BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION

For

MIXED BED SYSTEM

MAITREE - 2 x 660 MW
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1.0 SCOPE OF SUPPLY

1.1 The intent of this specification is to cover Design, Engineering, Manufacturing, shop testing, supply, Technical advisory services for Erection supervision, Commissioning assistance and support for Performance guarantee test of following systems

- De-gasser System
- Mixed Bed (MB) System.

The scope shall fully cover the requirement of the Design Criteria and Technical requirement of this specification for treating the permeate water from two stage Reverse Osmosis (RO) Desalination Plant to meet the boiler makeup water quality requirement. The scope shall include but not limited to the following.

a) (1W + 1S) MSRL Degasser tower with internals & accessories
b) (1W + 1S) Degasser blower with motor assembly and air filter box (suction) & accessories with interconnecting piping / ducts and inlet & outlet controls from blower to degasser tower.

c) (2W + 1S) Mixed Bed Unit along with internals & all accessories
d) Cation resin for all the three Mixed Bed units
e) Anion resin for all the three Mixed Bed units
f) Inert resin for all the three Mixed Bed units
g) (2W + 1S) Mixed Bed feed pumps with motors and all accessories.
h) (1W + 1S) MB regeneration Pumps with motors and all accessories
i) (1W + 1S) MB Blower with motor assembly, air connection pipes, valves and all accessories for MB regeneration
j) (1W + 1S) Acid Measuring Tanks (AMT) with ejector, fume absorber & other accessories
k) (1W + 1S) Caustic Dilution Tanks (CDT) with agitator, ejector & other accessories
l) 3 Sets of MB frontal piping (MSRL construction) along with pneumatic operated diaphragm valves with a provision for flow regulation, resin traps at appropriate locations and pipe supports.
m) All type of valves required for the entire mixed bed system (2W + 1S) as per P&ID are in bidder scope.
n) 1 set of inter connecting piping between all equipment for the entire system including valves and accessories for auto operation of the plant as per P&ID

o) Solenoid valve enclosure boxes required for pneumatic operated diaphragm valves for the complete MB system as per ROS: 4191 are in bidder’s scope.
p) Necessary foundation bolts for all the equipment

q) 1 set of miscellaneous items including fasteners, gaskets, ladders, common platforms, supports for piping & valves

r) (2 x 15 Cum) Bulk Acid storage tank with fume absorber, interconnecting piping, valves, ladder, common platform, handrails, etc.

s) (2 x 10 Cum) Bulk Alkali storage tank with CO₂ absorber, interconnecting piping, valves, ladder, platform, handrails, etc.

t) (1W + 1S) Acid unloading pumps with motor assembly & all accessories

u) (1W + 1S) Alkali unloading pumps with motor assembly & all accessories

v) (2 x 3 Cum) Bulk NaOCl storage tank, interconnecting piping, valves, ladder, platform, handrails, etc.

w) (1W + 1S) NaOCl unloading pump with motor assembly & all accessories

x) (1W + 1S) CIP N pit disposal pump with motor assembly & all accessories

y) (1W + 1S) N pit disposal pump with motor assembly & all accessories

z) 1 set of Commissioning spares

aa) 1 set of Mandatory spares (Initial spares)

bb) 1 set of recommended spares for 3 years O & M (optional).

1.2 Following Technical information are to be provided by the vendor in order to complete the MB system in all respects.

a) List of instruments required for complete automation of the MB system.

b) Necessary tapings (Preferably 1” ANSI B 16.5 150#) with flange end connections are to be provided in the pipe line at appropriate location for connecting the online instruments (viz, Pressure indicator, pressure transmitters, DP transmitter, flow indicator, sampling point for silica analyzer, conductivity analyzer, etc.)

c) Necessary tapings (as indicated in respective tanks) with flange end connections are to be provided in the process tanks at appropriate location for connecting the level instruments (viz, Level indicator, Level transmitter etc.)

Following scope of supply / work shall be taken care by BHEL.

a) Requirement of Cables, LTMCC, DCS & Instruments etc.

b) All civil works Viz, Equipment foundations, trenches, construction of RCC tanks, etc.

c) Erection, commissioning & trial operation of Mixed Bed system including MB regeneration system.

1.3 Items though not mentioned but needed to make the system complete in all respect as stipulated under these specifications are also to be supplied unless otherwise specifically excluded.
1.4 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 / Owner, 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.

