

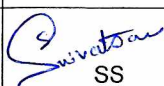
	SPECIFICATION FOR Zero Liquid System – Crystallizer cum Evaporator	SPEC.NO.ROS: 6244
		REV.: 00

BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION

FOR

ZERO LIQUID SYSTEM
(Crystallizer cum Evaporator)

00	15.04.19	 SS	 IMRL	 MSM	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

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1.0 INTRODUCTION

KPCL has invited a “Request for Proposal” for “Design, Construction, Testing, Trial Run and Commissioning of ZERO LIQUID DISCHARGE PLANT(ZLD) of YELAHANKA COMBINED CYCLE POWER PLANT(YCCPP) (1X370MW) Capacity at Yelahanka, Bangalore with Operation and Maintenance on Turnkey basis.

BHEL intends to participate as a “Turnkey Contractor” in above tender.

As per Tender requirement, turnkey contractor (here BHEL) can participate in the bid with a Consortium partner.

Consortium partner shall fulfill the minimum qualifying requirement as indicated in the tender specification and proof of the same shall be in the name of Consortium partner only.

BHEL will be the lead bidder and the Consortium agreement will be submitted along with the bid.

This “AGREEMENT” should be valid up to expiry of Operation and Maintenance period of BHEL for the plant as per contractual agreement with KPCL.

Any reference made as “Bidder” refers to the probable Consortium Partner in this specification.

2.0 SCOPE OF WORK

The intent of this specification is to elaborate the scope of “Mechanical Vapour Recompression forced circulation crystallizers” for ZLD Plant of YCCPP. The Prospective Consortium partner will undertake that the MVR technology shall conform to all technical specification requirement set forth in the tender attached and further agrees to abide by with the execution schedule.

In the event, BHEL led consortium is declared as successful EPC Bidder and awarded the “Project”, the Consortium partner shall be responsible for design & supply of proprietary equipment of the process, overall ZLD plant design, performance guarantee of the complete system and technical assistance in execution of the project till expiry of operation and maintenance period for the said project for the agreed scope of work.

The scope of work of the Technology provider covers design, engineering, manufacture/ fabrication, shop painting, shop testing, packing, transportation, transit insurance, unloading, storage at site, watch and ward, handling at site, erection, site testing, final painting and commissioning of entire mechanical equipment, Piping with valves and fittings, electrical, instrumentation & control in accordance with the requirement of the proposed plant complete with interconnecting pipes and cables for the proposed Zero Liquid Discharge plant of inlet capacity 6 m³/hr as per the technical specification outlined hereinafter on turnkey basis and the specifications laid down in various chapters in this document.

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The scope shall fully cover the requirement of the Design Criteria and Technical requirement of this specification. The scope of supply & services shall include but not limited to the following:

- 1) Supply of all technical literature, drawings & documents, general arrangement drawings, assembly & sub assembly drawings of all the plant & equipment, construction & erection & as-built drawings, operation & maintenance manuals, etc.,
- 2) Submission of all design calculations, data sheets, Inspection categorization plan, Quality assurance plan (QAP), Field quality plan (FQP) for various equipment's, pipeline sizing calculation and calculation for sizing of various sub systems and integrated systems for approval of KPCL / Consultant and finalizing the same as per approval of KPCL / Consultant
- 3) ZLD plant under Consortium partner's scope comprises of the following facilities
 - a. Crystallizer feed pumps, including suction piping from Crystallizer feed tank
 - b. Evaporator cum forced circulation Crystallizer with Mechanical vapour Recompression
 - c. Salt Centrifuge system and accessories.
 - d. Entire piping, fittings, valves within the system
 - e. Instrumentation,
 - f. Cables, cable trays & acc.
 - g. Chemical dosing facilities for ZLD system.
 - h. Other miscellaneous systems required for completeness of work
 - i. Erection & commissioning of ZLD system
 - j. PG test of ZLD system
 - k. Supply of commissioning spares & consumables.
 - l. O&M of ZLD system for 5 years

Items though not mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

- a) It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / BHEL, who will interpret the meaning of drawing & the specification and shall be entitled to reject any work or material, which is not in full accordance herewith.
- b) In case of any deviation, the Bidder shall indicate the same, clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid confirms strictly to the specification.
- c) General terms & conditions, instructions to the bidder & other attachments referred to elsewhere are part of this specification.

