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
10.	Atmospheric tank	Bulk Alkali storage tanks for Stage –I – 2nos. along with Seal pot and CO2 absorber	BHEL	Complete vessel internals (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
11.	Atmospheric tank	Bulk Alkali storage tanks for Stage –II – 2nos. along with Seal pot and CO2 absorber	BHEL	Complete vessel internals (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL
12.	Atmospheric tank	Acid Measuring Tank for Neutralization- pit - 2 nos. along with applicable seal pot and fume absorber	BHEL	Complete vessel internals (as applicable) by Bidder	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL

Sr. no.	Type of vessel	Description of the item with Nos.	Vessel/tank material supply and fabrication by	Vessel complete internals supply scope for all vessels	Integration of these internals with main tank/ vessel by	Relevant drawing supporting the installation of internals shall be provided by	Vessel GA drawing along with fabrication drawing including complete dimensioning shall be provided by	Rubber Lining & Painting	Inspection and Testing arranged by	Packing (as required and as applicable)
13.	Atmospheric tank	Alkali Measuring Tank for neutralization-pit-2nos. along with Seal pot and CO2 absorber	BHEL	Complete vessel internals (as applicable) by Bidder Agitator with motor along with reduction gear arrangement and supporting structure shall be provided by bidder for fitting on the tanks.	BHEL (as applicable)	Bidder	Bidder	BHEL	BHEL	BHEL

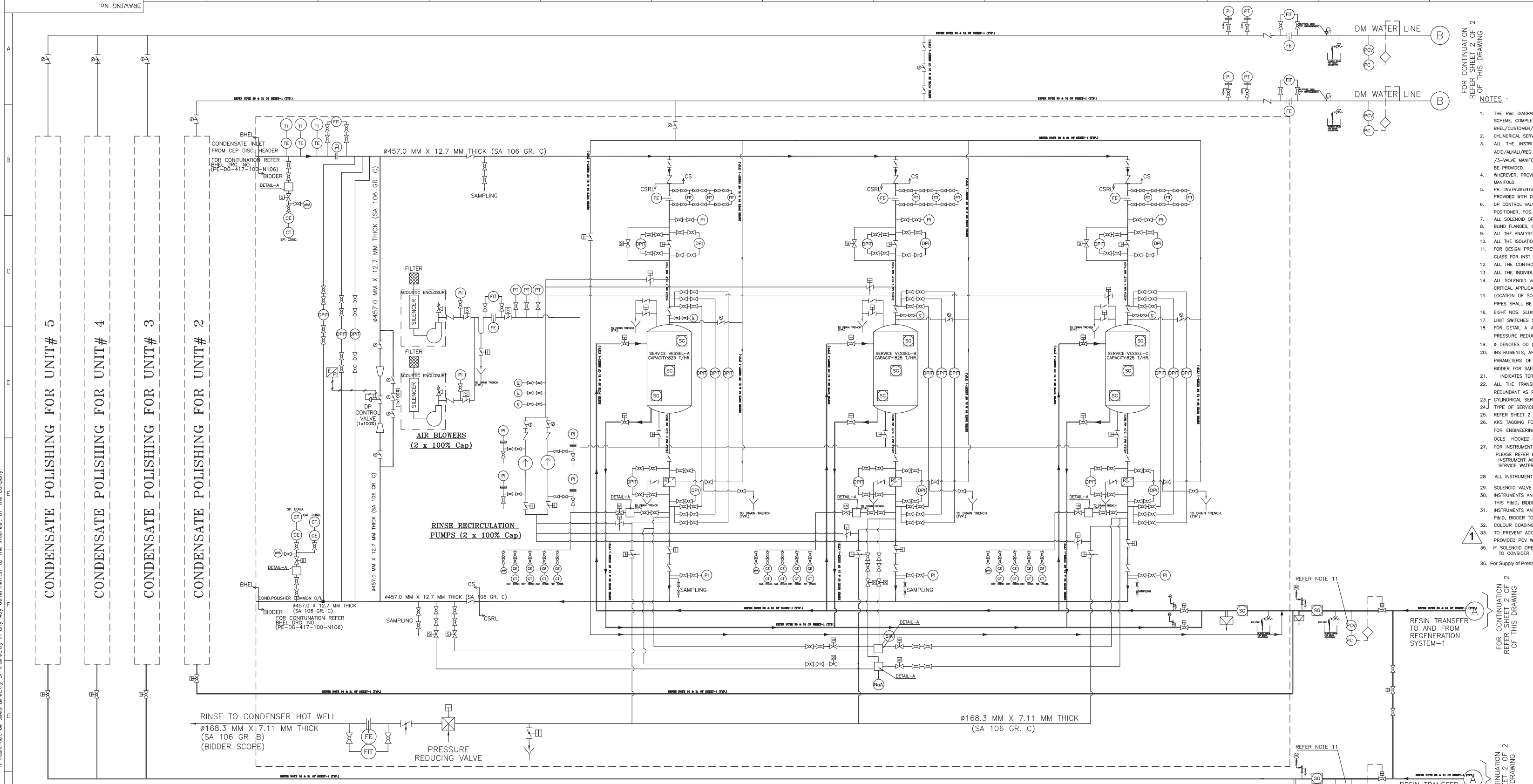
Notes:

A) The sizing of the vessels shall be strictly as per the tender specification requirement and shall be subject to BHEL/ Customer Approval
B) Rubber lining shall be part of BHEL scope for the vessels which are fabricated by BHEL.
C) All the internals as required shall be supplied at BHEL Jagdishpur Fabrication Plant by the Bidder.
D) Bidder will give the detailed fabrication drawing (the drawing should cover all the details required for fabrication) and mechanical GA drawing of all the vessels with internal details to enable BHEL so that fabrication of the vessels shall be done as per drawing.
E) Bidder will furnish the detailed step wise fabrication procedure of all the vessels which has to be fabricated by BHEL.
F) Supervision of fabrication of the vessels at BHEL Jagdishpur works shall be part of Bidder’s scope. For this bidder to consider 30 man days (6 visits of 5 working days each). Bidder shall depute his fabrication Engineer/ Expert to supervise and guide the fabrication of the vessels.
G) Bidder shall supply all the required internals in line with the fabrication requirement. Bidder shall strictly follow and co-ordinate with BHEL Jagdishpur Plant to synchronize the supplies of internal and its fabrication activities. Apart from the supervision of the fabrication of the vessels Bidder shall also guide and supervise the fitting and attachment of the internals in the vessels.
H) To avoid any mismatch, it is Bidder’s responsibility to provide complete details on time to BHEL. It is Bidder’s responsibility to ensure that the vessels are fabricated as per the approved drawing/ design requirement.
I) In case of any fault observed in the fabrication vessels due to incomplete/ faulty details in the drawing or due to negligence in supervision or guidance, then the same shall be rectified by BHEL at the risk and cost of Bidder.
J) Material of the construction of the vessels shall be as per the technical specification requirement.
K) The required nozzles/ strainers as per the technical specification requirement shall be part of Bidder’s scope for all the vessels.
L) Bidder shall furnish the final Nozzle orientation along with the fabrication and GA drawing. The counter flange as required at the nozzle shall be part of Bidder’s scope. However, the Flange associated with the nozzle for the vessels which are fabricated by BHEL shall be in BHEL scope.
M) Packing as required and as applicable for the vessels which are fabricated by BHEL shall be in BHEL scope.
N) Bidder to note that BHEL reserve the right to change the fabrication place/ Fabricator. Hence, all the scope as defined in the technical specification will be applicable for new fabrication place/ fabricator.
O) The fabricated vessels (which are part of BHEL fabrication) shall be directly dispatch from BHEL fabrication works to Project Site by BHEL.
P) Platform and ladders as required for all the pressure vessels and tanks shall be in part of bidder's scope. Bidder to supply and integrate these platforms and ladders at project site.
Q) Final touch-up paint at project site for all tanks and pressure vessels shall be in bidder's scope.

P & ID

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

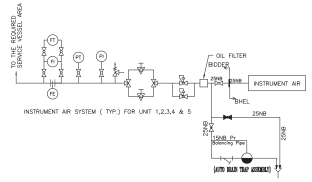

CONDENSATE POLISHING FOR UNIT# 5
CONDENSATE POLISHING FOR UNIT# 4
CONDENSATE POLISHING FOR UNIT# 3
CONDENSATE POLISHING FOR UNIT# 2
CONDENSATE INLET FROM CEP DISC. HEADER
ø457.0 MM X 12.7 MM THICK (SA 106 GR. C)
AIR BLOWERS (2 x 100% Cap)
RINSE RECIRCULATION PUMPS (2 x 100% Cap)
SERVICE VESSEL-A CAPACITY:825 T/HR.
SERVICE VESSEL-B CAPACITY:825 T/HR.
SERVICE VESSEL-C CAPACITY:825 T/HR.
DM WATER LINE
RESIN TRANSFER TO AND FROM REGENERATION SYSTEM-1
RESIN TRANSFER TO AND FROM REGENERATION SYSTEM-2
FOR CONTINUATION REFER SHEET 2 OF 2 OF THIS DRAWING
RINSE TO CONDENSER HOT WELL
ø168.3 MM X 7.11 MM THICK (SA 106 GR. B) (BIDDER SCOPE)
PRESSURE REDUCING VALVE
ø168.3 MM X 7.11 MM THICK (SA 106 GR. C)

CONDENSATE POLISHING SERVICE VESSEL AREA FOR UNIT-1 (TYPICAL)

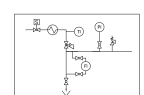
NOTES :