1.5 All fasteners are to be of SS 316 only, which shall consist of two washers, stud / bolt with suitable nut (except foundation bolts)

1.6 Resin supply packing shall be made in drums only. Resin supply by any other means is not acceptable.

1.7 The order of priority of this specification is as follows:
   a) Specifications
   b) P&ID drawing and Layout drawing
   c) General design requirements

1.8 Bidder shall submit their total detailed shipping list and Quality Plan for BHEL approval well in advance for dispatch clearance. Material should not be dispatched without BHEL clearance. The seaworthy packing instructions are enclosed as Annexure-A (53 pages). Bidder shall use the instructions as applicable for the items and dispatch accordingly

1.9 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.

2.0 General terms & conditions, instructions to the tenderer & other attachments referred to elsewhere are also part of this specification.

2.1 The frontal piping for MB vessels shall be trial assembled at bidder's works prior to despatch to site. The pipes & fittings have to be match marked and sent to site.

2.0 PROJECT INFORMATION
1. Owner : Bangladesh India Friendship Power Company Limited
   Bangladesh
2. Project Title : Maitree 2 x 660 MW STPP
3. Location : Khulna Dist., Bangladesh

3.0 TECHNICAL REQUIREMENT
3.1 MB PLANT CAPACITY
MB unit shall be capable of producing Boiler Make-up water of required quality using design inlet water quality, specified in this specification, with the output capacity of 67 cu.m/hr per each stream on continuous operation basis. The output between regeneration (OBR) continuous operation basis shall be 3120 cum in 2 days (48 hrs.) for each stream.
   a. No of streams of the MB system = 2W + 1S
   b. Output capacity of MB system per Stream = 67 cu.m / hr
      (ie. Each mixed bed unit)
c. Output between regeneration of MB system = 3120 cu.m per stream (le. Each mixed bed unit) excluding regeneration requirement

d. Output capacity of MB system with two stream = 134 cu.m / hr

3.2 INLET WATER QUALITY FOR DESIGN OF MB SYSTEM

The inlet water quality to be considered for design of MB system is 2nd pass RO permeate and the analysis is indicated below.

### WATER QUALITY EXPECTED AT DEGASSER INLET

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Parameters</th>
<th>Unit</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td></td>
<td>4.5 - 5.5</td>
</tr>
<tr>
<td>2</td>
<td>TDS</td>
<td>ppm</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Temperature - Min &amp; Max</td>
<td>deg C</td>
<td>20-34</td>
</tr>
<tr>
<td>4</td>
<td>Carbon di Oxide as CO2 - Design</td>
<td>ppm</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>SiO2 as SiO2</td>
<td>ppm</td>
<td>0.4</td>
</tr>
<tr>
<td>6</td>
<td>Sodium as Na</td>
<td>ppm</td>
<td>6.3</td>
</tr>
<tr>
<td>7</td>
<td>Potassium as K</td>
<td>ppm</td>
<td>0.4</td>
</tr>
<tr>
<td>8</td>
<td>Calcium as Ca</td>
<td>ppm</td>
<td>0.2</td>
</tr>
<tr>
<td>9</td>
<td>Magnesium as Mg</td>
<td>ppm</td>
<td>0.4</td>
</tr>
<tr>
<td>10</td>
<td>Bicarbonate as HCO3</td>
<td>ppm</td>
<td>1.0</td>
</tr>
<tr>
<td>11</td>
<td>Chloride as Cl</td>
<td>ppm</td>
<td>10.6</td>
</tr>
<tr>
<td>12</td>
<td>Sulphate as SO4</td>
<td>ppm</td>
<td>0.5</td>
</tr>
<tr>
<td>13</td>
<td>Nitrate as NO3</td>
<td>ppm</td>
<td>0.2</td>
</tr>
<tr>
<td>14</td>
<td>Flouride as F</td>
<td>ppm</td>
<td>-</td>
</tr>
</tbody>
</table>

3.3 GUARANTEED OUTLET WATER QUALITY:

The plant design should meet the outlet water quality at MB outlet as indicated below.