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- d) The order of priority of this specification is as follows:
- KPCL Tender specification along with Pre-bid replies, amendments, etc.
 - Technical requirement/Equipment Specification,
 - Drawings
 - General design requirements

Any contradiction either between various parts or contents of the specification shall be a matter for clarification to be obtained by the bidder. The BHEL's decision shall be final.

- e) The material shall be dispatched to site as per the bidder's shipping list approved by BHEL. The format for the shipping list & quality plan will be given by BHEL after ordering for the successful bidder. All the items shall be dispatched as per the instructions provided by the customer.

3.0 PROJECT INFORMATION

- 2.1 Owner : Karnataka Power Corporation Ltd.
- 2.2 Project Title : 1x370MW Yelahanka CCPP
- 2.3 Location : Doddaballapur Road, S N Halli Post,
Near Puttenehalli, Yelahanka,
Bangalore- 560064
- 2.4 Nearest Railway Station : Bangalore City Railway station
- 2.5 Nearest Airport : Bangalore International Airport

4.0 TECHNICAL REQUIREMENT

4.1 ZLD SYSTEM CAPACITY

Crystallizer cum Evaporator : 6 m³/hr

4.2 INLET WATER QUALITY FOR DESIGN

The feed water quality to be considered for the design of ZLD system is indicated below:

S.No	Description	Unit	Value
1.	Ca	ppm	1168.1
2.	Mg	ppm	312
3.	Na	ppm	8550
4.	NH4	ppm	210.5

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S.No	Description	Unit	Value
5.	CO3	ppm	28.7
6.	HCO3	ppm	516.5
7.	SO4	ppm	1963
8.	Cl	ppm	14743.8
9.	F	ppm	12
10.	NO3	ppm	36.4
11.	PO4	ppm	8.7
12.	SiO2	ppm	124.5
13.	CO2	ppm	2.9
14.	TDS	ppm	27674
15.	Hardness	as CaCO3	4199
16.	pH		8.2

4.3 PERFORMANCE & GUARANTEE REQUIREMENT OF ZLD SYSTEM

The plant design should meet the outlet water quality as indicated below:

Sl. No.	Parameters	Guaranteed Values
1	Distillate Purity (Non-volatile TDS)	TDS < 100 ppm
2	Moisture content (MC) in final product Salt centrifuge output (Reject)	≤ 20% by weight

5.0 TECHNICAL SPECIFICATION - MECHANICAL

5.1 DESIGN CRITERIA

Crystallizer

RO reject along with softener injection shall be fed into crystallizer feed tank from RO reject storage tank. Provisions shall be provided to add Sulphuric OR HCl / Caustic to the feed if required for process. A Crystallizer feed pump transfers the waste water from the crystallizer feed tank to the feed preheater. The plate and frame heat exchanger pre-heats the feed with the sensible heat of the vapour condensate (distillate) and is then fed into the crystallizer vapour body.

The circulation loop of the crystallizer recirculates the crystallizer slurry and pumped by the VFD centrifugal crystallizer recirculation pump through the shell and tube crystallizer heater. Start-up steam shall be drawn from the HRSG with suitable temperature and pressure. The brine is heated a few degrees (sensible heating) as it passes through the

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heat exchanger by gaining the heat from it and flashes when it re-enters the vapour body, effectively converting the sensible heat to latent heat in the form of vapour. Boiling within the tubes is suppressed by the liquid elevation in the vapour body. Evaporation takes place in the vapour head, thus concentrating the solution. The crystallizer heater is connected to the vapour body by the recirculation duct.

The process vapour is collected in the vapour body, passes through a chevron integral entrainment separator then into the suction of the compressor system. The compressor system consists of lobe blower / radial type fan that increases the saturation pressure of the vapour. The compressed and de-superheated vapour condenses in the shell of the crystallizer heater where it transfers the heat content to the salt slurry circulating in the tube side. The condensed vapour drains to a crystallizer distillate tank. The portion of the distillate is pumped out of the tank to the plate and frame heat exchanger to preheat the feed before it is returned to the facility and remaining distillate shall be collected in distillate tank from where it shall be transferred to CW makeup tank.

Foaming may occur in the crystallizer vapour body due to the presence of fine crystals, organic contaminants, and/or improper pH control. The crystallizer vapour body shall be designed with low vapour rise rates and extra disengagement height to minimize foaming potential and subsequent carryover. Small doses of antifoam can be metered into the process on a continuous basis to control foaming. Foam detection probes are installed so that if an upset occurs, a large dose of antifoam can be automatically pumped into the vapour body to reduce the foam.