1. THE P&I DIAGRAM IS INDICATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHALL FURNISH SCHEME, COMPLETE IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT,TROUBLE FREE OPERATION OF PLANT FOR BHEL/CUSTOMER/CONSULTANT APPROVAL DURING DETAILED ENGINEERING.
2. CYLINDRICAL SERVICE VESSELS SHOWN IS INDICATIVE ONLY. SERVICE VESSELS SHALL BE OF SPHERICAL DESIGN.
3. ALL THE INSTRUMENT ISOLATION VALVES OTHER THAN FOR ACID/ALKALI APPLICATION SHALL BE GLOBE PATTERN AND DIAPHRAGM TYPE FOR ACID/ALKALI/REG WASTE APPLICATION TO BE PROVIDED AT SOURCE. NEAR THE INSTRUMENT 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS /3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
4. WHEREVER, PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE, TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
5. PR. INSTRUMENTS USED IN ACID, ALKALI, DM LINE, REG WASTE, RESIN LINES, REGENERATION VESSEL AND MIXED RESIN STORAGE VESSELS, SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
6. DP CONTROL VALVE BETWEEN INLET/OUTLET OF CPU SHALL BE MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, POS. XMTR, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
7. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
8. BLIND FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE.
9. ALL THE ANALYSERS SHALL BE PANEL MOUNTED.
10. ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316 CONFORM TO ANSI 300# CLASS.
11. FOR DESIGN PRESSURE BETWEEN 40 BAR TO 60 BAR, DESIGN TEMPERATURE LESS THAN 425 DEG C, 2 NOS. ROUTE VALVES OF 15 NB SIZE OF 800 CLASS FOR INST. (PRESSURE, FLOW, LEVEL MEASUREMENT). HAVE TO BE PROVIDED BY THE BIDDER.
12. ALL THE CONTROL LOOPS SHALL BE INDICATED IN VENDOR DOCUMENT.
13. ALL THE INDIVIDUAL "Y" TYPE STRAINERS SHALL BE PROVIDED WITH DPIT.
14. ALL SOLENOID VALVE SHALL BE PROVIDED BY BIDDER WITH LOCAL LED STATUS DISPLAY AND LIMIT SWITCHES SHALL BE PROVIDED BY BIDDER FOR CRITICAL APPLICATIONS TO FACILITATE REMOTE INDICATION ON OWS.
15. LOCATION OF SODIUM & SILICA ANALYZER SHALL BE INSIDE THE CONTROL ROOM. ALL REQUIRED TUBING AND RACK ALONG WITH DRAIN DISPOSAL PIPES SHALL BE IN BIDDER'S SCOPE.
16. EIGHT NOS. SLUICE GATES INDICATED IN N-PIT SHALL BE IN BIDDER'S SCOPE.
17. LIMIT SWITCHES SHALL BE PROVIDED BY THE BIDDER FOR ALL THE PUMPS FOR AUTO OPERATION.
18. FOR DETAIL A AND ALL ANALYZERS, ALL REQUIRED ACCESSORIES & VALVES SUCH AS ISOLATION VALVES, PRESSURE REDUCING VALVES, BACK PRESSURE REDUCING VALVES ETC SHALL BE PROVIDED FOR IMPLEMENTING SAMPLE MEASUREMENT AS PER BIDDER'S STANDARD PRACTICE.
19. ø DENOTES OD (OUTER DIAMETER).
20. INSTRUMENTS, ANALYZERS ETC. USED IN SYSTEM SHOULD SUSTAIN OPERATING & DESIGN PARAMETERS OF SYSTEM. IN CASE OPERATING & DESIGN PARAMETERS OF INSTRUMENTS,ANALYSERS ARE LESS THAN SYSTEM's PARAMETER,NECESSARY ARRANGMENT/ACCESSORIES SHALL BE PROVIDED BY BIDDER FOR SAFE OPERATION.
21. INDICATES TERMINAL POINTS BETWEEN BHEL & BIDDER.
22. ALL THE TRANSMITTERS (PRESSURE,LEVEL,TEMPERATUTRE,DIFFERENTIAL PRESSURE,FLOW ETC.) USED FOR INTERLOCK & PROTECTION, SHALL BE REDUNDANT AS PER SECTION IIC AND IIIC OF THIS TECHNICAL SPECIFICATION.
23. CYLINDRICAL SERVICE VESSELS SHOWN IS INDICATIVE ONLY.
24. TYPE OF SERVICE VESSEL SHALL BE SPHERICAL ONLY.
25. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.
26. KKS TAGGING FOR CPU P&ID SHALL BE PROVIDED DURING DETAIL ENGINEERING AFTER AWARD OF CPU PACKAGE .KKS TAGGING SHALL BE DONE FOR ENGINEERING AFTER AWARD OF CPU PACKAGE .KKS TAGGING SHALL BE DONE FOR INSTRUMENTS/EQUIPMENTS/ AUTO VALVES/VALVES WITH OCLS HOOKED UP TO CONTROL SYSTEM/DDCMIS.
27. FOR INSTRUMENT AIR,POTABLE WATER, SERVICE WATER & SERVICE AIR TERMINAL POINTS
PLEASE REFER BELOW MENTION BHEL DRAWINGS:
INSTRUMENT AIR DISTRIBUTION SCHEME FOR COMPRESSED AIR SYSTEM BHEL DRAWING NO. PE-DG-417-555-A001, REV 0
SERVICE WATER DISTRIBUTION SCHEME BHEL DRAWING NO. PE-DG-417-172-N003, REV 0
28 ALL INSTRUMENT AIR DISTRIBUTION FOR SOV SHALL BE THROUGH SS316 MANIFOLD WITH SS316 ISOLATION VALVES AND AUTO DRAIN TRAPS.
29. SOLENOID VALVE SHALL BE KEPT IN PNEUMATIC JUNCTION BOXES ONLY. SS TUBING FOR SOV TO VALVE SHALL NOT BE MORE THAN 6 METERS.
30. INSTRUMENTS AND TRANSMITTERS IN RESIN TRANSFER LINES SHALL BE CAPILLARY DIAPHRAGM TYPE. IF THE SAME IS NOT INDICATED ALL PLACES IN THIS P&ID, BIDDER TO CONSIDER THE SAME IN THEIR SCOPE WHEREVER APPLICABLE.
31. INSTRUMENTS AND TRANSMITTERS IN DM WATER LINES SHALL BE CAPILLARY DIAPHRAGM TYPE. IF THE SAME IS NOT INDICATED ALL PLACES IN THIS P&ID, BIDDER TO CONSIDER THE SAME IN THEIR SCOPE WHEREVER APPLICABLE.
32. COLOUR COADING FOR ALL NON STAINLESS PIPES SHALL BE PROVIDED DURING DETAIL ENGINEERING AFTER AWARD OF CPU PACKAGE BY BIDDER.
33. TO PREVENT ACCIDENTAL OVER PRESSURIZATION OF THE RESIN TRANSFER PIPE LINE AND REGENERATION FACILITIES CONNECTED TO IT, IT SHALL BE PROVIDED PCV WITH PRESSURE CONTROLLER AND OPERABLE FROM DC AND ALSO PROVIDED WITH SAFETY RELIEF MECHANISM.
35. IF SOLENOID OPERATED BUTTERFLY VALVE AT THE OUTLET OF AIR BLOWER LINE AS INDICATED IN P&ID IS NOT TECHNICALLY FEASIBLE THEN BIDDER TO CONSIDER THE SAME AS MOTORISED OPERATED BUTTERFLY VALVE THEIR SCOPE.
36. For Supply of Pressure Vessels and Atmospheric Tanks Bidder to refer Annexure - XIII of this specification

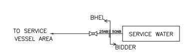
S.NO.	DESCRIPTION	MOC
1.	RESIN TRANSFER PIPING	ASTM A 312 GR.TP304 SCH10S (MINIMUM)
2.	DM WATER PIPING	ASTM A 312 GR.TP304 SCH40 FOR PIPING <OR=50NB ASTM A 312 GR.TP304 SCH10 FOR PIPING >OR=65NB
3.	CONDENSATE COMMON INLET	SA 106 GR. C (ASTM A 106 GR. C)
4.	CONDENSATE COMMON OUTLET	SA 106 GR. C (ASTM A 106 GR. C)
5.	INSTRUMENT AIR/SERVICE AIR PIPING	ASTM A 312 GR.TP304 SCH40 FOR PIPING <OR=50NB ASTM A 312 GR.TP304 SCH10 FOR PIPING >OR=65NB
6.	SERVICE WATER/POTABLE WATER	ERW Carbon Steel Pipe to ASTM 53 Gr. B / IS-1239, Part-I heavy grade for pipe size up to 150mm NB and IS-3589 for 200mm NB & above
7.	CONDENSATE INDIVIDUAL INLET LINE TO SERVICE VESSEL	CSRL (SA 106 GR. C WITH INSIDE LINED WITH NATURAL RUBBER 3mm THICK IN TWO LAYERS WITH SHORE HARDNESS 65 ± 5 IN SCALE-A
8.	CONDENSATE INDIVIDUAL OUTLET LINE FROM SERVICE VESSEL	CSRL (SA 106 GR. C WITH INSIDE LINED WITH NATURAL RUBBER 3mm THICK IN TWO LAYERS WITH SHORE HARDNESS 65 ± 5 IN SCALE-A
9.	CPU BYPASS LINE	SA 106 GR. C (ASTM A 106 GR. C)
10.	SERVICE VESSEL RINSE TO CONDENSER HOT WELL LINE PIPING & RINSE RECIRCULATION PUMPS SUCTION DISCHARGE, RINSE RECIRCULATION LINES PIPING.	CS TO ASTM A 106 GR. B & CS TO ASTM A 106 GR. C RESPECTIVELY.



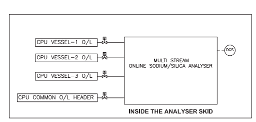
INSTRUMENT AIR SYSTEM (TYP.) FOR UNIT 1,2,3,4 & 5



DETAIL - A



SERVICE WATER (TYP.) FOR UNIT 1,2,3,4 & 5



TYPICAL FOR UNIT 1,2,3,4 & 5

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE / PLUG VALVE		DRAIN
	BUTTERFLY VALVE		OVERFLOW SEAL POT/CO_2 ABSORBER
	GLOBE VALVE		RUPTURE DISC
	DIAPHRAGM VALVE		PRESSURE REDUCING VALVE
	MOTORISED VALVE		CONDENSATE LINE
	PRESSURE RELIEF VALVE		D.M.WATER/DRAIN LINE
	NON RETURN VALVE		RINSE WATER LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ACID SOLUTION LINE
	SOLENOID VALVE		ALKALI SOLUTION LINE
	RESIN TRAP		RESIN TRANSFER LINE
SG	SIGHT GLASS		FIELD MOUNTED INSTRUMENT
	DOUBLE ACTING PNU.CYLINDER OPERATOR		CONCENTRATION ANALYSER
	PNEUMATICALLY OPERATED CONTROL VALVE		PULSATION DAMPER
	'Y' TYPE STRAINER		DIAPHRAGM SEAL
PCV	PRESSURE CONTROL VALVE		AUTO DRAIN TRAP

	CATION CONDUCTIVITY ANALYSER	LIT	LEVEL INDICATING TRANSMITTER
	SPECIFIC CONDCTIVITY ANALYSER	NaA	SODIUM ANALYZER (MULTI CHANNEL)
CS	CONTROL SYSTEM	CIT	CONDUCTIVITY INDICATING TRANSMITTER
LS	LEVEL SWITCH	DI	DENSITY INDICATOR
TT	TEMPERATURE TRANSMITTER	TE	TEMPERATURE ELEMENT
PI	PRESSURE INDICATOR	LI	LEVEL INDICATOR
PT	PRESSURE TRANSMITTER	PHE	pH ELECTRODE
TI	TEMPERATURE INDICATOR	pHA	pH ANALYSER
FI	FLOW INDICATOR	SiA	SILICA ANALYZER (MULTI CHANNEL)
CE	CONDUCTIVITY ELEMENT		ORIFICE (Pressure Breakdown)
FIT	FLOW INDICATING TRANSMITTER	LT	LEVEL TRANSMITTER
DPI	DIFF. PRESSURE INDICATOR		SAMPLE COOLER
DPS	DIFF. PRESSURE SWITCH		AIR FILTER REGULATOR
FT	FLOW TRANSMITTER		
FE	FLOW ELEMENT		
CT	CONDUCTIVITY TRANSMITTER		
DPIT	DIFF. PRESSURE INDICATING TRANSMITTER		
FS	FLOW SWITCH		
	VERTICAL CENTRIFUGAL PUMP WITH MOTOR		

CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA, INDIA
5 x 800 MW YADADRI TPS, NALGONDA

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED,BANGALORE

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 417
STATUS CONTRACT
DISTRIBUTION

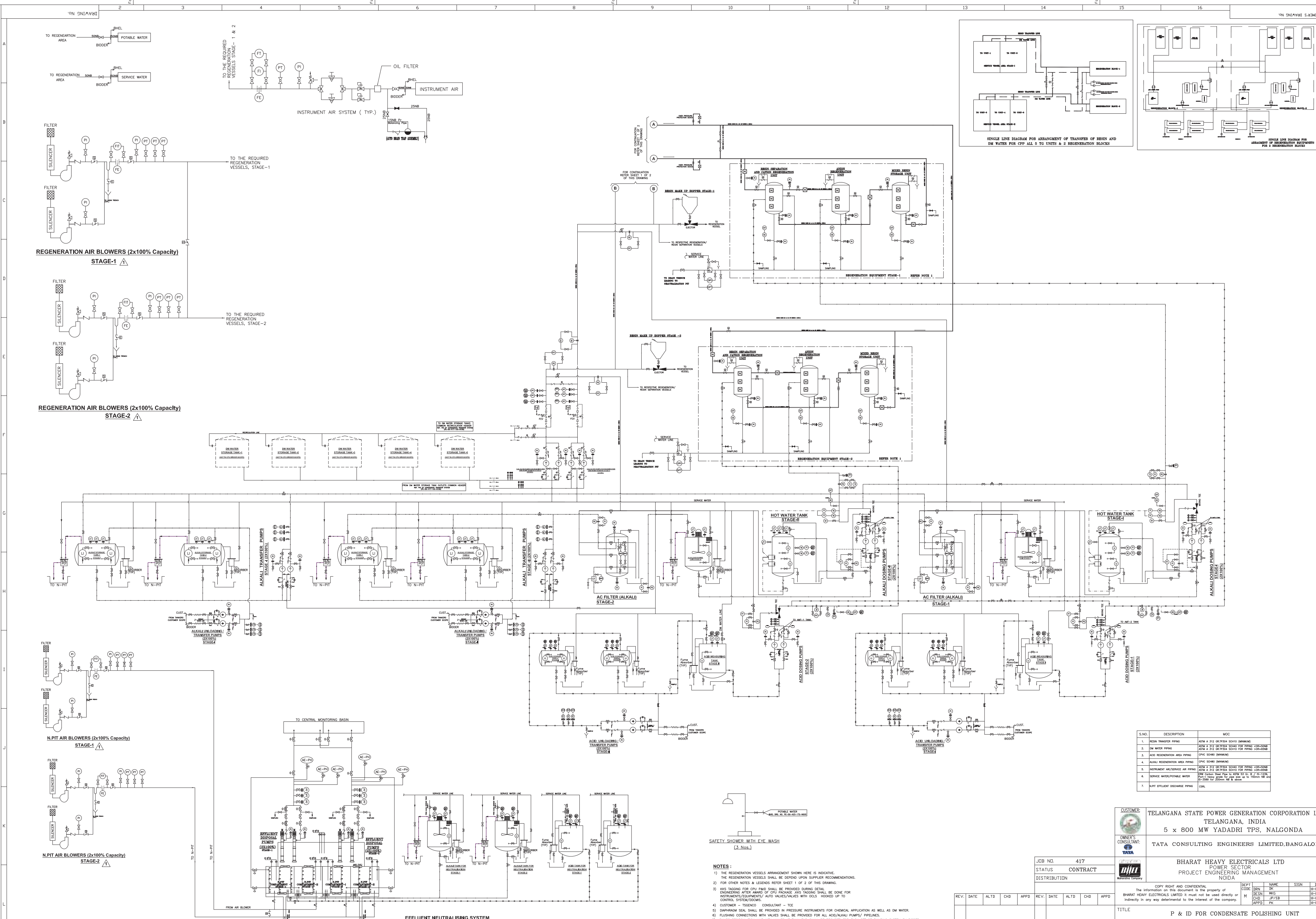
REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	DK		10-01-2020
	DESN	MKG		10-01-2020
	CHD	JP/SB		10-01-2020
	APPD	PK		10-01-2020

TITLE: P & ID FOR CONDENSATE POLISHING UNIT

DRAWING NO. PE-DG-417-155A-A001
SHEET 01 OF 02
REV. 00
SIZE-A0

FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM



NOTES :

1) THE REGENERATION VESSELS ARRANGEMENT SHOWN HERE IS INDICATIVE. THE REGENERATION VESSELS SHALL BE DEPEND UPON SUPPLIER RECOMMENDATIONS.
2) FOR OTHER NOTES & LEGENDS REFER SHEET 1 OF 2 OF THIS DRAWING.
3) KKS TAGGING FOR CPU P&ID SHALL BE PROVIDED DURING DETAIL ENGINEERING AFTER AWARD OF CPU PACKAGE .KKS TAGGING SHALL BE DONE FOR INSTRUMENTS/EQUIPMENTS/ AUTO VALVES/VALVES WITH OCLS HOOKED UP TO CONTROL SYSTEM/DDCMIS.
4) CUSTOMER – TSGENCO CONSULTANT – TCE
5) DIAPHRAGM SEAL SHALL BE PROVIDED IN PRESSURE INSTRUMENTS FOR CHEMICAL APPLICATION AS WELL AS DM WATER.
6) FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL ACID/ALKALI PUMPS/ PIPELINES.
7) PUMPS RECIRCULATION LINE WITH VALVES AT TANK END SHALL BE PROVIDED FOR EACH SET OF PUMPING SYSTEM BY BIDDER.
8) All THE INTERLOCKED TRANSMITTERS AND ANALYSERS SHALL BE REDUNDANT AS PER SECTION IC AND IIC OF THIS TECHNICAL SPECIFICATION.

S.NO.	DESCRIPTION	MOC
1.	RESIN TRANSFER PIPING	ASTM A 312 GR.TP304 SCH10 (MINIMUM)
2.	DM WATER PIPING	ASTM A 312 GR.TP304 SCH40 FOR PIPING <OR=50NB ASTM A 312 GR.TP304 SCH10 FOR PIPING >OR=65NB
3.	ACID REGENERATION AREA PIPING	CPVC SCH80 (MINIMUM)
4.	ALKALI REGENERATION AREA PIPING	CPVC SCH80 (MINIMUM)
5.	INSTRUMENT AIR/SERVICE AIR PIPING	ASTM A 312 GR.TP304 SCH40 FOR PIPING <OR=50NB ASTM A 312 GR.TP304 SCH10 FOR PIPING >OR=65NB
6.	SERVICE WATER/POTABLE WATER	ERW Carbon Steel Pipe to ASTM 53 Gr. B / IS-1239, Part-I heavy grade for pipe size up to 150mm NB and IS-3589 for 200mm NB & above
7.	N.PIT EFFLUENT DISCHARGE PIPING	CSRL

CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA, INDIA
5 x 800 MW YADADRI TPS, NALGONDA

OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED,BANGALORE

JOB NO. 417
STATUS CONTRACT
DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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DEPT CODE		NAME	SIGN	DATE
M	DRN	DK		10-01-2020
	DESN	MKG		10-01-2020
	CHD	JP/SB		10-01-2020
	APPD	PK		10-01-2020

REV.	DATE	ALTD	CHD	APPD

TITLE: P & ID FOR CONDENSATE POLISHING UNIT

DEPT. SIGN SCALE

DRAWING NO. PE-DG-417-155A-A001
SHEET 02 OF 02 REV. 00
SIZE-A0

PRODUCED BY AN AUTODESK STUDENT VERSION

DATASHEET – A

1.0	**DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :**	
(i)	No. of TG units	Five (5) nos.
(ii)	Capacity of each unit	800 MW
(iii)	Total flow in all working service vessels of each units	1650.0 Tons/hr (VWO, 1% Make Up condition)
2.0	**CONDENSATE POLISHER SERVICE VESSELS PER UNIT :**	
(i)	No. of condensate polisher service vessel per TG unit	Three (3X50%) nos. per TG unit
(ii)	Total Number required for all 5 TG units	15 nos.
(iii)	Capacity of each condensate polisher service vessel	50% of total condensate flow per unit
(iv)	Flow through each condensate polisher service vessel per unit	825 Tones per hour
(v)	Operating pressure of each condensate polisher service vessel	31.27 kg/cm2 (g)
(vi)	CEP shut off pressure	38.8 kg/cm2 (g)
(vii)	Design pressure of each condensate polisher service vessel	47 kg/cm2 (g)
(viii)	Design code of each condensate polisher service vessel	ASME Sec VIII div 1 Latest edition / IS 2825 as applicable
(ix)	Process design Temperature	51.8 ^{0}C
(x)	Design temperature of service vessel, its internals and accessories	60 ^{0}C
(xi)	Type of vessels	Spherical
(xii)	Percentage deration to be considered on design exchange capacity for design of the system	Minimum 10 %
(xiii)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(xiv)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(xv)	Output between two successive regeneration (each Service vessel)	198000 Tons (Under Normal run condition) 39600 Tons (Under startup condition) 39600 Tons (Under condenser tube leakage condition)
(xvi)	Cycle time	240 hours (Under Normal run condition) 48 hours (Under startup condition) 48 hours (Under condenser tube leakage condition)
(xvii)	Average velocity of condensate through service vessels/Surface flow rate	≤ 105 m/ hour
(xviii)	Resin bed depth (Minimum)	1100 mm
(xix)	Resin traps at the outlet of each condensate polisher service vessel & rinse outlet	SS-316 with SS 316 Internals
2.1	**RINSE RECIRCULATION PUMPS PER UNIT:**	
(i)	Number	Two (2x100%) nos. per TG unit
(ii)	Total Number required for all 5	10 nos.