### MIXED BED OUTLET WATER QUALITY

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Description</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td></td>
<td>6.8 to 7.3</td>
</tr>
<tr>
<td>2</td>
<td>Conductivity at 25 deg C</td>
<td>μS/cm</td>
<td>&lt; 0.08</td>
</tr>
<tr>
<td>3</td>
<td>Sodium</td>
<td>ppb</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>3</td>
<td>Silica as SiO2</td>
<td>ppb</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>
4.0 TECHNICAL SPECIFICATION - MECHANICAL

4.1 DESIGN CRITERIA

The Mixed Bed (MB) unit shall be of automatic operation (but, in case of regeneration, initiation shall be done manually and sequence of operation shall be automatic) through common DCS system (Common DCS is envisaged for UF system, 1st & 2nd pass RO plants, remineralization plant and MB system). DCS system will be provided by BHEL. Vendor shall render all technical assistance in implementing the sequential operation of their system with the DCS.

The 2nd pass RO permeate shall be treated (degasified) in Degasser System comprising of (1W + 1S) Degasser Tower(DGT) and (1W + 1S) Degasser Blowers. The degassed water shall be collected in a RCC 2nd pass RO Permeate Tank (not in Bidder scope). The degasser tower shall be mounted on the 2nd pass RO permeate tank.

As the feed water to the degasser tower will be directly connected from the RO membrane permeate outlet-having limitations of backpressure, bidder to limit the degasser tower height to less than 3 meters.

The degassed water from 2nd pass RO Permeate tank shall be pumped to each MB Unit by MB Feed Pump (2W + 1S). Each MB unit shall be sized to meet the guaranteed output quality and quantity as called for in the specification.

A common regeneration system shall be included in the design to regenerate the Mixed Bed resins. It shall consist of MB regeneration pumps, blowers, interconnecting pipes & pipe fittings, valves, Acid Measuring Tanks, Caustic Dilution Tanks, ejectors, Bulk storage tanks (for Acid & alkali), acid unloading pumps, alkali unloading pumps, etc.

The design shall take care to terminate the regeneration effluent through pipes to the nearest trench outside the building which shall lead to neutralizing pit.

Necessary piping, manual operated valves, pneumatic operated diaphragm valves, limit switches, shall be provided in the system as per the preliminary P&ID drawing enclosed along with this specification.

The details of the equipment / system are elaborated in respective section of this specification.

4.2 TERMINAL POINTS:

Scope and terminal point details are indicated in the enclosed drawings, P & ID : No : 1-WT-220-01098 Rev.01 (Sheet 1 & Sheet 2) and MB system Layout: 2-WT-220-00268 Rev.01 with this specification.
a) 2nd Pass RO permeate water will be supplied by the customer (BHEL) at the inlet nozzle flange of degasser tower.

b) One suction nozzle (flooded) with a flange connection (ANSI B16.5, 150 class) will be provided at 2nd Pass RO permeate tank (RCC). Further interconnecting piping, valves, fasteners (bolt, nut with two washers), gaskets, etc., from this flange to MB Feed Pumps system shall be in vendor’s scope. Vendor shall study the preliminary layout and P&ID drawings and consider sufficient length of piping with reserve (approximate distance: 10 meter) and from pump delivery to MB vessel inlet common header.

c) Outlet DM water piping of all the three Mixed Bed units shall be connected into the common header and terminated outside the MB SHED at a distance of 5mtr. with flanged end connection. The required outlet pressure is 2 bar (g). Further piping to DM water tank is under BHEL’s scope.

d) All drains from MB vessel are to be connected to N-pit drain trench outside the building at a distance of 5 meter from the shed.

e) Necessary instrument air connection will be provided by BHEL at inlet for pneumatic valves. Refer E, C&I specification ROS: 4191. Bidder shall indicate the requirement of the instrument air with quantity and pressure in their offer.

f) The required chemicals (HCl & NaOH) for MB regeneration will be made available at bulk storage tank by BHEL. Piping from Bulk storage tank to AMT / CDT and then to the MB system with suitable isolation valves wherever required shall be in the bidder's scope. Technical grade Hydrochloric Acid (HCl) 30 to 33% conc. and Rayon grade Sodium Hydroxide (NaOH) lye 48% conc. alone will be provided by the BHEL for MB regeneration chemical requirement. Bidder shall indicate the requirement of these chemicals in their offer(for regeneration of each vessel).

g) Necessary civil works like equipment foundation with pockets, acid resistant tiling in the AMT, CDT area, trenches etc., are excluded from the bidder’s scope. However bidder shall provide the load details of all the equipment for civil design in their offer. Supply of foundation bolts for all the equipment is in bidder's scope.

h) E,C&I items shall be as per the ROS:4191.

i) Requirement of piping, valves, external supports, etc for the following lines shall be provided by the vendor

