3.04.08 Remotely operated valves suitably interlocked with the plant operation, shall ensure that the resins get transferred to and from only the particular service vessel which has been selected by the operator.

3.04.09 All lined vessel connections and connections in unlined vessels (25 Nb and larger) shall be flanged to ANSI 125 lb class except the polisher service vessels which shall be ANSI 300 lb class : Flat face flanges shall be used throughout. Nozzle material shall be ASTM-106 Gr.B. Sch.80 pipe for all vessels. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full face gaskets. All the pipeline in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.

3.05.00 **Valves**

3.05.01 All valves shall be designed as per applicable AWWA/BID/BS or equivalent international standard / codes.

3.05.02 The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of stainless steel construction.

3.05.03 Emergency bypass control valve shall be of double flanged butterfly type. Isolation valves of wafer (lugged) type butterfly valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and downstream sides of the control valve.

3.05.04 Isolation Valves handling Acid, Alkali, Ammonia etc. shall be diaphragm type in MSRL (mild steel rubber lined) construction.

3.05.05 Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be SS construction.

3.05.06 Non-return valves for DM Water & alkali shall be SS construction and for acid non return valve shall be lined type or as per manufacturer's standard practice.

3.05.07 All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.

3.05.08 MOC of butterfly valve at inlet of service vessel seat CS, Disc- SS and outlet of service vessel seat – SS, disc- SS

3.06.00 **Pressure Vessels, Atmospheric tanks & Miscellaneous Items**

3.06.01 Design pressure of the condensate Polisher Service Vessels shall be as indicated in the data sheet. For all other pressure vessels, unless otherwise mentioned design pressure shall be at least 8 kg/cm2(g).

3.06.02 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.

3.06.03 Design of all horizontal cylindrical storage tanks containing water, acid, alkali and other chemicals shall conform to BS -2594

3.06.04 Unless otherwise mentioned design temperature of all pressure vessels and storage tanks shall be 10 Deg.C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.

3.06.05 In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.

3.06.06 All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end of torospherical type.

3.06.07 Spherical vessels for CPU service vessels are acceptable.

3.06.08 All the atmospheric tanks shall have sufficient free board above the ''Level High /Normal Level'' as the case may be. The overflow level shall be kept at least 20 cm or 10% of vessel height above the ''Level High /Normal Level'' for all the tank. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of tank.

3.06.09 Material:

i All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII or IS 2825 standard. Suitable mill tolerances shall be considered for determining the thickness of the shells and dished ends. A minimum thinning allowance of 2 mm shall be considered for the dished ends of torospherical type.

ii Pressure vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Spherical vessels for CPU service vessels are acceptable. Conical or flat ends shall not be accepted. All the atmospheric vessels shall be atleast 6 mm thickness.

iii All pressure vessels(Mixed bed polisher) shall be fabricated from carbon steel plates to Carbon steel plates to SA 516 Gr. 60 /SA 516 Gr. 70 and lined internally. Pressure vessels other that mixed bed polisher/condensate polisher vessel shall be fabricated from (Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70 for shell and Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70 for Head) and lined internally. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore -A meeting the requirements of IS:4682 , Part-I. The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

iv <u>Vessel internals shall meet the following requirements</u>:

1) Inlet water and regenerant distributor: - Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316 except for acid service which will be of Hastealloy-B.

2) Under drains: Same as above with screened laterals with internal perforated pipes and rubber lined flat bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA - clog type with pora septanurese screen, fully supported by subway grid or equal).

3) All internal fasteners shall be of SS-316 and heavy duty locknuts shall be used throughout.

v Resin Traps: Outlet of each condensate polisher vessel, activated carbon filter and waste effluent header of the common regeneration shall be provided with a resin trap. Pressure drop at design flow through a clean resin trap shall not exceed 0.35 kg/sq.cm. Resin trap shall be of rubber lined steel construction and internals (cord & screen) shall be of JOHNSON SCREENS IRELAND or equivalent (SS-316) construction. Resin traps of process effluent line shall have screen opening not exceeding 120 percent of associated process vessel under drain screen opening. Other resin traps shall have screen opening of 60 mesh. In place manual back flushing shall be provided for all resin traps.

vi Carbon Trap (for ACF): Outlet of each Activated Carbon filler on Carbon trap (media trap) shall be provided.

4.00.00 CONTROL & OPERATION

4.01.00 General

4.01.01 It is not the intent to specify here the complete details of the control system. Basic type of controls required has been specified below. The bidder shall submit with the proposal the complete detail of the system offered by him like the extent of automation offered, operation of the complete system, logic/flow diagrams, type and details of the presentation of information, the type of mimic, hardware details etc. along with detailed circuit descriptions.

4.01.02 It shall be possible to operate in Auto/Semi-Auto /Manual mode. In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi-Auto' mode each step shall be performed only after initiation by the operator. In 'Manual' mode complete operation shall be by the operator by operation of the Control switches on the panel.
Control for chemical dosing system and alkali preparation facilities shall be provided in it.

4.01.03 'Close-Auto-Open' control facility shall be provided from OWS/control panel for solenoid valves. In 'Auto' position, the valves shall receive close / open command from the Control system.

4.01.04 'Stop-Auto-Start' Control facility shall be provided from OWS / control panel for the various drives. In 'Auto' position, the drives shall receive stop/start command from the Control system.

4.01.05 On control system failure, it shall be possible to operate the valves by means of manual operator of solenoid valves too.

4.01.06 The control system shall link the various steps such as closing/opening of different valves, starting/stopping of various pumps etc. which form a sequence. The logic system shall adhere to the correct sequence of operation and predetermined time intervals. The system shall have interlocks so that, criteria necessary for each step are complete prior to proceeding to the next step.

4.01.07 It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.

4.01.08 For steps, which require frequent time adjustment, it shall be possible to change the time setting from the front of the panel. For all other steps it shall be possible to adjust the time setting from inside the panel.

4.01.09 For all sequences, the current step number, set time of the step, elapsed time of the step and the total elapsed time of the sequence shall be indicated in the OWS/control panel.

4.01.010 A mimic shall be provided for the CPP scheme and Regeneration system scheme shall be provided. Status of various vessels, drives, valves etc shall be indicated by on the mimic.

4.01.011 The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criterion is not fulfilled or missing for a pre-determined time interval, the steps should not proceed further, and Alarm shall be provided. Missing criteria, sequence, which is under hold up etc., shall be displayed.

4.01.012 The safety system for any sequence/step shall check the opening of the required valves and closure of the remaining valves of the plant to avoid mal-operation.

4.01.013 Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.

4.01.014 The detailed logic for the sequence and for each of the drive shall be subject to the BHEL/Customer's approval.

4.01.015 Start, progress and stop of each of the sequence shall be annunciated.

4.01.016 The status of vessels of Condensate Polishing Plants shall be available in all the CPP panels of all TG units and as well as in the regeneration plant control panel. Similarly the status of regeneration plant status shall be available in the panels of Condensate Polishing Plants of all TG units.

4.02.00 Control & Operation of the Condensate Polishing Unit

4.02.01 The regeneration system control system shall be linked with TG control system for data transfer through a two way link for both information and control.

4.02.02 It shall be possible to select each of the CPU vessel for any of the following operations or mode :

(1) Standby (Applicable for where spare service vessel (s) are provided)

(2) Service

(3) Isolation from service.