	TG units	
(iii)	Type	Horizontal, centrifugal
(iv)	Service/Duty	Intermittent
(v)	Capacity & head	As per System requirement
(vi)	Suction condition	Flooded
(vii)	Material of construction	
	Casing, impeller	SS 316
	Shaft	SS 410
	shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Pump Speed	Maximum 1500 rpm
(x)	Accessories required for each pump	Common base plate, coupling guards, drain plug, vent valve, isolation valves, Y-type strainers etc.
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615
(xii)	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.
(xiii)	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).
(xiv)	Dynamic Balancing Test	To be provided
2.2	**AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER UNIT**	
(i)	Number per unit	Two (2x100%) nos. per TG unit
(ii)	Total Number required for all 5 TG units	10 nos.
(iii)	Type	Rotary, Twin Lobe, oil free, positive displacement
(iv)	Duty	Intermittent
(v)	Capacity and head	As per System requirement
(vi)	Noise level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Location	Indoor
(ix)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(x)	Accessories	With acoustic enclosure for each blower
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615
(xii)	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.
(xiii)	Dynamic Balancing Test	To be provided
3.0	**EXTERNAL REGENERATION FACILITIES (Consists of 2 sets of external regeneration)**	
3.1	**REGENERATION VESSELS**	
a.	**RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Number required	Two (2) nos. vessel
(ii)	Design Temperature	60°C

(iii)	Minimum Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin, Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2 (g) whichever is maximum.
(iv)	Type	Vertical Cylindrical
(v)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(vii)	Design code	ASME Sec VIII div 1 (Latest edition) / IS 2825 as applicable
(viii)	Free board	Not less than 100%
b.	**ANION RESIN REGENERATION VESSEL (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Number required	Two (2) nos. vessel
(ii)	Design Temperature	60^0C
(iii)	Minimum Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin, Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2 (g) whichever is maximum.
(iv)	Type	Vertical Cylindrical
(v)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Dished ends	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(vii)	Design code	ASME Sec VIII div 1 (Latest edition) / IS 2825 as applicable
(viii)	Free board	Not less than 100%
c.	**MIXED RESIN STORAGE VESSEL (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Number required	Two (2) nos. vessel
(ii)	Design Temperature	60^0C
(iii)	Minimum Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin, Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2 (g) whichever is maximum.
(iv)	Type	Vertical Cylindrical
(v)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Dished ends	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(vii)	Design code	ASME Sec VIII div 1 (Latest edition) / IS 2825 as applicable
(viii)	Free board	Not less than 100%
d.	Resin traps at the common outlet header of regeneration vessels	2 nos. (Body :CSRL with SS 316 Internals)
e.	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. minimum), handhold (1 no. of 150mm dia) & manhole (Minimum-2 nos.) etc. for each vessel shall be provided.

	The vessels indicated against sr. no. a, b and c above is for reference only. Please note that number and type of regeneration vessels shall be as per supplier recommendation only.		
3.2	**BULK ACID STORAGE TANKS (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	**CHEMICAL TANKS**	Acid Storage Tank for 1st set of Regeneration system	Acid Storage Tank for 2nd set of Regeneration system
(ii)	Number required	Two (2) Nos.	Two (2) Nos.
(iii)	Design code	----------As per BSEN : 12285 or equivalent ----------	
(iv)	Dimensions (diameter, length & thickness)	----------As per BSEN : 12285 or equivalent ----------	
(v)	Location	----------Outdoor----------	
(vi)	Useful capacity	Capacity of both tanks together shall adequate to hold the quantity of commercial Acid (30-33% HCl) required for thirty (30) days of operation of 2 TG Units complete cation resin regeneration requirement plus acid required to neutralize excess alkali present in regeneration waste of 1st set of regeneration system.	Capacity of both tanks together shall adequate to hold the quantity of commercial Acid (30-33% HCl) required for thirty (30) days of operation of 3 TG Units complete cation resin regeneration requirement plus acid required to neutralize excess alkali present in regeneration waste of 2nd set of regeneration system.
(vii)	Type and Pressure class	Horizontal cylindrical with dished ends, atmospheric, above ground	
(viii)	Material of construction	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(ix)	Protection – Inside	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(x)	Protection – Outside/Painting	As per BHEL/ TSGENCO approved painting schedule	
(xi)	Concentration	30 -33 % HCl	30 -33 % HCl
(xii)	Accessories for each tank	Vent, overflow, Drain, fume absorber cum seal pot, sample connection , Manhole (2 nos. Minimum), operating platform, ladders, lifting lugs (4 nos. Minimum) etc.	
(xiii)	Pipe & flanges M.O.C.	CPVC Sch.80 minimum	
(xiv)	Valve M.O.C.	CPVC PN 10 minimum	
(xv)	Manhole, staircase	To be Provided	To be Provided
3.3	**BULK ALKALI STORAGE TANKS (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	**CHEMICAL TANKS**	Alkali Storage Tank for 1st set of Regeneration system	Alkali Storage Tank for 2nd set of Regeneration system
(ii)	Number required	Two (2) nos.	Two (2) nos.
(iii)	Design code	----------As per BSEN : 12285 or equivalent ----------	
(iv)	Dimensions (diameter, length & thickness)	----------As per BSEN : 12285 or equivalent ----------	
(v)	Location	----------Outdoor----------	

(vi)	Useful capacity	Capacity of both tanks together shall adequate to hold the quantity of commercial Alkali required for thirty (30) days of operation of 2 TG Units complete anion resin regeneration requirement plus alkali required to neutralize excess acid present in regeneration waste of 1st set of regeneration system.	Capacity of both tanks together shall adequate to hold the quantity of commercial Alkali required for thirty (30) days of operation of 3 TG Units complete anion resin regeneration requirement plus alkali required to neutralize excess acid present in regeneration waste of 2nd set of regeneration system.
(vii)	Type and Pressure class	Horizontal cylindrical with dished ends, atmospheric, above ground	
(viii)	Material of construction	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(ix)	Protection – Inside	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(x)	Protection – Outside/Painting	As per BHEL/ TSGENCO approved painting schedule	
(xi)	Concentration	48 % NaOH	48 % NaOH
(xii)	Accessories	Vent, overflow, Drain, CO2 absorber ,seal pot, sample connection ,spare connection ,Manhole (2 nos. Minimum), operating platform, ladders, lifting lugs (4 nos. Minimum) etc.	
(xiii)	Pipe & flanges M.O.C.	CPVC Sch.80 minimum	
(xiv)	Valve M.O.C.	CPVC PN 10 minimum	
(xv)	Manhole, staircase	Provided	Provided
3.4	**ACID UNLOADING / TRANSFER PUMPS(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	**PUMPS**	Acid Unloading/Transfer Pumps for 1st set of Regeneration system	Acid Unloading/Transfer Pumps for 2nd set of Regeneration system
(ii)	Number required	Two (2x100%) nos. (1W+1S)	Two (2x100%) nos. (1W+1S)
(iii)	Type	----------Horizontal Centrifugal----------	
(iv)	Location	----------Outdoor----------	
(v)	Service	----------Intermittent----------	
(vi)	Pressure gauge	---------- One per pump with Teflon diaphragm seal----------	
(vii)	Capacity and head	----------10 m3 / hr and 10 MLC (minimum)----------	
(viii)	Liquid to be handled	30 -33 % HCL	30 -33 % HCL
(ix)	Material of construction		
	Casing	Polypropylene	Polypropylene
	Impeller	Polypropylene	Polypropylene
	Shaft	BS-970 Hardened Steel EN8	BS-970 Hardened Steel EN8
	Types of shaft sealing	Mechanical seal	Mechanical seal
(x)	Pump speed	1500 rpm	1500 rpm
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xii)	Accessories required	Coupling guard, drain plug, vent valve ,suction hoses, isolation valves, Y- type strainers etc. for each pump.	
(xiii)	Type of coupling between motor and pump	Flexible coupling	
(xiv)	Reinforced rubber house with coupling and isolation valve	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber

(xv)	MOC for piping, valves & fittings in acid handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xvi)	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.	
(xvii)	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).	
(xviii)	Dynamic Balancing Test	To be provided	
3.5	**ALKALI UNLOADING / TRANSFER PUMPS(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	**PUMPS**	Alkali unloading/Transfer pumps for 1st set of Regeneration system	Alkali unloading/Transfer pumps for 2nd set of Regeneration system
(ii)	Number required	Two (2x100%) nos. (1W+1S)	Two (2x100%) nos. (1W+1S)
(iii)	Type	----------Horizontal Centrifugal----------	
(iv)	Location	----------Outdoor----------	
(v)	Service	----------Intermittent----------	
(vi)	Pressure gauge	---------- One per pump with Teflon diaphragm seal----------	
(vii)	Capacity and head	----------10 m3 / hr and 10 MLC (minimum)----------	
(viii)	Liquid to be handled	48% NaOH	48% NaOH
(ix)	Material of construction		
	Casing	SS-316	SS-316
	Impeller	SS-316	SS-316
	Shaft	SS-410	SS-410
	Types of shaft sealing	Mechanical seal	Mechanical seal
(x)	Pump speed	1500 rpm	1500 rpm
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xii)	Accessories required	Coupling guard, drain plug, vent valve ,suction hoses, isolation valves, Y- type strainers etc. for each pump.	
(xiii)	Type of coupling between motor and pump	Flexible coupling	
(xiv)	Reinforced rubber house with coupling and isolation valve	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber
(xv)	MOC for piping, valves & fittings in alkali handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xvi)	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.	
(xvii)	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).	
(xviii)	Dynamic Balancing Test	To be provided	
3.6	**CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM**		
a)	**ALKALI TRANSFER CUM RECIRCULATION PUMPS WITH MOTOR(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	Total Nos. required	Four (4x100%) (2 W+ 2 SB)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Location	Outdoor	

(v)	Pressure gauge	One per pump with Teflon diaphragm seal	
(vi)	Maximum Pump Speed	1500 rpm	
(vii)	Type of Coupling between pump & motor drive	As per manufacturer's standard practice	
(viii)	Type of Sealing	Mechanical Seal	
(ix)	Type of Suction Strainer	Y- Type	
(x)	Concentration of working media.	44 - 48% Sodium Hydroxide (NaOH)	
(xi)	Capacity & head of each pump	10 m3/hr & 10 MLC (minimum)	
(xii)	Suction condition	Flooded	
(xiii)	Materials of construction		
a.	Casing, impeller	Stainless Steel – 316	
b.	Shaft	Stainless Steel -410	
(xiv)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xv)	Accessories required	Coupling guard, drain plug, vent valve **,** isolation valves, Y- type strainers etc. for each pump.	
(xvi)	Type of coupling between motor and pump	Flexible coupling	
(xvii)	MOC for piping, valves & fittings in alkali handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xviii)	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.	
(xix)	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).	
(xx)	Dynamic Balancing Test	To be provided	
b)	**CHEMICAL TANKS (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	**ALKALI MEASURING CUM PREPEARTION TANK**	**ACID MEASURING TANK**
(i)	Total Number required	Two (2) nos.	Two (2) nos.
(ii)	Type	Vertical cylindrical atmospheric with dished bottom and cover at top	
(iii)	Liquid to be handled	48% NaOH	30-33% HCL
(iv)	Location	---------- To be designed for indoor duty ----------	
(v)	Useful capacity (each tank)	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	Adequate to hold quantity of acid required (30-33% HCL) for single regeneration of a condensate polisher mixed bed with 20% overall margin.
(vi)	Material (Shell, Dished end & top cover)	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Top cover - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(vii)	Internal protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(viii)	External painting	As per BHEL/ TSGENCO approved painting schedule	
(ix)	Level indicator	Provided	Provided
(x)	Level transmitter per tank	As per CPU P&ID	As per CPU P&ID
(xi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable

(xii)	MOC of Agitator	SS – 316	Not Applicable
(xiii)	Drive motor of stirrer	Energy Efficiency Class IE-3 as per IS : 12615	Not Applicable
(xiv)	Dissolving Basket	Provide (50-60 mesh B.S.)	Not Applicable
(xv)	MOC of Basket	SS – 316	Not Applicable
(xvi)	Accessories	Fume absorbers, carbon dioxide absorber, vent, overflow, drain connection, overflow seal pot, sample connection, level gauge, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum), manhole, hand hole etc.	
c)	**DOSING PUMPS (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	**ACID DOSING PUMPS**	**ALKALI DOSING PUMPS**
(i)	Total number required	Four (4x100%) nos. (2W+ 2SB)	Four (4x100%) nos. (2W+ 2SB)
(ii)	Type	Positive displacement and hydraulic operated diaphragm type with stroke adjustment	
(iii)	Duty	Continuous and suitable for parallel operation	
(iv)	Design Temperature(in˚C)	60	
(v)	Fluid to be handled	Commercial (30-33%) Hydrochloric Acid	Commercial (40-48%) Sodium Hydroxide
(vi)	Suction Condition	Flooded	
(vii)	Location	Indoor	
(viii)	Whether suction strainer required	---------- Yes ----------	
(ix)	Range of operation (%)	0-100%	
(x)	Material of construction		
	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.)	Polypropylene	SS-316
	Diaphragm	-------PTFE----------	
	Packing	-------PTFE----------	
	Shaft	----- Hardened steel EN 8 (BS : 970)------	
	Worm & worm wheel (if applicable)	----------Manganese Bronze ----------	
	Connecting rod	----------Manganese Bronze ----------	
	Cross head guide	----------Bronze ----------	
(xi)	Capacity & head for each pump	Capable of meeting regeneration one cation /Anion unit (with 20% margin); head as per system requirement.	
(xii)	Accessories		
	Pressure/Pulsation Dampener	One per pump	One per pump
	External safety relief valve (in addition to inbuilt safety valve)	Four (One per pump) MOC -Polypropylene	Four (One per pump) MOC- SS-316
	MOC of safety relief valve	Poly propylene	SS-316
(xiii)	Pressure gauge	---------- One per pump with Teflon diaphragm seal ----------	
(xiv)	Pump Speed, (RPM)	1500 rpm	
(xv)	Maximum pump stroke speed per minute	---------- 100 ----------	
(xvi)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.	
(xvii)	Drive motor of pump	The drive motor of each pump will be Energy Efficiency Class IE-3 as per IS : 12615	

(xviii)	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.	
(xix)	Type of coupling between Pump & Motor	Flexible Spacer	
(xx)	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).	
(xxi)	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.	
(xxii)	Hydro-test	As per IS-1520 and IS-5120.	
(xxiii)	Dynamic Balancing Test	To be provided	
(xxiv)	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and CPU tender P&ID Drawings.	
(xxv)	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility.	
(xxvi)	Trip interlock	To be provided.	
d)	**Density Meter**	**Acid**	**Alkali**
(i)	Total Number	One (1) at each mixing tee outlet (Total 2 nos.)	One (1) at each mixing tee outlet (Total 2 nos.)
(ii)	Type	Density indicator (Hydrometer type)	Density indicator (Hydrometer type)
(iii)	Indication	Local	Local
(iv)	Location	Diluted Acid line	Diluted Alkali line
e)	**Flow Indicator**		
(i)	Number	One in each DM water line(Total 2 nos.)	One in each DM water line(Total 2 nos.)
(ii)	Type	Rotameter	Rotameter
f)	**Flow Transmitter**	One in each water line (Total 4 nos.) /As per CPU tender P&ID	
g)	**Concentration Analyzer**	One (1) at each mixing tee outlet (Total 4 nos.)/ As per CPU tender P&ID	
3.7	**ACTIVATED CARBON FILTER FOR ALKALI(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**		
(i)	Total Numbers required	Two (2) nos.	
(ii)	Type	Vertical cylindrical with dished ends	
(iii)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2(g) whichever is maximum	
(iv)	Time Period for each Service Cycle between two consecutive regenerations, in hrs.	24	
(v)	Design Temperature(in ˚C)	60	
(vi)	Capacity	10 m3/hr (minimum) or Not less than the design capacity of alkali transfer cum recirculation pump	
(vii)	Surface flow rate/Velocity through each ACF	Not more than 15 m3/m2 /hr	
(viii)	Bed depth	1200mm activated carbon + 300 mm Gravel support (Min)	
(ix)	Percentage Free board	75% minimum	
(x)	Pressure gauge	As per CPU tender P&ID.	

(xi)	Number and Location	Two Nos. for each filter
(xii)	Seal	Teflon diaphragm
(xiii)	Material of construction	
	Shell	Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Dish ends /Head	Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(xiv)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(xv)	Design code	ASME sec VIII div 1 Latest edition / IS 2825 as applicable
(xvi)	Influent Distributor Material	SS 316
(xvii)	Backwash	DM water
(xviii)	Backwash Velocity	As per system requirement
(xix)	Manhole for each ACF	Two (2) nos. minimum each of Davit type and 500 mm dia.
(xx)	Sight Windows for each ACF	One (1) no. in backwash space
(xxi)	Hand hole for each ACF	One (1) no. of 150 mm dia for removal of activated carbon.
(xxii)	Accessories for each ACF	Manhole, vent drain, sample connection, operating platforms, ladders, supports, lifting lugs (4 nos. min) etc.
3.8	**ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK) (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Numbers required	Two (2) nos.
(ii)	Type/Capacity of each HWT	Vertical Cylindrical with dished end with Electric heater / 120% of water required for single regeneration of a condensate polisher mixed bed.
(iii)	Design Temperature (in˚C)	60
(iv)	Electric heater Qty. for each HWT	2 nos. Electric heater (2X60%)
(v)	Temperature of alkali to be heated for each HWT	To obtain temp. from 15^{O}C of 50^{O}C at alkali mixing feed out let within 5 hours.
(vi)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2 (g) whichever is maximum
(vii)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	dished end	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(viii)	Design code	ASME sec VIII div 1 latest edition / IS 2825 as applicable
(ix)	Temperature gauge, Temp. transmitters	To be provided by the bidder (as per P&ID)
(x)	Burn out protection for each HWT	To be provided by the bidder
(xi)	Inside protection	Inside lined with Natural Rubber [8.0 mm thick in (6) layers] with shore hardness 65 ± 5 in Scale-A suitable for temperature 70°C.
(xii)	Accessories for each HWT	Manhole , vent, drain, sample connection, level transmitter, level

		gauges -2 nos. (minimum),operating platform, ladders, lifting lugs (4 Nos. minimum) etc.
3.9	**CPU REGENERATION CUM RESIN TRANSFER PUMPS FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Numbers required	Four (4x100%) nos. (2W+2SB)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Intermittent
(iv)	Liquid to be handled	DM Water
(v)	Capacity & head	To be selected by the Bidder as necessary to meet the system requirements
(vi)	Suction condition	Flooded
(vii)	Material of construction	
•	Casing & impeller	SS 316/ ASTM A 351 CF 8M
•	Shaft	SS 410
•	Wearing rings	As per manufacturer's Standard
•	Shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Mechanical Seal	To be Provided by bidder
(x)	Pump Speed	Maximum 1500 rpm
(xi)	Pressure gauge	One for each pump with Teflon diaphragm seal
(xii)	Recirculation line with motor actuated valve	Provided
(xiii)	Accessories required for each pump	Common base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.
(xiv)	Drive motor	The drive motor of each Pump will be Energy Efficiency Class IE-3 as per IS : 12615
(xv)	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.
(xvi)	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).
(xvii)	Dynamic Balancing Test	To be provided
3.10	**AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA) (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)**	
(i)	Total Numbers required	Four (4x100%) Nos. (2W+2SB) with acoustic enclosure
(ii)	Type	Rotary ,Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As per system requirement
(vi)	Noise Level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(x)	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.

(xi)	Dynamic Balancing Test	To be provided
4.0	**NEUTRALISING SYSTEM**	
4.1	**Neutralization Pit for 1st set of Regeneration system**	
(i)	Number	One (1) no. Pit with two (2) compartments
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided by bidder in each compartment for effective neutralization of the waste effluent for air agitation
(iii)	Material of Construction	RCC inside lined with PVC sheet (3 mm thick).- BHEL Scope
(iv)	No. of compartments	Two compartments
(v)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of Condensate Polisher Mixed Bed plus 20% overall margin.
(vi)	Gates	Four Nos. (in bidder's scope) for each neutralization pit. MOC of the gates will be Carbon Steel rubber lined.
4.2	**Neutralization Pit for 2nd set of Regeneration system**	
(i)	Number	One (1) no. Pit with two (2) compartments
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided by bidder in each compartment for effective neutralization of the waste effluent for air agitation
(iii)	Material of Construction	RCC inside lined with PVC sheet (3 mm thick).- BHEL Scope
(iv)	No. of compartments	Two compartments
(v)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of Condensate Polisher Mixed Bed plus 20% overall margin.
(vi)	Gates	Four Nos. (in bidder's scope) for each neutralization pit. MOC of the gates will be Carbon Steel rubber lined.
4.3	**Neutralization Pit Disposal Pumps for 1st set of Regeneration system**	
(i)	Number	Two (2X100%) nos. (1 working + 1 Standby)
(ii)	Type	Vertical Centrifugal
(iii)	Capacity & head	Capacity= 100 M3/Hr min. (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours) Head- As per system requirement (Margins shall be considered as defined elsewhere in this Technical specification under section C1)
(iv)	Duty	Intermittent
(v)	Pump Speed	1500 rpm
(vi)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC ; Energy Efficiency Class IE-3 as per IS : 12615
(vii)	Material of Construction	
	Casing	DUPLEX Stainless steel
	Impeller	DUPLEX Stainless steel
	Shaft	DUPLEX Stainless steel
	Pump Wetted Parts	DUPLEX Stainless steel
(viii)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(ix)	Accessories required for each pump	Base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, Pressure transmitter ,pulsation dampener etc.
(x)	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.	
(xi)	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).	
(xii)	Dynamic Balancing Test	To be provided	
4.4	**Neutralization Pit Disposal Pumps for 2nd set of Regeneration system**		
(i)	Number	Two (2X100%) nos. (1 working + 1 Standby)	
(ii)	Type	Vertical Centrifugal	
(iii)	Capacity & head	Capacity= 100 M3/Hr min. (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours) Head- As per system requirement (Margins shall be considered as defined elsewhere in this Technical specification under section C1)	
(iv)	Duty	Intermittent	
(v)	Pump Speed	1500 rpm	
(vi)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC ; Energy Efficiency Class IE-3 as per IS : 12615	
(vii)	Material of Construction		
	Casing	DUPLEX Stainless steel	
	Impeller	DUPLEX Stainless steel	
	Shaft	DUPLEX Stainless steel	
	Pump Wetted Parts	DUPLEX Stainless steel	
(viii)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615	
(ix)	Accessories required for each pump	Base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, Pressure transmitter ,pulsation dampener etc.	
(x)	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.	
(xi)	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).	
(xii)	Dynamic Balancing Test	To be provided	
4.5	**Chemical Tanks for N-pit**	**Acid Measuring Tank –N. pit for 1st set of Regeneration system**	**Acid Measuring Tank –N. pit for 2nd set of Regeneration system**
(i)	Number required	One (1) No.	One (1) No.
(ii)	Type	Vertical cylindrical atmospheric with dished bottom and cover at top	
(iii)	Location	---------- To be designed for outdoor duty ----------	
(iv)	Liquid to be handled	30-33% HCL	30-33% HCL
(v)	Useful capacity for each tank	Suitable to meet the requirement for neutralisation of excess alkali present in the regeneration waste effluent from CPU + 20% margin	
(vi)	Material (Shell, Dished end & top cover)	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Top cover - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(vii)	Internal protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(viii)	External painting	As per BHEL/ TSGENCO approved painting schedule.	
(ix)	Level indicator for each tank	Provided	Provided