- 2nd Pass RO Permeate terminal point to degasser tower inlet flange
- 2nd Pass RO Permeate storage tank to MB feed pump suction flange.
- MB feed pump discharge line up to common inlet header of MB unit.
- Common MB outlet water pipeline shall be terminated outside the RODM building.
- DM water storage tank to Regeneration pump suction.
- MB regeneration pumps discharge to common inlet header of MB system.
- MB regeneration pipe line from AMT / CDT to MB units.
- Backwash effluent and rinse water from MB exchanger to N-pit trench outside the building at a distance of 10 mtr.
- For handling of Acid from Bulk storage tank to AMT
- For handling of Alkali from Bulk storage tank to CDT
- MB blowers to MB vessels
- N.pit disposal pumps suction and discharge piping upto terminal point
- CIP- N.pit disposal pumps suction and discharge piping upto terminal point

The approximate distances are indicated in the attached layout (2-WT-220-00268, Rev 01) approximate and the bidder to indicate per meter rate for the above piping beyond the specified length.

4.3 EQUIPMENT SPECIFICATIONS:

4.3.1 DEGASSER TOWER

1) Application : To reduce CARBON DI OXIDE level in the Feed water.
2) Quantity : 2 Nos. (1W + 1S)
3) Operation : Continuous.
4) Installation : Mounted on the top of 2\textsuperscript{nd} pass RO permeate tank (RCC)
5) Type : Vertical tower type & forced draught.
6) Inlet water flow(each) : 134 m\textsuperscript{3}/hr (min)
7) Air to water ratio : 26 m\textsuperscript{3}/m\textsuperscript{3} (min)
8) Specific Velocity of water : 60 m\textsuperscript{3}/hr/m\textsuperscript{2} (max)
9) DGT air vent velocity : 6 m/sec (max)
10) Shell thickness & Height : 6.0 mm & 3.0 m (max)
11) Media Packing height : 2.0 m (min)
12) Material of Construction
   8) Tower : ASTM standard (equivalent to IS - 2062 Gr-A)
   - Rasching Ring : Polypropylene.
   - Grid : MSRL
13) Internal protection : Rubber lining 4.5 mm thick as per international standard (equivalent to IS 4682) & shore hardness 65 ± 5 Gr.A
14) Inlet design water quality : As per section 3.2 for Maximum CO\textsubscript{2} level
15) Guaranteed Outlet water quality : As per section 3.3
16) Design Code : API 650

4.3.2 DEGASSER BLOWER WITH MOTOR

1) Application : To supply air to Degasser Tower
2) Quantity : 2 Nos. (1W + 1S)
3) Operation : Continuous
4) Type : Centrifugal,
5) Installation: Outdoor on RCC tank
6) Flow: Bidder to Specify
7) Head: Bidder to Specify
8) Accessories: Air filter box (suction), anti-vibration mountings, ducting piping and flexible discharge connection etc.
9) MOC - Blower casing & impeller: MS
   - Shaft & Sleeve: EN8 / ASTM A 321 & ASTM A276 TP316
10) Motor: As detailed in ROS: 4191

4.3.3 MIXED BED UNIT

1) Application: To generate the Boiler make-up water from Degassed 2nd pass RO Permeate water.
2) Quantity: 3 Nos. (2W + 1S)
3) Type: Vertical, shell type cylindrical pressure vessel with dished end.
4) Feed water quality: As in section 3.2
5) Mixed bed Outlet water quality: As per section 3.3
6) Guaranteed output, m³/hr: 67 / MB Unit
7) OBR / MB Unit m³: 3120 between two successive regeneration
8) Continuous operating hours hrs: 48
9) Regeneration duration hrs: Vendor to specify (shall be < 4 hrs.)
11) Internal protection: Rubber lining min.4.5 mm thick as per International std (equivalent to IS 4682), shore hardness 65 ± 5 Gr.A
12) External protection: Epoxy painting as per painting specification
   Clause No: 4.7
14) Design Pressure: 6 bar (g) minimum.
15) Test Pressure: 1.5 times of Design Pressure
16) Design Temperature: 65 deg.C
17) Vessel dia x height mtr: Bidder to provide
18) Vessel shell Thickness mm: as per ASME SEC VIII DIV I or 8 mm whichever is higher
19) Vessel dish end Thickness mm: as per ASME SEC VIII DIV I or 10 mm whichever is higher
20) Resin bed height: Minimum 0.5 mtr for Cation resin
   Minimum 1.0mtr for Anion resin.
   However, bidder to select increased resin bed height if required to meet the design ionic load
   (For the calculation of resin volume of anion & cation, ion exchange vessels sizing etc. 10% (ten percent) deration factor on corrected exchange capacity, as obtained from characteristic curves, shall be considered to provide margin towards ageing of resins). Calculation is to be provided along with offer.
21) Surface flow rate m³/hr/m²: > 20 and < 25
22) Free Board: 100% free board shall be provided over resin bed below the BW outlet nozzle.