(4) Exhausted Resin Transfer from CPU vessel to Regeneration plant.

(5) Regenerated Resin Transfer from Regeneration plant to CPU vessel

(6) Rinse mode.

Each mode or operation is described as below:

4.02.03 Standby Mode:

(1) Among the vessels, any one of the vessels may be selected in this mode.

(2) Under this mode, the vessel, which was regenerated in previous cycle and filled with regenerated resin, shall be kept ready for next Service cycle.

(3) The selection of any vessel for Standby mode shall be initiated by operator and there shall be indication about the details such as “Condition of the resin ; Whether it is filled with regenerated resin or exhausted resin, whether the standby vessel has undergone rinse cycle or not, date and time of receipt of regenerated resin and completion of rinse cycle etc

4.02.04 Service mode:

(1) Service flow rate for each polishing vessel shall be monitored. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence.

(2) A differential pressure transmitter installed between the influent and effluent headers will on a high signal cause an alarm and bypass system shall be initiated as described elsewhere in this section.

(3) By observing the individual vessel flow indicators, or conductivity at vessel outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of resin cleaning.

(4) Cation conductivity indicators shall monitor the polishing system influent and effluent streams as well as the discharge of each service vessel. A high influent conductivity alarm will alert the plant operator that a problem condition such as air or condenser cooling water leakage has occurred. This conductivity analyzer shall also provide contacts for an alarm at the power station main control room. A high effluent header or service vessel conductivity alarm will alert the operator to the need for regeneration of a polishing vessel.

(5) When the vessel under Service mode is ready for regeneration, the operator shall change the same into “Isolation mode” in the panel. Subsequently the “Standby vessel” shall be selected for “Service mode” from the OWS/control panel. The selection shall follow, required sequences such as pressurization of the vessel, checking of the effluent quality and putting the vessel in service on satisfactory effluent quality.

4.02.05 Isolation from Service: Normally "Service Vessel" once exhausted shall be isolated from service till the "Resin Transfer" operation is initiated. In addition, provision to be kept for isolation of one or all the vessels from service if required by operator from the panel.

4.02.06 Resin Transfer from CPU vessel to Regeneration plant:

(1) When a vessel in a service mode needs regeneration as stated above, the resin transfer from the particular vessel to the regeneration plant shall be initiated from the panel of the condensate polishing plant.

(2) The transfer of resin from the service vessel shall include operations such as isolation of the service vessel, hydraulic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel.

(3) The sequence of "Resin Transfer" operation shall be initiated from the Control system in panel of CPP and shall be controlled in the regeneration Panel.

(4) The completion of the operation shall be exhibited in the panel.

4.02.07 Resin Transfer from Regeneration Plant to CPU Vessel:

(1) When the regeneration is completed in the regeneration plant, the resin shall be transferred to the empty vessel of Condensate Polishing plant.

(2) This shall be initiated by the operator from the control panel of condensate polishing plant of the unit from which resin was transferred to the regeneration plant in previous service. Provision shall also be kept to transfer the regenerated resin to any of the empty vessel of the CPP of any of the TG unit if required.

(3) The transfer of resin from the regeneration plant shall include operations such as hydraulic transfer of the resin and the complete drain down of the water.

(4) The sequence shall be initiated from the panel of CPP and shall be controlled in the regeneration Control Panel.

(5) The completion of resin transfer operation shall be exhibited in both the Control panels.

4.02.08 Rinse mode :

(1) After transfer of regenerated resin from the regeneration plant to the empty condensate polisher vessel, this rinse cycle shall be initiated from the Control system of the respective unit so that the vessel may be rinsed and kept ready for next service cycle.

(2) The rinse mode shall be a manually initiated full automatic sequence. This sequence shall include the rinse down step using condensate at a suitable rate until the unit effluent quality is acceptable for boiler feed water. Prior to rinsing, the resin shall be given air scrub by means of air blowers provided near the CPP.

(3) The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is returned to the condenser hotwell for recycle.

(4) Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

(5) The completion of rinse operation shall be annunciated in the panel so that the rinsed vessel may be selected for "Standby mode" or "Service mode" as per requirement.

4.03.00 External Regeneration Control System

4.03.01 A manually initiated automatic sequence for physical cleaning and chemical regeneration of the resin shall be provided. Control for chemical dosing system and alkali preparation facility shall also be provided in it.

4.03.02 Physical cleaning of the resin shall consist of three steps, drain to level, air scrub and rinse. The air scrub and rinse steps are of short duration, approximately 1 and 2 to 3 minutes respective time. However the program will allow the operator to increase or decrease the number of times the sequence is repeated to meet the requirements existing at that time.

4.03.03 The chemical regeneration is a many step sequence. This will include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels. The Bidder may include a layer of inert, intermediate density resin to achieve a better separation of the cation and anion resins, improve resin regeneration, and reduce leakage. The separated resins are then back washed, regenerated with hydrochloric acid and sodium hydroxide solutions respectively and then rinsed. Following the rinse step the resins shall be given an air scrub followed by a good backwash. The resin is then transferred back to the resin separation vessel and the resins are air mixed. The mixed resins after regeneration are given a final rinse with the discharge conductivity being monitored. The quality of this discharge will determine if the regeneration has been effective. If the quality is not satisfactory the regeneration sequence must be repeated. If satisfactory, the mixed resin is transferred to the resin storage vessel.

4.03.04 A resin mixing and final rinse may occur in the resin storage vessel provided that the system design will permit direct return of the resins to the resin separation vessel in the event of an unsatisfactory regeneration.

4.03.05 Upon satisfactory completion of regeneration, the status shall be annunciated audio-visually in the regeneration system OWS/control panel and as well as in the Balance of Plant Control System. This repeat annunciation in the CPP OWS/panel shall facilitate the operator to initiate resin transfer operation from the regeneration plant to the desired vessel of the Unit in which the service vessel is empty.

4.03.06 Upon resin transfer operation from regeneration plant as described by the operator from the I Control System, the regeneration plant shall be ready to receive next batch of exhausted resin from any of the CPP. The status of regeneration plant (Whether ready to receive resin for regeneration or under regeneration etc) shall be available in the Control System of CPP.

4.03.07 Demineralized water shall be used throughout the regeneration process for backwashing, diluting the regenerant, rinsing and resin transfer.

4.03.08 A conical bottom hopper having a water ejector will be used for resin make-up.

4.03.09 At any time only one of the sequence shall be in progress.

4.04.00 Interlocks

4.04.01 All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement.

4.04.02 Service vessels can be back in service, only after they have been pressurized.

4.04.03 Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.

4.04.04 Resin can be transferred to and from only one service vessel at a time.

4.04.05 Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.

4.04.06 Regeneration sequence can commence, only when the level in the waste neutralisation pit is low enough to receive the entire waste quantity of waste water from the regeneration operation.

4.04.07 Wherever possible, completion of all timed steps in the regeneration and resin transfer process shall be physically verified by effluent conductivity etc, as applicable. The automatic sequence shall be prevented from advancing to next step, till these required physical conditions are achieved, and at the same time this delay shall be annunciated in the control panel, to draw the attention of the operator. The automatic sequence of operations shall be interruptive at any time by the operator and he shall be able to take over the control to manual from that step onwards. Further operator should be able to over ride sequence, if required. It shall be possible for the operator to extend the timing of a particular step by isolating the timer for the duration. The timer will restart once the operator puts back the system on 'auto' and the other steps will then follow as programmed.