(x)	Level transmitter per tank	As per CPU tender P&ID	As per CPU tender P&ID
(xi)	Vent, Overflow, drain connection	Provided	Provided
(xii)	Accessories	Fume absorbers cum over flow seal pot , vent, overflow, drain connection, sample connection, level gauge, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum), manhole, hand hole etc.	
4.6	**Chemical Tanks for N-pit**	**Alkali Measuring Tank–N. pit for 1st set of Regeneration system**	**Alkali Measuring Tank–N. pit for 2nd set of Regeneration system**
(i)	Number required	One (1) No.	One (1) No.
(ii)	Type	Vertical cylindrical atmospheric with dished bottom and cover at top	
(iii)	Location	---------- To be designed for outdoor duty ----------	
(iv)	Liquid to be handled	48% NaOH	48% NaOH
(v)	Useful capacity for each tank	Suitable to meet the requirement for neutralisation of excess acid/alkali present in the regeneration waste effluent from CPU + 20% margin	
(vi)	Material (Shell, Dished end & top cover)	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Top cover - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
	Internal protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
	External painting	As per BHEL/ TSGENCO approved painting schedule.	
(vii)	Level indicator for each tank	Provided	Provided
(viii)	Level transmitter per tank	As per CPU tender P&ID	As per CPU tender P&ID
(ix)	Vent, Overflow, drain connection	Provided	Provided
(x)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.
(xi)	MOC of Agitator	SS – 316	SS – 316
(xii)	Drive motor of stirrer	Energy Efficiency Class IE-3 as per IS : 12615	Energy Efficiency Class IE-3 as per IS : 12615
(xiii)	Dissolving Basket	Provide (50-60 mesh B.S.)	Provide (50-60 mesh B.S.)
(xiv)	MOC of Basket	SS – 316	SS – 316
(xv)	Accessories	carbon dioxide absorber, hand hole, vent, drain, sample connection, level gauge, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum) ,manhole etc.	
4.7	**AIR-BLOWERS FOR N-PIT (REGENERATION AREA) (FOR 1ST REGENEARTION SYSTEM)**		
(i)	Total Numbers required	Two (2x100%) Nos. (1W+1SB) with acoustic enclosure	
(ii)	Type	Rotary ,Twin lobe type, oil free, positive displacement	
(iii)	Location	Indoor	
(iv)	Duty	Intermittent	
(v)	Capacity and head	As per system requirement	
(vi)	Noise Level	85 dB (A) Max. at one meter	
(vii)	Pressure gauge	One per blower	
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8	
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615	

(x)	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.
(xi)	Dynamic Balancing Test	To be provided by bidder
4.8	**AIR-BLOWERS FOR N-PIT (REGENERATION AREA) (FOR 2nd REGENEARTION SYSTEM)**	
(i)	Total Numbers required	Two (2x100%) Nos. (1W+1SB) with acoustic enclosure
(ii)	Type	Rotary ,Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As per system requirement
(vi)	Noise Level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(x)	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.
(xi)	Dynamic Balancing Test	To be provided by bidder
5.0	PIPING & VALVES	
(i)	Resin Transfer piping	ASTM A 312 Gr. TP 304 Schedule 10S; Minimum pipe Size: NB80 Velocity : 2-3 m/s
(ii)	DM water line	ASTM A 312 Gr. TP 304 Schedule 40S for Piping less than and equal to 50 mm NB & ASTM A 312 Gr. TP 304 Schedule 10S for piping equal to greater than 65 mm NB
(iii)	Piping-Service Vessel Inlet	Piping-ASTM A 106 Gr C Ball Valves – SS-(CF8M) BFV – ASTM A 216 Gr. WCB- Body SS-(CF8M) - disc.
(iv)	Piping-Service vessel Outlet	Piping – ASTMA 106 Gr. C BFV – SS-(CF8M) - Body & disc both. Ball Valves – SS-(CF8M)
(v)	Service vessel bypass piping (Butterfly Valves)	Piping – ASTMA 106 Gr. C BFV – ASTM A 216 Gr. WCB – body CF8M -Disc
(vi)	Service vessel Rinse to condenser Hot well line piping & Rinse recirculation pumps suction, discharge , rinse recirculation line	CS to ASTM A 106 Gr. B & CS to ASTM A 106 Gr. C respectively
(vii)	Effluent Transfer Piping	Piping, & Fittings shall be CSRL only & valves shall be minimum PN 10 rating.
(viii)	Acid & Alkali Regeneration piping all concentration (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 80 (minimum) only & valves shall be PN 10 rating (minimum).
(ix)	Acid / Alkali Transfer piping all concentration (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 80 (minimum) only & valves shall be PN 10 rating (minimum).

(x)	Instrument Air/ service air piping	ASTM A 312 Gr. TP 304 Schedule 40S for Piping less than and equal to 50 mm NB & ASTM A 312 Gr. TP 304 Schedule 10S for piping equal to greater than 65 mm NB
(xi)	Piping for air blower	Hot dip MS galvanized (heavy grade).
(xii)	Sampling Pipe	Stainless Steel to ASTM Schedule-10.
(xiii)	Service water	ERW Carbon Steel Pipe to ASTM 53 Gr. B / IS-1239, Part-I heavy grade for pipe size up to 150mm NB and IS-3589 for 200mm NB & above
6.0	VALVES	
(i)	**BUTTERFLY VALVES**	Butterfly valves shall be of low leakage rate confirming to AWWA-C-504 or EN593/ BS:5155 PN 10 (min.) All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. For larger sizes i.e. 150 NB and above valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Hand wheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard. All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 CI.300 (min.) used for Service vessel area. Butterfly valves shall be lugged wafer type of construction. However specifically mentioned bypass control valves type will be as defined elsewhere in this technical specification.
(ii)	**BALL VALVE**	These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.
(iii)	**DIAPHRAGM VALVE**	The Diaphragm shall conform to following requirement for DM water application: i) Design standard: BS: 5156 or equivalent of required rating / class. (Minimum rating of valves shall be PN 10). ii) Type: Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type iii) Material of Construction a) Body, Bonnet: Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining: Soft natural rubber(Neoprene), ebonite, Polypropylene c) Hand wheel: Cast Iron d) Compressor: Stainless Steel (SS-316) e) Stem and Bush: Stainless Steel For Acid and Alkali services the valve shall be CPVC PN10 (minimum) only.
(iv)	**Other Type of valves (Globe, NRV, pressure relief valve, pressure reducing valve etc.)**	The same shall be as defined in Section –II A of this specification under chapter Low pressure piping (for #150 class/PN10 valves) and high pressure piping (for #300 class valves).

7.0	**SAFETY EQUIPMENTS**	Four (4) sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. Three number personnel water drench shower/safety shower and eye bath each in regeneration area & acid/alkali storage area shall be provided by the bidder.
8.0	**Painting**	Painting of all equipments of CPU service vessel area and CPU regeneration area equipments shall be as per TSGENCO approved painting schedule.
9.0	**Inspection & Testing**	Inspection and testing of all equipments of CPU service vessel area and CPU regeneration area equipments shall be as per TSGENCO approved QAP.

10.0 PUMPS AND PIPE SELECTION CRITERIA.

Pump and Pipeline carrying water and chemicals etc. shall generally be sized on the following velocities. However wherever minimum pipe sizes are defined in the drawing/datasheets, the selected size shall not be less than the specified size.

	VELOCITY IN m/sec.		
	BELOW 50 MM.	**50-150 MM**	**200 MM AND ABOVE**
Pump Suction for water	------	1.2-1.5	1.2-1.8
Pump discharge for water	1.2-1.8	1.8-2.4	2.1-2.5
Header for water	-------	1.5-2.4	2.1-2.4
Air velocity	20-30	25-40	25-40
Resin Transfer line	2-3		
Pump Suction for chemical solution	1.0-1.2	1.1-1.3	-------
Pump discharge for chemical solution	1.2-1.4	1.3-1.5	--------
Gravity flows	1.0 (maximum).		

Note 1- All piping system shall be capable of withstanding the maximum pressure in the corresponding line.

Note 2- TDH of all pumps shall be decided by the supplier assuming the following 'C values in Hazen & Williams equation for calculation of friction loss.

a) **Carbon steel pipes – 100**
b) **C. I pipes –100**
c) **Stainless Steel pipes-100**
d) **Rubber lined steel pipe – 120**
e) **PVC/HDPE pipes – 140**

10% margin shall be taken over the pipe friction losses for calculating the pump head.
Static head to be considered as specified elsewhere in this technical specification.
Major pressure drop of pipes shall be calculated by William & hazen equation.

COMPUTER FILE NAME: ---

DRAWING No.