Crystals are continuously formed within the brine slurry in the vapour body. As a result of the heating and flashing of the brine, water is removed in the form of vapour. The brine becomes supersaturated and the salts precipitate from solution.

A slip stream from the recirculating brine is directed to the pusher type salt centrifuge. The centrifuge recovers the solids containing approximately 15- 20% moisture.

The solids will be suitable for disposal at a landfill. The liquid removed from the solids is directed to the agitated centrate tank and then pumped back into the circulation line of the crystallizer by the centrate pump. A crystallizer dump / boil out tank has been included to allow the contents of the crystallizer vapour body to be pumped into the tank during process upsets, unplanned outages, and cleaning operations. The vapour body contents are transferred from the crystallizer recirculation duct by the crystallizer drain pump to the crystallizer dump tank. Once the system is back online, the contents in the crystallizer dump tank can be pumped back in to the system through the crystallizer transfer pump into the crystallizer recirculation line.

FEATURES OF CRYSTALLIZER

Vapour Body Design

The waste water crystallizer solids consist of several salts, making it a “mixed salt” crystallizer rather than a commodity salt crystallizer. The vapour body shall be designed to minimize foaming and allow proper crystallization of mixed salts of differing size to

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allow the centrifuge to operate properly. The vapour body for a mixed salt system shall be generally larger than for a single commodity salt system based on differences in the design vapour and liquid rise rate and the brine recirculation rate.

Heater

The heater shall be designed for mixed salt heat transfer coefficients and for higher velocities than commodity salt systems. The heater temperature rise is also lower in mixed salt devices to maximize intervals between cleanings. The horizontal 2 or 4 pass configuration allows for simple cleaning of the tubes when necessary. The liquor boxes are flanged and can be easily dismantled if needed without removing the circulation piping.

Dewatering Device

Pusher centrifuge shall be provided to dewater the solids coming from Crystallizer unit. The mixed salt shall be collected and disposed off for landfill. The centrate water shall be again slowly fed to crystallizer to concentrate and process.

Foaming

Technology provider shall provide sophisticated antifoam detection and delivery system and closed circuit TV camera to observe any foaming. The Crystallizer system has both low and high antifoam dosing pumps. Antifoam addition is automatically controlled with a foam detection capacitance probe in the crystallizer vapour body.

Cleaning

Since the salts in a mixed salt crystallizer are typically very soluble, a hot water rinse, or boil-out, using distillate or service water can be used to periodically clean the system. Regular boil-outs can prevent the need for more rigorous cleaning, such as chemical cleaning or hydro blasting chemical cleaning is accomplished by circulating a cleaning solution in the same manner that the brine is recirculated. In those occasional cases when a process or operator upset causes severe fouling, mechanical cleaning of these surfaces can be accomplished to return all heat transfer surfaces to a clean condition.

5.2 EQUIPMENT LIST

Indicative list of equipment's for zero liquid discharge plant and their MOC shall be as below. Any other equipment's / facilities not listed below but required for the completion for the ZLD plant is in the scope of the Bidder without any additional implications. Quantities and list of equipment's shall be finalized during detail engineering.

Stages indicated for evaporators / Crystallizer is tentative it may vary depending upon the functional requirement / OEM recommendation / which shall be decided after finalization of supplier and during detailed engineering stage.

Sl.no.	EQUIPMENT ITEM	MATERIAL (Or Equivalent)
1.	Crystallizer Feed Tank	Coated Concrete
2.	Crystallizer Feed Tank Mixer	Dup. SS 2507/ 6% Moly