4.04.08 The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition, which do not permit the various desired parameter of this step to be achieved. A manual override for this shall also be provided.

4.04.09 Annunciation logic shall be carefully designed so that the alarms are activated only under abnormal conditions. As for example, low flow of diluent water is only relevant when the chemical dosing is in progress. All other times, when no diluent water flow is required, this annunciation should be blocked. In general, Normal and trouble free operation of the plant shall not activate any of these alarms.

4.04.10 Adequate diluent water flow shall be established before starting of the ejectors/ dosing pumps for acid and alkali.

4.04.11 The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.

4.04.12 CPU service vessel inlet & isolate values will close automatically in the event of tripping of condensate extraction pump.

CONDENSATE POLISHING SYSTEM
(CONT.)

CONTENTS

ATTACHMENTS

1.00.00 SYSTEM DESCRIPTION

1.01.00 On line Condensate Polishing System (CP System) is envisaged to achieve high order of availability of various power cycle equipment as well as to ensure quick start up of the unit & continue the unit operation without any restriction by maintaining desired quality of condensate water as recommended by Boiler manufacturer. The CP System should also be capable of maintaining specified condensate quality with condenser tube leakage (clarified water).

1.02.00 The proposed CP System shall comprise of 3 x 50 % Condensate Polisher Mixed Beds for 1 x 800 MW Unit and One (1) no. common External Regeneration System for 1 X 800 MW Unit.

1.03.00 The Condensate Polisher Mixed Beds and associated pipe works, valves, instruments, control panels etc. shall be located at ground floor of Power House.

1.04.00 The regeneration facilities comprising of Regeneration Vessels, Measuring Tanks and Pumps shall be located in a separate place near and outside the Power House. The resins will be transferred to the Regeneration Area from the Condensate Polisher Mixed Beds and vice versa through a pipeline.

2.00.00 SCOPE OF SUPPLY AND SERVICES

It is not the intent to completely specify all the details of design, construction and installation herein. Nevertheless, the equipment along with accessories and installation shall conform to a high standard of engineering design and workmanship and capable of performing continuous and satisfactorily. Details not furnished here shall be subject to approval.

The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.

The equipment and accessories of CP System shall be complete to ensure the recommended condensate water quality both in terms of physical & chemical properties.

The CP System should consist of but not limited to the equipment and accessories as follows:

2.01.00 Three (3) nos. Condensate Polisher Mixed Beds (3 x 50 %) for 800 MW Unit, each complete with condensate inlet and outlet connections, connections for resin transfer to and from vessels, bed support-cum-under drain system, inlet water distributors, all accessories and appurtenances etc.as required.

2.02.00 Resin transfer lines of stainless steel construction between the Condensate Polisher Mixed Beds and the External Regeneration Vessels along with all accessories for 800 MW Unit.

2.03.00 External resin traps at the outlet of each of the Condensate Polisher Mixed Beds each designed for in-place manual back wash facility.

2.04.00 Condensate inlet and outlet headers for Condensate Polisher Mixed Beds of 800 MW Unit within the boundary limits.

2.05.00 Resin transfer lines of stainless steel construction between the External Regeneration Vessels and the Condensate Polisher Mixed Beds along with all necessary supports, anchors etc for 800 MW Unit.

2.06.00 Rinse water outlet header from Condensate Polisher Mixed Beds of 800 MW Unit.

2.07.00 Two (2) nos. Rinse Recycle Pumps each complete with electrical drive motor and all other accessories as required.

2.08.00 All necessary valves and fittings along with the actuators necessary for operation from CP System Control Panel of 800 MW Unit. These shall include suitable arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it, which are designed for pressure much lower than that of the Condensate Polisher Mixed Beds.

2.09.00 A common drain header for the Condensate Polisher Mixed Beds of 800 MW Unit.

2.10.00 All necessary drains, vents and sampling points along with isolation valves as required.

2.11.00 Two (2 x100%) nos. blowers for 800 MW Unit for Condensate Polisher Mixed Beds (if required), each complete with electrical drive motor and all other accessories as required.

2.12.00 Emergency bypass system between the condensate inlet and outlet headers with its automatic valve, isolation valves on both sides and controls for each of Condensate Polisher Mixed Beds for 800 MW Unit.

2.13.00 External Regeneration System

The equipment and accessories for external regeneration of ion-exchange resins as addressed below are tentative and for 1 x 800 MW Unit.

However, any other proven alternative scheme of external regeneration as per the standard practice of Supplier of CP System may also be

adopted subject to suitability of the same in all respects for satisfactory operation and performance of Condensate Polisher Mixed Beds.

2.12.01 One (1) no. Resin Separation Vessel complete with all accessories.

2.12.02 One (1) no. Anion Resin Regeneration Vessel complete with all accessories.

2.12.03 One (1) no. Cation Resin Regeneration Vessel / Mixed Resin Storage Vessel complete with all accessories.

2.12.04 One (1) no. Resin Hopper, complete with a water ejector system for resin make-up complete with all accessories.

2.12.05 One (1) no. Hose Station for Transfer of Hydrochloric Acid. The hose station shall have two (2) nos. each 80 mm NB rubber hose connections.

2.12.06 Two (2) nos. Hydrochloric Acid Transfer Pumps each complete with electrical drive motor and all other accessories as required.

2.12.07 One (1) no. Hydrochloric Acid Storage Tank complete with integral pipe works, valves and all other accessories as required.

2.12.08 One (1) no. Hydrochloric Acid Measuring Tank for regeneration of Cation Resins, complete with integral pipe works, valves and all other accessories as required.

2.12.09 Two (2) nos. Hydrochloric Acid Dosing Pumps each complete with electrical drive motor and all other accessories as required

2.12.10 Two (2) nos. Alkali Transfer Pumps, each complete with electrical drive motor and all other accessories as required.

2.12.11 One (1) no. Activated Carbon Filter for Alkali, complete with internals, integral pipe works, valves and all other accessories as required.

2.12.12 One (1) no. Alkali Storage Tank, each complete with integral pipe works, valves and all other accessories as required.

2.12.13 One (1) no. Alkali Measuring Tank for regeneration of Anion Resins, complete with integral pipe works, valves and all other accessories as required.

2.12.14 Two (2) nos. Alkali Dosing Pumps each complete with electrical drive motor and all other accessories as required

2.12.15 Two (2) nos. air blowers, each with electric motor drives, V-belt drive with belt guard, air filters, silencers, for supply of process air required for regeneration of the resins.

2.12.16 Two (2) nos. DM Water Regeneration / Resin Transfer Pumps each with electric drive motor, one normally operating and the other standby, for water supply for chemical preparation / dosing and transfer of resin from Condensate Polisher Mixed Beds to Regeneration vessels and vice-versa, backwash etc.

2.12.17 One (1) no. Water Heater for regeneration of Anion Resins, complete with integral pipe works, valves and all other accessories as required.

2.12.18 One (1) no. Neutralization Pit with two (2) compartments, each complete with all accessories.

2.12.19 One (1) no. Acid Measuring Tank for neutralization, complete with integral pipe works, valves and all other accessories as required.

2.12.20 One (1) no. Alkali Measuring Tank for neutralization, complete with integral pipe works, valves and all other accessories as required.

2.12.21 Two (2) nos. Neutralized Waste Transfer Pumps, each complete with electrical drive motor and all other accessories as required.