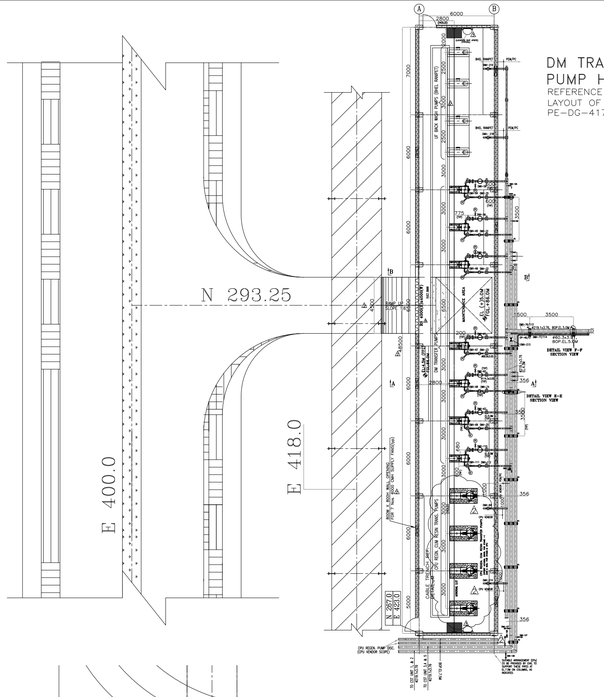
CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DM TRANSFER PUMP HOUSE ③

REFERENCE DRG NO.:
LAYOUT OF PIPING IN & AROUND DM TANK & P/H
PE-DG-417-100-M041, REV3



NORTH
CONSTR. NORTH

EQUIPMENT LIST :-

CPU REGENERATION BUILDING

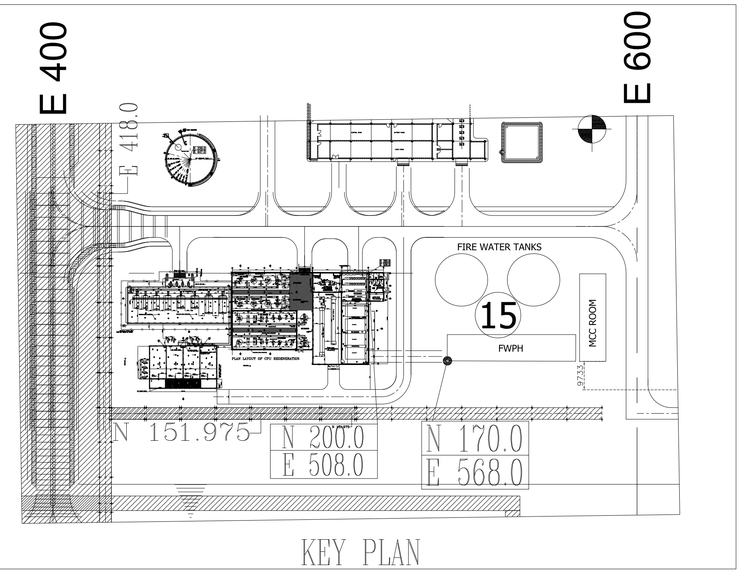
	S.No.	EQUIPMENT	APPROX. SIZE OF EQUIPMENT	QTY
#	01	MIXED RESIN STORAGE VESSEL	APPROX. 2200mmDia x 5000mmHOS	2 Nos.
#	02	SEPERATION/CATION REGENERATION VESSEL	APPROX. 2150mmDia x 4800mmHOS	2 Nos.
#	03	ANION REGENERATION VESSEL	APPROX. 2200mmDia x 4600mmHOS	2 Nos.
#	04	RESIN MAKEUP HOPPER	APPROX. 900mm x 900mm x 900mm(H)	2 Nos.
	05	CPU REGENERATION CUM RESIN TRANSFER PUMPS (LOCATED IN LAYOUT OF DM TANK & P/H)	APPROX.1800mm(L)x850mm(W)	4 Nos.
	06	REGENERATION AIR BLOWERS	APPROX.2000mm(L)x1500mm(W)	4 Nos.
	07	NEUTRALIZATION PIT	APPROX. 11M(L) x 5.5M(W) x 3.6M(H) (1 COMP.)	4 Nos.
	08	HOT WATER TANK	APPROX. 2600mmDia x 2900mmHOS	2 Nos.
#	09	ACID MEASURING TANK FOR CATION	APPROX. 2050mmDia x 1800mmHOS	2 Nos.
	10	ACID DOSING PUMPS	APPROX.2000mm(L)x900mm(W)	4 Nos.
#	11	ALKALI MEASURING TANK FOR ANION	APPROX. 1250mmDia x 1200mmHOS	2 Nos.
	12	ALKALI DOSING PUMPS	APPROX.800mm(L)x600mm(W)	4 Nos.
	13	ACTIVATED CARBON FILTER	APPROX.1100mmDia x 2200mmHOS	2 Nos.
	14	ALKALI TRANSFER CUM RECIR. PUMPS	APPROX.1200mm(L)x525mm(W)	4 Nos.
	15	BULK ACID STORAGE TANK FOR STAGE-1 REGENERATION SYSTEM	APPROX.1500mmDia x 4250mm(L)	2 Nos.
	16	BULK ACID STORAGE TANK FOR STAGE-2 REGENERATION SYSTEM	APPROX.2000mmDia x 4750mm(L)	2 Nos.
	17	BULK ALKALI STORAGE TANK FOR STAGE-1 REGENERATION SYSTEM	APPROX.2750mmDia x 4000mm(L)	2 Nos.
	18	BULK ALKALI STORAGE TANK FOR STAGE-2 OF REGENERATION SYSTEM	APPROX.2750mmDia x 5750mm(L)	2 Nos.
	19	ACID UNLOADING / TRANSFER PUMPS	APPROX.685mm(L)x220mm(W)	4 Nos.
	20	ALKALI UNLOADING / TRANSFER PUMPS	APPROX.685mm(L)x220mm(W)	4 Nos.
	21	N. PIT EFFLUENT TRANSFER PUMPS (VERTICAL)	----------	4 Nos.
	22	ACID MEASURING TANK FOR N.PIT	APPROX. 1000mmDia x 1000mmHOS	2 Nos.
	23	ALKALI MEASURING TANK FOR N.PIT	APPROX. 1000mmDia x 1000mmHOS	2 Nos.
#	24	AIR BLOWER FOR N. PIT	APPROX.1000mm(L)x500mm(W)	4 Nos.

C&I BATTERY PANEL/BOX DETAILS

S.No.	EQUIPMENT	APPROX. SIZE OF EQUIPMENT	QTY
25	WALL MOUNTED BATTERY JUNCTION BOX	650 MM L X 300 MM D X 550 MM H	1NO.
26	WALL MOUNTED BHMS DISPLAY PANEL	500 MM L X 150 MM D X 500 MM H	1NO.
27	WALL MOUNTED BHMS INTERFACE PANEL	300 MM L X 200 MM D X 500 MM H	4 NOS

TABLE : VENTILATION FANS DETAILS

TYPE OF VENTILATION	ACPH	CAPACITY	NO. OF FANS
WALL MOUNTED EXHAUST FANS FOR THE CPU REGEN AREA.	10	7500 CMH	12
WALL MOUNTED "SUPPLY" FANS FOR THE MCC ROOM WALL MOUNTED EXHAUST FANS FOR THE MCC ROOM	15	7500 CMH 6000 CMH	2 2
WALL MOUNTED EXHAUST FANS FOR THE BATTERY ROOM	20	7500 CMH	2W + 2S
WALL MOUNTED EXHAUST PROPELLER FANS FOR TOILET	5	1200 CMH	4



LEGEND:-

RMH	RESIN MAKEUP HOPPER
ARV	ANION REGENERATION VESSEL
SCRV	SEPARATION/ CATION / ANION REGENERATION VESSEL
MRSV	MIXED RESIN STORAGE VESSEL
RAB	REGENERATION AIR BLOWERS
HWT	HOT WATER TANK
ALMT	ALKALI MEASURING TANK
ALDP	ALKALI DOSING PUMPS
AMT	ACID MEASURING TANKS
ADP	ACID DOSING PUMPS
N-PIT	NEUTRALIZATION PIT
CPURP	CPU REGENERATION CUM RESIN TRANSFER PUMPS
EL	ELEVATION
BOB	BOTTOM OF BEAM
SLG	SLUICE GATE
MCC	MOTOR CONTROL CENTER
FGL	FINISHED GROUND LEVEL
FFL	FINISHED FLOOR LEVEL
TOC	TOP OF CONCRETE
D1	SINGLE DOOR
D2	DOUBLE DOOR
IL	INVERT LEVEL
ALTRP	ALKALI TRANSFER CUM RECIRCULATION PUMP
ACF	ACTIVATED CARBON FILTER
AMTNPT	ACID MEASURING TANK FOR N.PIT
ALMTNPT	ALKALI MEASURING TANK FOR N.PIT
BAST	BULK ACID STORAGE TANK
BCST	BULK ALKALI STORAGE TANK
AUP	ACID UNLOADING PUMP
ALUP	ALKALI UNLOADING PUMP
NETP	NEUTRALISED EFFLUENT TRANSFER PUMP