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3.	Crystallizer Feed Pump & Motor	Cd4MCuN
4.	Crystallizer Feed Preheater Plates	Ti Gr.1 / 6% Moly/Ti. Gr.11
5.	Crystallizer Vapour Body	6% Moly / Inconel 625 / C-276
6.	Mist Eliminators	Dup 2507/ 6% Moly
7.	Crystallizer Heat Exchanger	
8.	Tubes	Ti-2/Ti-12 / Ti-16
9.	Tube sheets	Ti-2/Ti-12 / Ti-16 clad 316L SS / C-276
10.	Shell	SS 316L
11.	Crystallizer Recirculation Ducts	6% Moly / 2507
12.	Vapour Ducts	SS 316L
13.	Vapour Duct Expansion Joints	SS 316L
14.	Centrifuge	6% Moly / 2507
15.	Centrate Tank Mixer	6% Moly
16.	Centrate Tank	Coated RCC
17.	Centrate Pump	Cd4MCuN
18.	Crystallizer Process Condensate Pump & Motor	SS 316
19.	Crystallizer Condensate Tank	SS 316L
20.	Crystallizer Condensate transfer Pump	SS 316
21.	Crystallizer Recirculation Pump	Cd4MCuN / CK3McuN / Inconel 625
22.	Mechanical Vapour Compressor	Centrifugal Fan, 2205 Casing, 2507 Impeller with IGV Or Rotary lobe PD Blower w/ silencers, Cast iron with Ni-Resist lobes, 316L SS silencers
23.	Surface Condenser	SS316L tubes, heads, shell
24.	Deaerator	6% Moly
25.	Dosing tanks	FRP
26.	Sulphuric Acid Pump	A-20/PTFE
27.	Hydrochloric Acid Pump	PP/PTFE/ H-alloy C
28.	Antifoam Pump	PVC/PP
29.	High Capacity Antifoam Pump	PVC/PP
30.	Antiscalant Pump	PVC/PP
31.	Caustic Pump	SS 316
32.	Crystallizer dump tank / Boil out tank	Coated RCC
33.	Crystallizer dump transfer pump	Duplex SS

Note: 1. Mechanical Vapour compressor shall be provided with acoustic enclosure to restrict the noise level to 70 db at 1mt distance.

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5.3 TERMINAL POINTS:

- a. RO reject will be terminated at Crystallizer feed tank inlet. Bidder's scope starts from Crystallizer feed pump (incl. suction nozzle & suction piping from Crystallizer feed tank).
- b. Distillate from Crystallizer shall be terminated by Bidder at Distillate tank inlet nozzle. Further pumping and piping will be by BHEL. All flange drilling standard shall be as per ANSI B 16.5.
- c. Solid waste from salt centrifuge shall be terminated at Salt drying bed by Bidder. Salt drying bed will be by BHEL.

5.4 EXCLUSIONS

- a. Civil works
- b. Disposal of solid waste from salt centrifuge

5.5 GENERAL DESIGN REQUIREMENTS

The common requirements for the system are stated in the general design requirements. However, the requirements indicated in the technical specification for mechanical equipment shall be strictly complied with.

5.5.1 COMMON REQUIREMENTS:

1. Only latest revision of standards shall be used.
2. The system coming in contact with corrosive fluids should be compatible for the chemicals.
3. All the rotating equipments noise level shall be < 85dBA measured at 1 mtr distance from the equipment.
4. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages/segments of the Unit.
5. All low points shall be provided with drains along with valves.
6. The size of the overflow pipes of all storage tanks shall be one size higher than inlet pipe sizes of these tanks.
7. All the piping & valves are to be located to facilitate easy accessibility and operation from the ground level.
8. All flange fasteners shall be SS316 MOC minimum.
9. The flange fasteners shall be of stud type with spring washers & nuts.

10. The direction of Flow shall be indicated by an arrow at regular intervals on all pipelines.
11. All the equipment, valves, instruments shall be provided with tag nos.

5.6 PIPING

5.6.1 LINE SIZING

1. Sizes of pipelines shall be selected such that the velocity of fluid (effluent) in pipes does not exceed the following limits under conditions of maximum possible volumetric flow. However, bidder to select the velocity for safe operation of the systems considering water hammer etc.,
 - Pump Suction : ≤ 150 mm - 1.2 to 1.5 m/sec
: ≥ 200 mm - 1.2 to 1.8 m/sec
 - Pump discharge & recirculation : < 50 mm - 1.2 to 1.8 m/sec
: ≤ 150 mm - 1.8 to 2.4 m/sec
: ≥ 200 mm - 2.1 to 2.5 m/sec
 - Header : ≤ 150 mm - 1.5 to 2.4 m/sec
: ≥ 200 mm - 2.1 to 2.4 m/sec
 - Compressed air : 15 m/s
2. All high points in piping system (each segment) shall be provided with required air vents along with valves. All low points shall be provided with drains along with valves.
3. Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic location in piping system.
4. Necessary thrust blocks shall be provided to minimize water hammer & vibration in piping & headers.
5. Supporting arrangement of piping system shall be rigid and properly designed for systems wherever hydraulic shocks and pressure surges may arise in the system during operation.

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6. Sufficient up stream and down stream lengths shall be provided for flow measuring device, control valves and other specialities as per Manufacturer's recommendation.
7. Test certificate / compliance certificate to be furnished by the bidder for all the components instruments & piping etc.