2.14.00 All integral and interconnected pipe works, necessary valves complete with the actuators as necessary for their remote automatic operation (These need to include all drains, vents, and sampling points with isolation valves as required) and fittings, sumps, gates, all types of pipe supports, pipe and cable racks, pipe and cable bridges, etc. for the entire System.

The above shall include DM water piping for dilution, resin transfer, backwashing, flushing, rinsing etc. including the DM water piping along with all supports and hangers between the Regeneration Facility and the CP System.

2.15.00 Operating platforms, ladders, supports and other structural works as required to facilitate accessibility for operation and maintenance for all the Condensate Polisher Mixed Beds, Regeneration Vessels, Storage Tanks and other equipment.

2.16.00 First fill of resins for all Condensate Polisher Mixed Beds, Mixed Resin Storage Vessel and Makeup Resin Hopper for all the units complete with make-up resin for first three years of operation (Quantity of make-up resins shall be calculated on the basis of 3% and 5% attrition loss per annum for cation and anion resin respectively).

2.17.00 Supply and application of shop painting and final painting at manufacturer's works and at site for the entire system as specified elsewhere in Volume III-C of this Bid Document.

2.18.00 All instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

2.19.00 All electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

2.20.00 All civil as well as structural design, construction and architectural works as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume –VII/C of this Bid Document.

2.21.00 All equipment and accessories as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.

2.22.00 All consumables (lubricating oil, inhibitor for oil), mandatory spares, recommended spares, spares required for erection and commissioning of complete system, new set of special tools and tackles, fixtures etc. required for regular operation and maintenance of the system as addressed in Lead Specification - Volume II-A of this Bid Document.

2.23.00 Services included under this Specification

All services as addressed in Lead Specification - Volume II-A of this Bid Document need to be considered as included with reference to Condensate Polishing System, under the scope of Specification:

3.00.00 **EXCLUSIONS**

Following items shall be considered as excluded from the scope:

3.00.01 Supply of river water.

3.00.02 All consumables, bulk chemicals like Hydrochloric Acid, alkali etc.

3.00.03 Supply of construction water and construction power.

3.00.04 For exclusions with reference to instrumentations and controls, Bidder may please refer to Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

3.00.05 For exclusions with reference to electrical equipment and accessories, Bidder may please refer to Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

3.00.06 For exclusions with reference to civil as well as structural design, construction and architectural works, Bidder may please refer to General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B &

Technical Specification for Civil, Structural and Architectural Work - Volume – VII/C of this Bid Document.

4.00.00 INTERFACE POINTS

Not Applicable.

5.00.00 SALIENT DESIGN FEATURES

5.01.00 The system shall be designed for 100% condensate polishing for 800 MW Unit corresponding to the maximum mass flow rate established with VWO condition of turbine with suitable bypass arrangement plus maximum heat cycle make-up, with due consideration of redundancy as described elsewhere in this specification.

5.02.00 Each of the Condensate Polisher Mixed Beds shall be designed to handle maximum fifty percent [33(1/3)%] of the system design flow rate for 800 MW Unit as addressed above and to suit the system design pressure as well as temperature.

5.03.00 Condensate Polisher Mixed Beds making up the system of each of 1 x 800 MW Units will be connected to the condensate cycle of respective units and will treat the entire flow. The Condensate Polisher Mixed Beds should be capable of operating without any prior filtration of the condensate.

5.04.00 When condensate temperature exceeds 50°C for a particular 800 MW Unit or bypass pressure difference reaches 0.35 Mpa, the bypass valve shall be 100 % opened automatically and the inlet/outlet of the Condensate Polisher Mixed Beds shall be closed to protect elements and resins inside the polisher.

5.05.00 After the bypass valve is 100 % opened, the bypass valve shall be closed manually. Before closing the bypass valve, one needs to ensure that Condensate Polisher Mixed Beds of 800 MW Unit have been put into operation.

5.06.00 Pressure differential across a Condensate Polisher Mixed Bed may also be judged by the flow value. When the flow of one Condensate Polisher Mixed Bed under service is less than that of the other, it indicates that pressure differential inside the Condensate Polisher Mixed Bed with small flow is high and the resin inside it shall be regenerated.

5.07.00 The Bidder shall provide all instrumentations and controls to analyze the condensate as per the requirements for safe and satisfactory operation of boiler. The system should be capable of producing the output characteristics which will be better than or equal to the specified conditions as prescribed by the Boiler Manufacturer or as specified elsewhere in this document whichever

is more stringent. The system should be also capable of monitoring and maintaining the characteristics during unit start up, load variations and condenser tube leakage.

5.08.00 The minimum design concentrations of various contaminants envisaged to be present in the condensate at inlet of CP System, shall be considered as per Annexure – I.

5.09.00 The CP System shall be designed to deliver the treated condensate as per the requirements of Annexure – II or as recommended by the Boiler manufacturer whichever are more stringent.

5.10.00 CP System shall operate in hydrogen cycle. The volume ratio of cation resin to anion resin shall be 2: 1. A minimum total bed depth of 1100 mm for resins is envisaged for each Condensate Polisher Vessel.

Under the normal conditions of operation as addressed above, the continuous service period between two successive regenerations is envisaged to be not less than 240 hours of continuous operation.

Continuous service period between two successive regenerations in course of Start Up as well as Condenser Tube Leakage shall be not less than 48 hours.

5.11.00 ~~The bed cross section shall be such that the average velocity of condensate through it does not exceed 120 m/hour at the design flow rate.~~

5.12.00 At the design flow rate, the pressure drop between inlet and outlet flanges of the Condensate Polisher Mixed Beds 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 about 3.5 bar including the pressure drop across effluent resin traps.

5.13.00 Exchange Resins

The Bidder shall provide suitable resins for the Condensate Polisher Mixed Beds, Mixed Resin Storage Vessel and Resin Makeup Hopper.

The cation resin shall be strong acid, with sulfonic acid functional group to the regenerated with Hydrochloric Acid.

The anion resin shall be strong base, with quaternary ammonium (Type-I) functional group to be regenerated with Sodium Hydroxide.

Insert resin, if used, shall be non-ionic compatible with the above resins.

After separation, anion resin in the cation resin shall be less than 0.1 % and cation resin in the anion resin shall be less than 0.1 %.

Deration factor of 10% for all resins shall be considered while calculating the quantity of resin to be supplied.

The resin strength and other physical properties shall be suitable to withstand the design pressures in the system.

The resins selected must have been in use in Condensate Polishing Systems capable of producing water as specified or better, for a period of not less than three (3) years.

The resin charge shall consist of material properly selected, washed, processed and graded to provide the guaranteed capacity and life. The resin shall have adequate abrasion resistance during its guaranteed life.

Cation resins shall be regenerated by dilution of technical grade hydrochloric acid (concentration 30-33%) and anion resins by dilution of sodium hydroxide, rayon grade available as (concentration 40-48%) lye. For calculations regeneration temperature should be taken as 25°C.

5.14.00 It is proposed that the external regeneration facility be common to each Condensate Polisher Vessel and shall be located in the vicinity of Power House.

The regeneration process offered by the Bidder, shall be of proven design and shall essentially be the same process for which the Bidder have experience and shall give proper resin separation compatible with the desired treated water quality. The Bidder shall include inert resin in the system if it is felt that it helps in better resin separation.