23) No. of Man holes: Minimum 2, Davit type manholes of Dia 500mm size(min) one at the top and another one at bottom to access the strainer on plate.

24) No. of sight windows: Min.3 Nos. clear width of window each (115W x 210H x 25 T) – MOC of toughened glass to withstand design pressure.

25) Acid available for regeneration: ~ 30% HCl technical grade

26) Alkali available for regeneration: ~ 48% NaOH rayon grade

27) Resin Type / life: Minimum 3 years for Anion resin & Minimum 5 years for Cation resin.

28) Attrition loss of resin – Cation: 3% per annum (max)
- Anion: 5% per annum (max)
  a. Resin Type  Cation: High capacity premium grade, strongly acidic, sulphonated polystyrene base, cross linked polystyrene & gel structure Cation exchange resins.
  Anion: Strongly basic polystyrene base macroporous; Type – I anion exchange resin. The anion resin shall be able to withstand a temperature of 60 deg.C. **Type II resin will not be accepted**
  Inert Resin: Suitable inert resin shall be selected and supplied for effective regeneration of cation / anion resin and to achieve the guaranteed MB outlet water quality.

**Type of regeneration shall be individual resin wise, self-neutralized. Simultaneous regeneration of cation and anion is not acceptable.**

29) Accessories: Necessary Resin traps service water outlet & regeneration water outlet, resin removal nozzle (DN 100), distributor nozzles, davit type manholes, inlet / outlet / regeneration nozzles, drain, vent, necessary sight glasses for viewing resin level, mounting legs, pneumatic operated valves for automatic operation / regeneration, access ladder with safety cage, handrails for manholes & sight glasses etc.

30) Support Legs
  - Quantity: 4 Nos
  - Size: Minimum 200NB pipe, carbon steel, pipe with necessary gusset plates for reinforcement.
- Base Plate: \( \sim 350 \times 350 \times 20 \text{ mm (L x B x Thick)} \)

31) Corrosion allowance for shell & dish end: \( 1.5 \text{ mm} \)
32) Thinning allowance for dished end: \( 2.0 \text{ mm} \)
33) All Fasteners including U bolts for vessel internals, sight glass & man holes: SS 316

34) Bottom collector assembly: Strainer on Plate.
   The bottom plate thickness must be minimum of 20mm with necessary bottom supports (or) calculated thickness whichever is higher.

### 4.3.4 MIXED BED BLOWER WITH MOTOR
1) Application: To supply air to MB during regeneration
2) Quantity: 2 Nos. (1W + 1S)
3) Operation: Intermittent
4) Installation: Indoor near Mixed Bed Shed
5) Type: Rotary Twin Lobe
6) Flow: Bidder to decide
7) Head: 0.5 bar (g) minimum Bidder to specify
8) MOC – Blower Casing & Impeller: International std (equivalent to cast Iron IS:210 Gr.FG260)
   - Shaft & sleeve: EN 8 / ASTM A321 & ASTM A276 TP 316
   - Piping: Mild steel / Carbon steel
9) Motor: As per section 5.0 (Refer ROS: 4191)
10) Accessories: Suction filter, silencers, check valve, safety relief valve, pressure gauge, base frame, sound proof housing, anti-vibratory mountings, pulleys with V-belts & guard and flexible discharge connections, Acoustic Hood etc.