5.7 PAINTING

The painting specification is as per KPCL Tender specification. Any changes shall be intimated during the post order stage.

5.8 VENDOR LIST FOR MECHANICAL ITEMS

Vendor list provided by KPCL Tender specification has to be followed. The vendor list is subject to the approval of end customer.

6.0 TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION

Electrical, Controls & Instrumentation requirements shall be as per KPCL tender specification.

7.0 TECHNICAL DETAILS FOR CIVIL WORKS:

Construction of civil shed, foundation and flooring etc for the ZLD system is not in bidder scope. However, the foundation materials like foundation bolts are in bidder's scope. The bidder shall provide the equipment layout drawing along with bid. Detailed construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipment, tanks, flooring requirements, trenches for pipe routing, cable routing & drains etc. shall be furnished to BHEL for further construction immediately after order.

Any special requirement like handling arrangement, pedestals, floor / trench protection etc. shall also be indicated in the drawings. All the plant drains & trenches are to be connected in a common trench and terminated near ZLD plant boundary. The approximate area & location are provided in KPCL tender. Bidder to accommodate the ZLD system with in the stipulated area only as indicated in the Tender layout drawing.

8.0 SPARES:

8.1 Commissioning Spares:

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The bidder should take care of this requirement for trouble free commissioning of the system since commissioning is under bidder's scope. The commissioning spares List and the individual price shall be indicated and included in the main supply. The bid price shall include these spares also. Any unutilized commissioning spares shall be handed over to the purchaser. The commissioning spares shall be delivered well in time before the start-up & commissioning of the plant.

8.2 Recommended Spares:

The bidder shall provide the list of recommended O&M spares. BHEL reserves the right to buy any of the recommended spares as considered necessary by him during later stage. The price of recommended spares will not be considered for bid evaluation.

9.0 DOCUMENTATION:

9.1 GENERAL:

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawing shall be submitted in English
2. Hard copies of all documents and drawings during bid stage to be submitted in duplicate.
3. Hard copies of all documents for approval shall be submitted in triplicate.
4. Hard copies of all final documents, drawings, Erection and O& M manual etc., shall be submitted in bound folder in 6 copies.
5. Soft copies of all final documents in MS word / MS office in the form of CD –1 set
6. Soft copies of all final calculations in MS excel/ MS office in the form of CD–1set
7. Soft copies of all final drawings in Auto Cad, latest version in the form of CD-1set

9.2 DOCUMENTS ALONG WITH BID:

The following drawings / documents are to be enclosed along with the bid for scrutiny.

1. All documents required as per KPCL's tender requirement.
2. Technical write-up giving details of equipment operation, interlocks / control requirement.
3. Process calculations.
4. Typical Guarantee document.
5. Preliminary P& I diagram
6. Preliminary Equipment layout drawing
7. Write-up about maintenance.
8. Chemical consumption for maintenance.
9. Utility requirements like instrument air, service air and service water, steam for maintenance & cleaning of ZLD system

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10. Cleaning sequence with flow rate, duration, effluent details, etc.,
11. Pump/blowers performance curves with marked duty point.
12. Sub vendor list for mechanical, electrical and C&I items.
13. Preliminary civil requirements.
14. PLC I/O list.
15. Typical Quality Plan for major equipment
16. Typical arrangement drawing & isometric drawing of all equipment, piping, valves, headers arrangement including space for maintenance, walkway etc.,
17. Tentative quantity of Power, Control and Screened cables to be supplied for the ZLD system by the BHEL.
18. Reference list of the plants of similar capacity meeting the KPCL PQR.
19. Deviation schedule duly filled, if any. Any deviation should have cost of withdrawal for our evaluation in the commercial bid.
20. Unpriced commercial offer on the scope of supply
21. Unpriced commercial offer for the recommended spares list

Bidder to note that failure to submit the above, will be considered as incomplete and offer is liable for rejection.

Note:

1. In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in **Annexure - 3**. If there is no deviation “NIL” statement shall be furnished. In the absence of the non-attachment of this **Annexure-3**, it will be construed that the bid confirms strictly to the specification.