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER AND ELEVATIONS IN METRES.
2. ALL DRAIN CHANNELS WILL BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
3. ACID/ALKALI DYKE AREA FLOOR & WALLS TO BE PROVIDED WITH ACID/ALKALI RESISTANT TILING.
4. ALL ELEVATIONS ARE MARKED W.R.T. EL(+/-) 0.00 (FINISH FLOOR LEVEL) WHICH CORRESPONDS TO RL(+)86.0M.
5. THE DIMENSIONS SHOWN HERE ARE INDICATIVE AND MAY UNDER GO MINOR CHANGE BASED ON THE SUPPLIER SPECIFIC REQUIREMENT DURING DETAIL ENGINEERING. HOWEVER OVERALL BUILDING DIMENSIONS WILL REMAIN UNCHANGED.
6. THIS VESSEL IS APPLICABLE ONLY BASED ON SUPPLIER REGENERATION PROCESS RECOMMENDATION. IN CASE THE VESSEL IS NOT APPLICABLE THEN THE SPACE WILL REMAIN VACANT AND CAN BE UTILIZED FOR MAINTENANCE PURPOSE.
7. ⟶ DENOTES DIRECTION OF SLOPE.
8. ALL CIVIL WORKS INCLUDING ACID/ALKALI PROOF LINING/TILING/PVC LINING, PRECAST SLAB, RUNGS, HAND RAILING TO NEUTRALIZATION PIT, AIR CONDITIONING/VENTILATION SYSTEM IS IN M/s BHEL SCOPE.
9. ALL EFFLUENT DRAINS AND INCLUDING DRAINS LEADING TO NEU. PIT ARE TO BE LINED WITH ACID AND ALKALI PROOF LINING AND DRAIN WIDTHS & DEPTH SHOWN ARE FINISHED DIMENSION AFTER LINING.
10. ACID/ALKALI PROOF LINING SHOWN THUS &
11. DRAIN INSIDE THE BUILDING SHALL BE COVERED BY PRECAST SLAB/GI GRATING.
12. DRAIN OUTSIDE THE BUILDING SHALL BE COVERED BY PRECAST SLAB.
13. LOCATION OF ALL SKID BASED EQUIPMENT SHOWN ARE INDICATIVE AND SHALL BE SUITABLY ADJUSTED TO MEET THE SKID/PIPING REQUIREMENTS CONSIDERING SOME MINOR VARIATIONS.
10. FOR CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNIT (REGENERATION AREA) SHALL BE PROVIDED IN M/s BHEL DRAWING NO.: PE-DG-417-155-A030.
11. FOR CABLE TRAY LAYOUT, TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CPU REGENERATION AREA) SHALL BE PROVIDED IN M/s BHEL DRAWING NO.: PE-DG-417-155-A044.
12. FOR PIPING LAYOUT (REGENERATION AREA) FOR CONDENSATE POLISHING UNIT SHALL BE PROVIDED IN M/s BHEL DRAWING NO.: PE-VD-410-155-A034.
13. N. PIT IS PROVIDED WITH NECESSARY AIR GRID ARRANGEMENT.
14. AC & VENTILATION DETAILS SHALL BE FURNISH IN ARCHITECTURAL DRG. BY CIVIL AND SHALL BE FINALISED DURING DETAIL ENGINEERING BY M/s BHEL AS THE SAME IN BHEL SCOPE.
15. PLEASE REFER ELECTRICAL LAYOUT INCLUDING CABLE TRAY LAYOUT DRAWING (REFER BHEL DRG. NO. PE-DG-417-100-E121).
16. EXACT LOCATION OF FANS AND LOUVRES ARE TENTATIVE AND FINALIZED IN ARCHITECTURAL DRAWINGS. CONTROL ROOM AND UPS PANEL ROOM SHALL BE PROVIDED WITH SPLIT AIR CONDITIONERS.
17. TOOL ROOM FURNITURE AND ACCESSORIES ARE IN TSGENCO SCOPE.

CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA, INDIA
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OWNER'S CONSULTANT: TATA CONSULTING ENGINEERS LIMITED,BANGALORE

JOB NO. 417
CONTRACT

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	DK		19/01/2019
	DESN	MKG		19/01/2019
	CHD	JP/SB		19/01/2019
	APPD	SKB		19/01/2019

REV.	DATE	ALTD	CHD	APPD
04	01.10.2020	DK	MKG/SB	SKB
	Revised as per TCE comments received vide transmittal no. TCE.11005A-ME/VDT-460 dated 03/SEP/2020			
01	13.12.19	MKG	JP/SB	SKB
	Revised as per TCE comments received vide transmittal ref no. TCE.11005A-ME-VDT-348 dated 17/10/2019			
02	19.6.2020	DK	MKG/SB	SKB
	Revised as per TCE comments received vide transmittal no. TCE.11005A-ME-VDT-383 dated 20/Feb/2020.			

TITLE
EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (REGENERATION AREA)

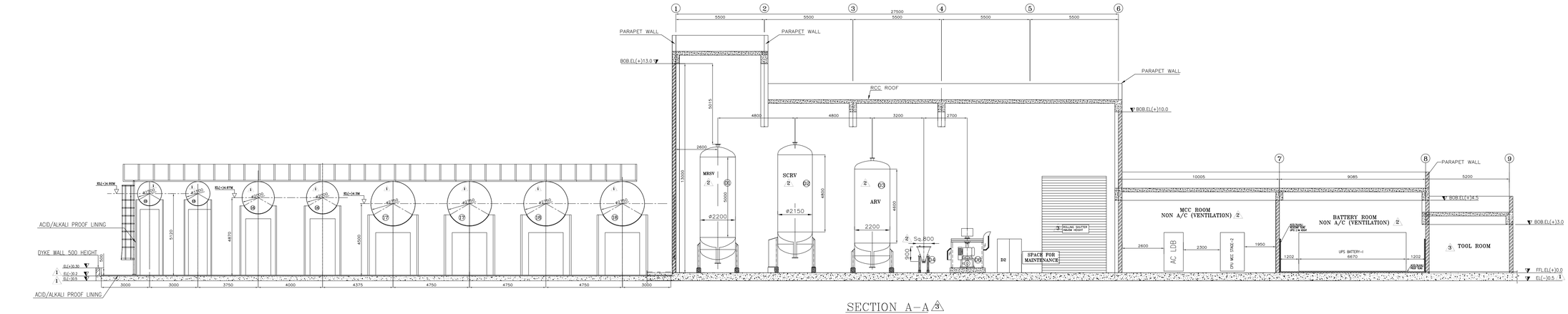
DEPT. | SCALE | SIGN

DRAWING NO. PE-DG-417-155-A003

SHEET 01 OF 02 | REV. 04

277 of 669

SIZE-A0



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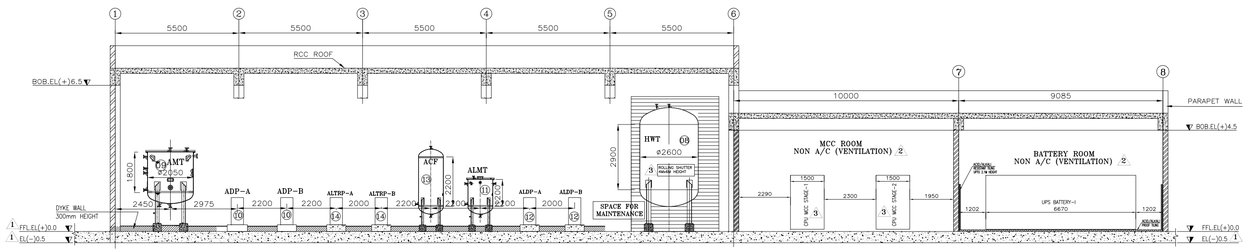

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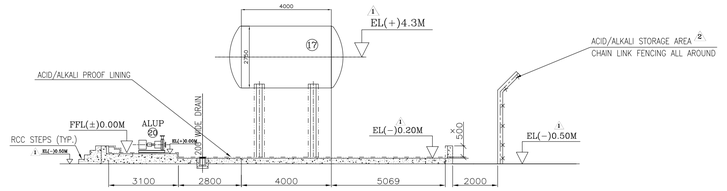

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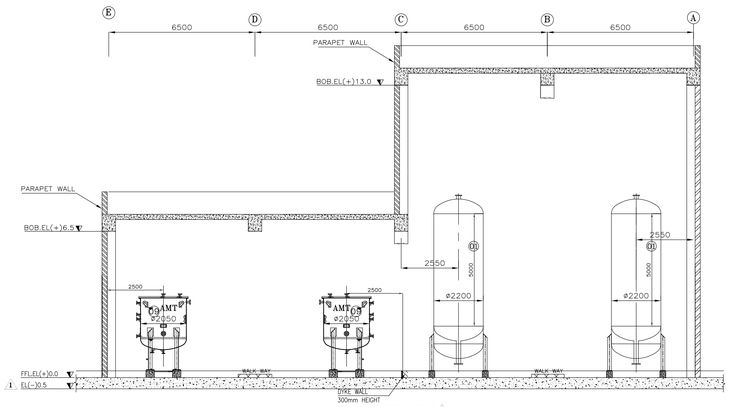

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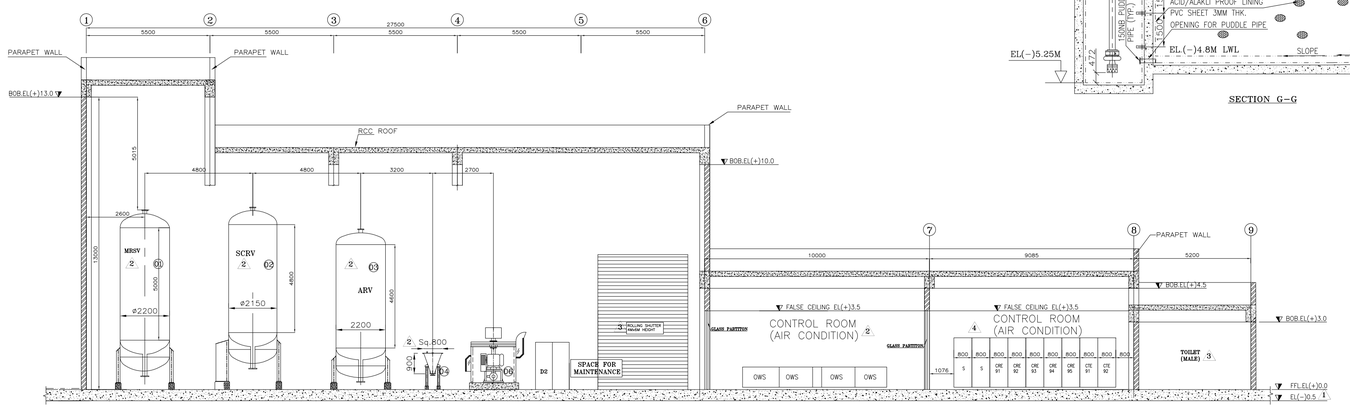

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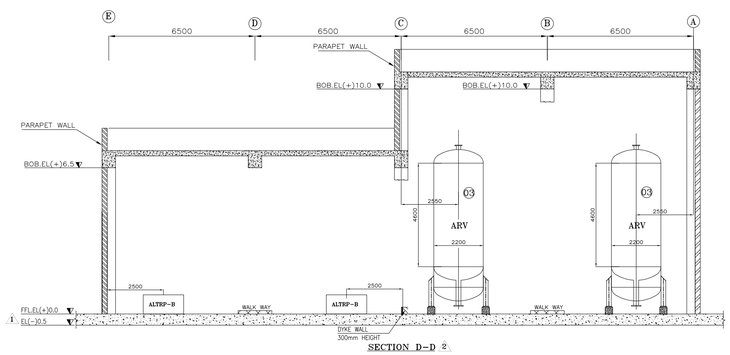
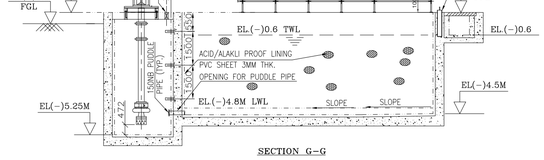


SECTION D–D 2



SECTION G–G

SECTION 1–1 SECTION 2–2

REV.	DATE	ALTD	CHD	APPD
04	01.10.2020	DK	MKG/SB	SKB

Revised as per TCE comments received vide transmittal no TCE.11005A-ME-V/DT-460 dated 03/SEP/2020

REV.	DATE	ALTD	CHD	APPD
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TITLE
EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (REGENERATION AREA)

DEPT. | SCALE | SIGN

DRAWING NO.
PE–DG–417–155–A003 3

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SIZE–A0