In case, after separation of resins, if there are undesired contaminant resins, the Bidder shall provide a system either to eliminate this cross contamination of resins or to nullify the detrimental effect of entrapped resins to the effluent quality.

The guaranteed chemical consumption figures must be supported by relevant published data such as performance of the resin system, statistical data on resin losses and actual field performances of Systems using a similar technique, indicating the quantity of chemicals required for regeneration, in particular, besides other parameters. The data on the chemical consumption figures and the calculations furnished by the Bidder shall be the primary basis of checking the guaranteed parameters during evaluation. The operating exchange capacity and regeneration levels shall be vetted by resin manufacturer and the Bidder must furnish the resin performance curves specially applicable for this project.

5.15.00 The minimum free board in various vessels are to be as follows:

a)	Mixed Bed Polisher	Not less than 100%
b)	Resin separation vessel	Not less than 80%
c)	Anion regeneration vessel	Not less than 100%
d)	Cation regeneration cum Mixed resin storage vessel	Not less than 100%

5.16.00 The common influent and effluent header of Condensate Polisher Mixed Beds will be connected to an automatic bypass line to be provided. This bypass line shall include a differential pressure device which on a high signal will cause an automatic valve to open, bypassing the Condensate Polisher Mixed Beds. Automatic bypass line shall be provided with a butterfly type control valve and wafer type butterfly isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve. In the event of excessive pressure differential between the condensate inlet and outlet headers, this control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when both Beds/one Bed/no Bed are/is in operation.

5.17.00 The control system shall be so designed that the Control valve is able to bypass 33 (1/3) % flow when any of the Condensate Polisher Mixed Beds is out of service and 100% of flow when all the Condensate Polisher Mixed Beds are out of service.

5.18.00 Under normal conditions, Condensate Polisher Mixed Bed will hold a complete charge of freshly regenerated and mixed resin, ready for use. For regeneration, resin from the exhausted Condensate Polisher Mixed Bed will be transferred hydraulically. The empty Condensate Polisher Mixed Bed will then be filled up with already regenerated resin available in the regeneration facility. This Condensate Polisher Mixed Bed shall come into service soon after prerequisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use.

5.19.00 The Bidder shall provide a hopper type tank for resin make-up, using water slurry, to the condensate polishing systems. This make-up system will constitute a portion of the condensate polishing external regeneration system. The resin hopper shall have a conical bottom and a flat top. The top shall have hinged port, having a lifting handle of sufficient size for easy resin loading. The resin shall discharge through a bottom connection to a water ejector for transport. Water shall be added to the hopper to assist in the resin transfer. The ejector discharge shall be led to the resin regeneration vessels. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be under the scope of the Bidder as a part of the external resin regeneration system.

5.20.00 Each Condensate Polisher Mixed Bed shall be provided with resin trap on effluent line. The resin trap in these lines shall be flanged at one end and will be connected at the end of the respective pipeline. The other end shall be open to the drain so that the flow can be seen to check the choking of the trap.

5.21.00 All nuts, bolts etc. in submerged and corrosive application shall be of SS-316.

5.22.00 Rubbers used for rubber lining of equipment and piping shall be of natural rubber with shore hardness 65 ± 5° in Scale-A.

5.23.00 Further specific salient design features of major equipment and accessories have been furnished under Annexure- I to III.

5.24.00 In addition to above, required general technical features for Pressure Vessels, Storage Vessels, Piping, Fittings, Valves, Miscellaneous Pumps, Protective Lining, Painting, Mechanical Erection, Testing and Commissioning have been addressed under Sections VI to XIII as attached elsewhere in Volume III-C of this EPC Bid Document.

5.25.00 The Condensate Polisher Vessels along with Air Blowers are located indoor at ground floor of the Power House.

Resin Separation Vessel, Anion Resin Regeneration Vessel, Cation Regeneration Vessel / Mixed Resin Storage Vessel, Resin Hopper, Air Blowers, Acid Measuring Tank, Alkali Measuring Tank and Hot Water Tank are located indoor in the vicinity Power House Area.

Resin Transfer Pumps cum Regeneration Water Pumps are located outdoor in Demineralized Water System area.

6.00.00 OPERATION AND CONTROL PHILOSOPHY

6.01.00 The operation CP System shall be semi-automatic through plant DDCMIS, except addressed otherwise. There shall be provision for remote manual operation also.

6.02.00 The CP System, shall be operated for service and resin transfer from concerned Service Area - Equipment Control centre (ECC) to be located indoor in the vicinity of Condensate Polisher Vessels.

Operation from this ECC can only be undertaken under authorization from Regeneration Area – ECC addressed hereinafter.

The regeneration of ion-exchange resins of CP System shall be carried out from Regeneration Area - ECC to be located in the vicinity of Power House area.

Remote Terminal Unit (RTU) as an extended node of DDCMIS shall be considered in the vicinity of the CPU regeneration area along with a dedicated work station for control and monitoring of the Regeneration System.

6.03.00 The Control System shall provide safe operation of CP System and provide all necessary protections and interlocks to prevent mal-functions of different equipment/drives and to ensure long term unattended safe and reliable operation.

6.04.00 The remote operation of all pumps, blowers and agitators shall be made through DDCMIS workstation.

Further to above, all drive motors shall have the facility of local Start/Stop. Local starting shall be possible through local / remote selector switch to be located in MCC. Tripping of drive motors shall be permissible by local lockable stop irrespective of local / remote selector switch position.

6.05.00 The salient features of operation of CP SYSTEM in different modes are as follows:

In the AUTO MODE, the state of Service, Resin Transfer or Regeneration shall be initiated by the operator and all subsequent steps in the sequence shall proceed in automatic manner. The system shall be based on sequential operation of various equipment such as valves, pumps, etc.

In the REMOTE MANUAL MODE, the operator has to initiate each step or sequence of regeneration.

6.06.00 The control of the CP System i.e. service and standby status of Polisher Vessels as well as Resin Transfer from Condensate Polisher Mixed Beds to Regeneration Area and vice versa will be achieved through the DDCMIS. DDCMIS shall show the operating mode of each Condensate Polisher Mixed Bed (in service, on standby, resin transfer, rinsing down etc.) the position of all automatic valves, operating parameters (such as flow, conductivity, silica levels, differential pressure etc.) and alarm conditions.
Condensate Polisher Mixed Bed Operation

Service flow rate for each Condensate Polisher Mixed Bed shall be monitored. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence. A differential pressure transmitter installed between the influent and effluent headers on a high signal will cause an annunciation alarm. By observing the individual vessel flow indications, or conductivity at vessel

outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of resin cleaning/regeneration.

Conductivity analyser shall monitor the polishing system influent and effluent streams as well as the discharge of each Condensate Polisher Mixed Bed. A high influent conductivity annunciation alarm will alert the System operator that a problem condition such as air or condenser cooling water leakage has occurred. This conductivity analyser shall also provide contacts for an alarm at the DDCMIS. A high conductivity annunciation alarm on outlet of Condensate Polisher Mixed Bed will alert the operator to the need for regeneration of a Condensate Polisher Mixed Bed.

Condensate Polisher Mixed Bed shall be automatically placed in service following manual pushbutton initiation from the control panel. The automatic sequence shall include steps for pressurisation of the Condensate Polisher Mixed Bed, a pre-service rinse and placing in service.