9.3 DOCUMENTS AFTER ORDER

9.3.1 Phase-I (for approval-within 3 weeks from the date of LOI):

1. All documents required as per KPCL’s tender requirement.
2. Technical Write-up and design basis (including the capacities of all the eqpt)
3. P&ID diagram including pipe sizes & terminal points (KKS tagging shall be followed).
4. Equipment layout showing building details, headroom, equipment.
5. GA drawing of ZLD system equipment with frontal piping & valves with dimensions.
6. Sizing, projections/process calculations for various equipment
7. Filled up datasheets for approval as per **Annexures 1 to 2**
8. ZLD system “Control Description” write-up including operation, controls, interlocks, protection, annunciation etc.
9. Activity chart / Bar Chart and schedules for drawing submission, manufacturing, erection and commissioning.

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10. Quality Plan and field quality checks, stage inspection etc. (for all equipment, pumps, blowers, tanks, dosing system, piping & valves etc.,).
11. Performance curves for pumps/blowers & motors
 - a. Flow Vs Head
 - b. Flow Vs efficiency
 - c. Flow Vs Power
 - d. Flow Vs NPSH
12. Instrument schedule.
13. Typical arrangement drawing & isometric drawing of equipment, piping, valves, headers arrangement including space for membrane removal, maintenance, walkway etc.,
14. Write-up about operation & maintenance.
15. PLC I/O list.

9.3.2 Phase-II (for information-within 6 weeks from the date of LOI):

1. All documents required as per KPCL's tender requirement.
2. Equipment storage procedure before commissioning
3. Piping and Valves schedule
4. Foundation Design drawings indicating foundation design, load data, anchor bolt location, pocket details, floor & trenches etc.
5. General arrangement drawings for all the equipment showing dimensions and details of materials.
6. As-built manufacturing drawing of the ZLD equipment, assembly including piping & valve system arrangements with Bill of material (BOM)
7. Isometric drawing of pipe segments.
8. Cross sectional drawing of pump & blowers etc. with BOM
9. Details of pneumatic actuator

9.3.3 Phase-III (for information-before dispatch):

1. All documents required as per KPCL's tender requirement.
2. Erection Manual indicating
 - a. Erection/installation instructions of equipment.
 - b. Log sheet containing stage check parameters & clearance
 - c. Log sheets for alignment check of pump & motor
 - d. Field quality checks
3. Performance Test procedure
4. All the documents called in Electrical specification.
5. Shipping list for BHEL's approval in BHEL format

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Phase-IV (for review):

1. All documents required as per KPCL's tender requirement.
2. Pump & Blower performance test reports
3. Pump & blower performance guarantees certificates
4. Operation and maintenance manual indicating, operating procedure for start-up, normal operation, chemical cleaning, shut down and emergency shutdown. (O & M manual shall be supplied with 6 sets of hard copies and one set in soft form in CD.
5. Maintenance instruction & assembly
6. Lubrication chart.
7. Electrical equipment layout, Cable trench layout, cable routing, cable schedules and cable termination details.
8. ZLD System Logic diagram & Sequential Flow Chart (SFC) for PLC.
9. Cable interconnection diagram for cables up to junction box & cable schedule.
10. Test Certificates for all the supplied instruments.
11. List of alarm, interlock & trip set points
12. Installation drawings for instruments
13. Wiring drawings & GA drawings for Local Panels, junction boxes.
14. As built drawings.
15. All other details called in Electrical specification.

Note: Bidder to confirm in their offer that these details called in 9.0 will be provided.

10.0 ATTACHMENTS

The following drawings/documents are enclosed are a part of the specification:

1. PFD for ZLD plant : 3-WT-220-01142, Rev 00
2. KPCL Tender documents, Amendments, Corrigendum, Pre bid replies.

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Annexure-1

ELECTRICAL POWER CONSUMPTION

Sl. No.	Equipment Description	Qty		Pump efficiency	Drive rating KW	Conn load. Load KW	Power consumption KW	Voltage, Phase
		W	SB					
A	FOR CONTINUOUS OPERATING EQPT.							
1								
2								
3								
4								
5								
6								
	Sub total of A							
B	FOR INTERMITTENT OPERATING EQPTS.							
1								
2								
3								
4								
5								
	Grand Total							

Note: W – Working SB – Standby

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Annexure-2

RECOMMENDED SPARES LIST FOR O&M

Sl. No.	Description of the equipment	Description of spares	Quantity	Price

	SPECIFICATION FOR Zero Liquid System – Crystallizer cum Evaporator	SPEC.NO.ROS: 6244
		REV.: 00

ANNEXURE -3

TECHNICAL DEVIATIONS

Sl. No	Section no.	Clause No.	Page / No.	Specification	Statement of Deviations/variatio	Reason for Deviation