The pre-service rinse shall be time controlled. If the conductivity of the Condensate Polisher Mixed Bed effluent is not acceptable at the end of the pre-service rinse, a rinse overtime alarm shall be sounded and the pre-service rinse continued for a second timed period. If an acceptable Condensate Polisher Mixed Bed effluent is not reached by the end of the second pre-service rinse, a pre-service rinse failure alarm shall be sounded and the vessel shall be automatically returned to standby. If acceptable conductivity at outlet of Condensate Polisher Mixed Bed is attained at the end of the first rinse or during the second rinse, the vessel shall automatically be placed in service. Interlocks shall be provided to prevent placing a vessel into the service mode while resin is being transferred.

The rinse recycle shall be manually initiated full automatic sequence. This sequence shall include a rinse down step using condensate at a suitable rate until effluent quality is acceptable for boiler feed water. The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is for recycle. Conductivity parameter shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

Condensate Polisher Mixed Beds shall be automatically removed from service following manual push button initiation from the DDCMIS work station.

Exhaustion of a Condensate Polisher Mixed Bed shall be annunciated by any of the following:

a) High differential pressure across the polisher battery.

b) High effluent conductivity from an operating vessel.

c) High effluent silica from an operating vessel.

d) Pre-set volume of condensate treated in an operating vessel.

When the differential pressure across the Condensate Polisher Mixed Bed header reaches the high set point level an alarm shall sound and by pass valve shall be automatically opened by a signal from the control system.

The alarms for a Condensate Polisher Mixed Bed shall be disabled when the Condensate Polisher Mixed Bed is not in service or pre-service rinse.

Resin Transfer Mode

Resin transfer from a Condensate Polisher Mixed Bed to the regeneration vessel shall be automatic from DDCMIS following manual pushbutton initiation from the DDCMIS work station.

Manually initiated automatic sequences shall be provided for transferring resin from a Condensate Polisher Mixed Bed to the remote regeneration facility for physical cleaning and chemical regeneration and for returning fresh resin to that Condensate Polisher Mixed Bed.

The transfer of resin from the Condensate Polisher Mixed Bed shall include isolation of the Condensate Polisher Mixed Bed, hydraulic transfer of the resin to the Regeneration Area.

The return of fresh resin to the empty Condensate Polisher Mixed Bed shall include the hydraulic transfer from the resin separation vessel of the external regeneration system using demineralized water. After receiving fresh resin the Condensate Polisher Mixed Bed will remain in the 'Off' position until returned to service by the operator.

The resin transfer sequence shall be interlocked to prevent resin transfer in any of the following situations:

a) Unsuccessful completion of a previous chemical regeneration of physical cleaning sequence in the external regeneration system.

b) The Condensate Polisher Mixed Bed condensate inlet and outlet valves not closed.

c) High pressure in the polisher Condensate Polisher Mixed Bed.

6.07.00 The control for the external regeneration system shall be from the Operation workstation with DDCMIS RTU located in a separate Control Room at Regeneration Area. This shall clearly show the status of each concerned Condensate Polisher Mixed Bed. This Console will provide a manually initiated automatic sequence for physical cleaning and chemical regeneration of the resins and show the status of the cycle at all times. This shall also provide all controls and operation facilities for the acid and alkali solution preparation and dosing system. The Regeneration Area Operation Console shall also control the sequences of Resin Transfer – i.e. to transfer resin from the Condensate Polisher Mixed Bed to the external regeneration facility and to receive freshly regenerated resin from the regeneration facility– this

involves depressurisation of the Condensate Polisher Mixed Bed, water sluicing of exhausted resins to the regeneration system, draining the Condensate Polisher Mixed Bed to the condenser hotwell, receiving a water slurry of fresh resin from the regeneration system and finally completely filling the vessel with condensate.

7.00.00 QUALITY CONTROL & SURVEILLANCE

The System / equipment to be supplied under this specification shall have assured quality and workmanship. In the proposal, the Bidder shall submit the Quality Assurance Plan containing quality assurance programme and quality assurance documents for Purchaser's approval. The Bidder shall be bound to conduct all stage inspections on various equipment / material during manufacturing process in accordance with the approved copy of this document. Purchaser shall have the right to carry out Quality Audit and Quality Surveillance by witnessing any or all such tests to be carried out at Bidder's / Sub-Bidder's works as and when desired. The procedure applicable to Bidder's works will also apply to the works of his sub-Bidders. For items coming under the purview of any Statutory Regulation during the course of manufacture, all stage inspections and tests shall be witnessed by an inspecting authority recognized under the statutory regulation. All unpriced copies of Bids of all major bought-out items giving technical details shall be sent to Purchaser for approval prior to placement of orders on sub-vendors.

These audit/surveillance/approvals shall however, do not relieve the manufacturer / sub-vendors of their responsibility of the Quality Assurance of their product and overall guarantee and responsibility shall wholly be confined on the Bidder.

Tests/inspections shall be carried out during and after the completion of manufacture of different components and assembly as applicable in accordance with relevant codes and standards. Test Certificates for all such tests/inspections shall be made available to the Purchaser for approval.

Purchaser or his authorised representative shall have his full access to witness any or all tests/inspections to be carried out at manufacturer's shop. In case, the job is sub-contracted, it will be Bidder's responsibility to make all arrangements so that Purchaser or his authorised representative can attend such tests at Sub-Bidder's premises. Inspection (including interstage inspection) and other tests shall be done as per Approved Quality Plan.

After erection at site, Condensate Polishing System shall be operated for a period of at least two (2) weeks to prove satisfactory, performance and guarantee data.

8.00.00 INSPECTION, TESTING, COMMISSIONING AND PERFORMANCE GUARANTEE TESTS

The equipment, parts and materials shall be tested and inspected, but not limited to the following

8.01.00 Shop Tests

Shop tests shall include all tests to be carried out at Bidder's works, works of their sub-vendors and at works where materials to be used for fabrication of equipment are manufactured. The tests to be carried out shall include but not be limited to the following:

a) Composition of all material, castings, forgings, etc.

b) Hydraulic tests for pressure vessels, pipes, valves, pump casing etc.

c) Tests to check faults in protective lining and painting.

d) Static balancing test for agitators, stirrers, paddles etc.

e) Static and dynamic balancing tests on all impellers.

f) Performance tests (Head, Capacity and Power) for each of pumps and blowers.

g) All tests with reference to instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

h) All tests with reference to electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

8.02.00 Tests before Trial Run

Bidder shall carry out tests at site to prove to the Purchaser that individual equipment of all the System complies with the requirements stipulated and is erected in accordance with requirements specified. Before the System is put on trial run, the Bidder will be required to conduct tests to demonstrate to the Purchaser that each individual item is capable of correctly performing the functions for which it has been designed for. These tests may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows:

a) The tests to be carried out for the fabricated storage vessels shall include:

i. During fabrication and before lining:

a) Bottom testing for leakage by soap solution, after the bottom and at least the bottom course of the shell plate have been welded.

b) Hydraulic shell testing for leakage.

c) Fixed roof test for leakage by soap solution.

ii. After lining:

Water leakage test for storage tank shall be carried out by filling it with water up to the overflow level.

b) All piping and valves, after installation, will be tested hydrostatically at one and half times of the maximum attainable pressure in the system to check against leak tightness.

c) All valves/isolation gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.

d) Each of all pumps and blowers shall be run with the specified fluid from shut off condition to valve wide-open condition. Head developed will be checked from the discharge pressure gauge reading. Capacity may be checked from flow indicator where available. Otherwise capacity shall be checked from the volume of fluid handled (determined from level indicator reading of concerned tank) wherever applicable and duration of test.

e) Each of pumps and blowers shall be tested at site to run smoothly without undue vibration, flow pulsation, temperature rise in bearing parts, noise etc.

f) Each of all the agitators and other rotating/moving devices shall be run at the rated speed with water/chemicals up to the normal water level for a period of twenty four (24) hours. During this period all the components shall function smoothly without any unbalance, vibration, overheating at bearing parts etc.

g) All the rubber lining are to be subjected to the following tests as per relevant code:

i. Adhesion test

ii. Resistance to bleeding

iii. Thickness measurement

iv. Shore hardness

v. High voltage spark test

h) Epoxy painting shall be checked by dry type thickness gauge.

i) All monorail hoists shall be subjected to full working load during all motions without showing any sign of defect.

j) Visual check on all structural components, welding, painting etc.

i) All tests with reference to instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

j) All tests with reference to electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

8.03.00 **Performance Guarantee Test Procedure**

a) The duration of the test shall not be less than 72 hours on continuous basis. These tests will be carried out within a reasonable period from the date of commissioning of the plant. The tests shall be conducted by the Bidder to prove beyond doubt the guaranteed performance of the plant to the satisfaction of the Purchaser.

b) The test procedures shall be as per applicable Indian Standards. Where Indian Standard is not available or applicable, the test procedures shall be as per standards from recognized origins. The test procedures shall be furnished for review and approval by Purchaser.

c) Necessary pumps shall be started and flow shall be established through all the streams. Valves be adjusted so as to have equal and rated distribution of flow through all the streams.

d) One (1) Condensate Polisher Mixed Bed shall be taken under service. Samples of water will be drawn every hour from the outlet and then tested in the laboratory. The results shall be compared against the required parameters stipulated elsewhere under this specification.

e) Exhaustion of each Condensate Polisher Mixed Bed shall be indicated by the features addressed under 'Operation and Control Philosophy'. The resins of Condensate Polisher Mixed Bed shall then be backwashed / regenerated at the specified regeneration level. Total amount of chemicals required for regeneration and the duration of chemical injection /regeneration shall be noted against the guaranteed figures.

f) The regenerated Condensate Polisher Mixed Bed shall be again put into service and tests addressed above will be continued. At the end of run, total amount of water treated will be noted from the flow integrators.

g) Inlet water analysis is determined by making arithmetic average of all hourly readings of feed water taken during the test.

h) Based on this inlet water analysis, design exchange capacity of resins and resin volume provided, the capacity of each Condensate Polisher Mixed Bed in terms of total volume of treated water (m^3) between two (2) successive regenerations shall be calculated. Resin volume shall not include the buffer and inert layers provided. The calculation shall be

approved by the Purchaser / Engineer.

i) Quantity of treated water as determined by tests as in above shall be checked against calculated quantity of treated water during regeneration as in above and must be equal to or more than the calculated amount.

j) All the above mentioned tests shall be separately done for each of the Condensate Polisher Mixed Beds of the complete Condensate Polishing System.

8.04.00 **Performance Guarantee parameters**

a) Each pump shall be guaranteed for capacity, total dynamic head and power consumption.

b) All blowers shall be guaranteed for head and power consumption.

c) Condensate Polisher Mixed Beds

i) 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.

ii) 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 Annexure-I. 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.

iii) 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.

iv) Qualities of treated water from Condensate Polisher Mixed Bed shall be as per treated water analysis as exhibited in Annexure-II.

9.00.00 **BID EVALUATION CRITERIA**

With reference to Bid Evaluation Criteria, Bidder may please refer to Lead Specification - Volume I of this EPC Bid Document.

10.00.00 PERFORMANCE GUARANTEE TOLERANCE AND PENALTY

10.01.00 Liquidated Damages (LD) for Additional Power Consumption

With reference to Additional Power Consumption, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.

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

The performance Guarantee parameters for Condensate Polishing System have been indicated elsewhere in this specification.

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 within three months period from the date of conducting PG test. 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.

10.03.00 **LIQUIDATED DAMAGES FOR DELAY IN DELIVERY & COMMISSIONING**

With reference to Liquidated Damages for Delay in Delivery & Commissioning, Bidder may please refer to Conditions of Contract - Volume I of this Bid Document.

11.00.00 **SPARES**

With reference to Spares, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.

12.00.00 **TOOLS & TACKLES**

With reference to Tools and Tackles, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.

13.00.00 **DRAWINGS / DOCUMENTS TO BE FURNISHED BY THE BIDDER**

The Bidder's formal proposal must be accompanied by the following Documents/Drawings/Information:

13.01.00 All the details as addressed under Bid Proposal Sheets under Volume-III of the EPC Bid Document.

13.02.00 Process and Instrumentation Diagram for the complete system.

13.03.00 Dimensional General Arrangement Drawing for the complete system.

13.04.00 Electrical Load List for the complete system.

13.05.00 Schedule of terminal points and their characteristics.

13.06.00 Quality assurance plan.

13.07.00 Requirement of construction power & water with the required characteristics, quantum etc.

13.08.00 Experience list addressing the details complete with the locations where Bidder have supplied and commissioned similar systems for similar application under similar duty conditions as specified under this EPC Bid Document.

13.09.00 List of imported items, if any.

13.10.00 List of proposed Sub-Vendors.

13.11.00 In case Bidder is offering equipment/plant/test procedures as per International Standards not mentioned specifically in the Bid Documents, he should furnish at least three (3) copies of English Version of the same along with the offer, for consideration.

13.12.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

13.13.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

13.14.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume – VII/C of this Bid Document.

13.15.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume IIID of this Bid Document.

14.00.00 DRAWINGS / DOCUMENTS TO BE FURNISHED AFTER AWARD OF CONTRACT

The Bidder need to comply with all Documents/Drawings/Information already furnished in their Bid and subsequent correspondences/clarifications if any till the date of issue of notice of award of Contract. Revision of any data must meet the approval of the Purchaser.

Requirements of Documents/Drawings/Information (not limited to) from the successful Bidder after finalization of contract in respect of individual equipment

as well as the complete system covered under the specification are furnished below:

Requirements of Documents/Drawings/Information under **'Approval'** category

14.01.00 Process Design Calculations, Mechanical Design Calculations (Sizing Calculations for each equipment, miscellaneous Hydraulic Calculations, miscellaneous Pressure Drop Calculations, miscellaneous Thickness Calculations, etc).

14.02.00 Process and Instrumentation Diagram for the entire system complete with all kinds of details.

14.03.00 Dimensional General Arrangement Drawing for the entire system complete with all kinds of applicable details.

14.04.00 Dimensional General Arrangement and Cross Sectional Drawing for each of all major equipment and each of all buildings complete with all kinds of applicable details.

14.05.00 Indoor and Outdoor Piping Layout with suitable sectional views for the complete system.

14.06.00 Procedures for Performance Guarantee Tests.

14.07.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

14.08.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

14.09.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume – VII/C of this Bid Document.

14.10.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.

Requirements of Documents/Drawings/Information under '**Information**' Category

14.11.00 Pipe Schedule for the complete system.

14.12.00 Valve Schedule for the complete system.

14.13.00 Isometric Piping Drawings the complete system.

14.14.00 Data Sheets, Dimensional General Arrangement and Cross Sectional Drawing

for each of pumps, blowers, agitators, valves, isolation gates, monorail hoists, etc.

14.15.00 Following test certificates/test curves/data shall be furnished :

a) Material test certificates.

b) Performance tests results and characteristics curves of pumps, fans and electric drive motors.

c) Hydraulic test results of pressure vessels, pipes, valves, fittings, etc.

d) Test results to anticorrosive coatings.

e) Nondestructive test results as applicable.

14.16.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

14.17.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

14.18.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume – VII/C of this Bid Document.

14.19.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.

The Bidder shall submit a complete list of documents and drawings along with the category for review/approval by Purchaser.

Before manufacturing of the equipment, the Bidder shall have to take approval of the relevant design calculations/drawings from the Purchaser. Any manufacturing done prior to approval of the of the relevant design calculations/drawing shall be at risk of the Bidder and in case of any discrepancy with reference to approved design calculations/drawings rectification shall be made by the Bidder at their own cost without any violation of delivery schedule.

It is to be noted by the Bidder that approval or release of Documents / Drawings by Purchaser does not include the checking for drafting and other errors, but only review of basic concepts and general principles involved. Approval does not relieve the Bidder from responsibility for correctness of design, details and dimensions.

15. 00.00 DEVIATION

15. 01.00 Should the Bidder opt to deviate from this specification in anyway, specific notice to such deviation shall be drawn by the Bidder.

15. 02.00 All such deviations along with reference clauses of the specification shall be clearly mentioned on the deviation sheet(s) as addressed under Bid Proposal Sheets under Schedule IX-B of Volume-IX. The deviation listed elsewhere in the text of the Bid will not be considered by the Purchaser.

15. 03.00 Unless the deviations are addressed in the deviation sheet(s) and submitted with Bid, it will be taken for granted that the Bid is in conformity with this specification in all respects.

ANNEXURE–I
DESIGN ANALYSIS OF CRUDE CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition
Ammonia	ppb	250	1500
Copper	ppb	5	5
Total Ferrous Iron	ppb	50	1000
pH value (polisher runs at 25^0C with H / OH mode)	ppb	8.5-9.0	9.0-9.6
Chloride (as Cl)	ppb	20	100
Sodium (as Na)	ppb	10	20
Silica (as SiO_2)	ppb	30	500
Crud (mostly black oxide of iron)	ppb	50	1000

NOTE:

Under condenser tube leak condition, the CP System shall be designed for ingress of 2000 ppb TDS in addition to the influent contaminants under Normal Condition as stated above. The cation and anion load distribution for 2000 ppb TDS shall be based on cooling water composition.

ANNEXURE–II
DESIGN ANALYSIS OF TREATED CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition	Tube Leakage Condition
Total Dissolved Solids (ammonia excluded)	ppb	Less than 25	Less than 50	
Ammonia	ppb	Below detectable limit	Below detectable limit	
Silica (as SiO_2)	ppb	Less than 5	Less than 20	Less than 20
Total Ferric Iron	ppb	Less than 2	Less than 10	
Total Copper	ppb	Less than 1	Less than 1	
pH value (runs in H/OH mode)	ppb	6.5 - 7.5	6.5 - 7.5	
Electric Conductivity after hydrogen column (25^0C)	μS/cm	Less than 0.1	Less than 0.2	
Chloride (as Cl)	ppb	Less than 2	Less than 10	
Sodium (as Na)	ppb	Less than 2	Less than 5	Less than 20
Crud (mostly black oxide of iron)	ppb	Less than 5	Less than 100	

ANNEXURE–III
MAJOR EQUIPMENT AND ACCESSORIES FOR CONDENSATE POLISHING SYSTEM

1.0 0.00 CONDENSATE POLISHER MIXED BEDS	
Number of unit	Four (4) [4 x 33(1/3) % for 800 MW Unit]
Description of each unit	
Design flow per unit (Net), m^3/hr	Not less than 33(1/3) % of total condensate at VWO condition of turbine with suitable bypass arrangement plus maximum heat cycle make-up for 800 MW Unit
Design continuous service period between two successive regenerations under different conditions, hrs	As per Tender Specification
Treated water quality	As per Tender Specification
Media inside the vessel	Strongly acidic high capacity polystyrene resin and Type-I strongly basic high capacity.
Percentage deration to be considered on design exchange capacity for design of the system	Minimum 10 %
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Regenerant Chemical	Dilute Hydrochloric Acid and Dilute Sodium Hydroxide
Design flow velocity, m/hr	Not more than 120
Design Temperature	60^0C
Design Pressure	Design pressure should be the maximum expected pressure to which the vessels 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
2.00.00 RESIN SEPARATION VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit

Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 80%
Design Temperature	60^0C
Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
3.00.00 ANION RESIN REGENERATION VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Design Temperature	60^0C
Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
4.00.00 CATION RESIN REGENERATION / MIXED RESIN STORAGE VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Design Temperature	60^0C

Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
5.00.0 NEUTRALISATION PIT	
Number required	One (1) no. Pit with two (2) compartments for 1x800 MW Unit
Type	Necessary air grid arrangement of polypropylene construction shall be provided in each compartment for effective neutralization of the waste effluent.
Effective Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of a Condensate Polisher Mixed Bed plus 20% overall margin.
MOC	RCC. minimum Inside lined with PVC sheet (3 mm thick).

6.00.00 MISCELLANEOUS TANKS FOR ACID

	Hydrochloric Acid Storage Tank	Hydrochloric Acid Measuring Tank for Condensate Polisher Mixed Bed	Acid Measuring Tank for Neutralization Pit
Number required	One (1)	One (1)	One (1)
Description (for each Unit)			
Type	Horizontal cylindrical with dished ends, over-ground	Vertical cylindrical with flat bottom, over-ground	Vertical cylindrical with flat bottom, over-ground
Type of fluid to be handled	30 - 33 % Hydrochloric Acid	30 - 33 % Hydrochloric Acid	30 - 33 % Hydrochloric Acid
Effective Capacity of each Tank	Adequate to hold the quantity of acid required for thirty(30) days of operation.	Adequate to hold the quantity of acid required for single regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.	Adequate to hold the quantity of acid required for neutralization of excess alkali in waste effluent due to single

			regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.
MOC	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. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].

7.00.00 MISCELLANEOUS TANKS FOR ALAKLI			
	Alkali Storage Tank	Alkali Measuring Tank for MB	Alkali Measuring Tank for Neutralization Pit
Number required	One (1)	One (1)	One (1)
Description (for each Unit)			
Type	Horizontal cylindrical with dished ends, over-ground	Vertical cylindrical with flat bottom, over-ground	Vertical cylindrical with flat bottom, over-ground
Type of fluid to be handled	48 - 48 % Sodium Hydroxide	48 - 48 % Sodium Hydroxide	48 - 48 % Sodium Hydroxide
Effective Capacity of each Tank	Adequate to hold the quantity of alkali required for thirty(30) days of operation.	Adequate to hold the quantity of alkali required for single regeneration of one(1) no. MB Unit with 20% overall margin.	Adequate to hold the quantity of alkali required for neutralization of excess acid in waste effluent due due to single regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.
MOC	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. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].