### 4.3.5 MIXED BED FEED PUMPS
1) Application: To feed water to mixed Bed units
2) Quantity: 3 Nos. (2W + 1S)
3) Operation: Continuous
4) Installation: Indoor
5) Type: Horizontal, Centrifugal type
6) Suction: Flooded from 2\textsuperscript{nd} pass RO Permeate tank
7) Discharge Flow rate \( \text{m}^3/\text{hr} \): 67 m3/hr
   Bidder to select with 10% margin.
8) Discharge head mwc: Bidder to select suitable pump considering all losses through resin bed, piping, valves, orifice, strainer etc. over and above the requirement plus 2 bar(g) at the MB final outlet terminal point.
9) Speed of the pump rpm: 1500 (max)
10) Pump MOC
   - Casing: SS 316
   - Impeller: SS 316
SPECIFICATION FOR
MIXED BED SYSTEM

SPEC.NO.ROS:6186
REV.: 02

- Shaft : SS 410 / SS 329
- Shaft sleeve : SS 316
- All other wetted parts : SS 316

11) Shaft Seal : Mechanical seal – API plan 11
12) Impeller type : Closed
13) Coupling : Flexible coupling (Spacer type) with guard
14) Bearing : Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL)
15) Lubrication : Oil / Grease / self-lubricated
16) All fasteners : Stainless steel SS316
17) Base frame for pump & motor : Carbon steel with epoxy painting
18) Additional requirements : Recirculation pipeline with control valve (as detailed in ROS :4191), check valve at discharge end and foundation bolts
19) Motor : As detailed in ROS: 4191

4.3.6 MB REGENERATION SYSTEM:

4.3.6.1 MIXED BED REGENERATION PUMPS

1) Application : To supply DM water from DM water storage tank to Mixed Bed units for regeneration of ion exchange resins.
2) Quantity : 2 Nos. (1W + 1S)
3) Operation : Intermittent
4) Installation : Indoor
5) Type : Horizontal, Centrifugal type
6) Suction : Flooded from DM water storage tank
7) Discharge Flow rate m3/hr : Bidder to select with 5% margin.
8) Discharge head mwc : Bidder to select suitable pump considering all losses through resin bed, piping, valves, orifice, strainer etc. with 10% margin over and above the requirement.
9) Speed of the pump rpm : 1500 (max)
10) Pump MOC
   - Casing : SS 316
   - Impeller : SS 316
   - Shaft : SS 410 / SS 329
   - Shaft sleeve : SS 316
   - All other wetted parts : SS 316
11) Shaft Seal : Mechanical seal – API plan 11
12) Impeller type : Closed
13) Coupling : Flexible coupling (Spacer type) with guard
14) Bearing : Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL)
15) Lubrication : Oil / Grease / self-lubricated
16) All fasteners : Stainless steel
17) Base frame for pump & motor : Carbon steel with epoxy painting
18) Additional requirements : Recirculation pipeline with valve, check valve at discharge end and foundation bolts
19) Motor : As detailed in ROS: 4191

4.3.6.2 ACID MEASURING TANK

1) Application: To hold acid for regeneration of cation resins of MB unit
2) No. of Tanks : 2 Nos.
3) Type : Vertical, Cylindrical Atmospheric type with Conical / dished end at bottom and cover on top (100% leak proof)
4) Capacity : Each tank to hold adequate chemical for 125% of one regeneration of one MB unit
35) MOC : ASTM standard (equivalent to IS - 2062 Gr-A)
5) 6) Tank Thickness : 6.0 mm (min)
7) Internal protection : Rubber lining min.4.5 mm thick as per international standard(equivalent to IS 4682), shore hardness 65 ± 5 Gr.A
8) External protection : Epoxy painting as per painting schedule
9) Fume absorber : 1 No (Adequate size, common for both AMT)
10) Fume absorber MOC : FRP / MSRL (HDPE not acceptable)
11) Provision for Level Indicator : 25NB flange as per ANSI B16.5 #150
12) Provision for Level Transmitter Class : 80NB flange as per ANSI B16.5 #150
13) Support Legs
   - Quantity : 4 Nos
   - Size : Channel - suitable size with necessary base plate & gusset plates
14) Vent, Overflow & drain connection : Required

NOTE : AMT inlet nozzle height shall be limited to 1.5m due to finalized elevation of Bulk chemical storage tank outlet nozzle (Gravity flow)

4.3.6.3 CAUSTIC DILUTION TANK

1) Application : Preparation & to hold caustic solution for regeneration of anion resins of MB unit
2) No. of Tanks : 2 Nos.
3) Type : Vertical, Cylindrical Atmospheric type with Conical / dished end at bottom and cover on top
4) Capacity : Each tank to hold adequate chemical for 125% of one regeneration of one MB unit
36) MOC : ASTM standard (equivalent to IS - 2062 Gr-A)
5) 6) Internal protection : Rubber lining min.4.5 mm thick as per international standard(equivalent to IS 4682), shore hardness 65 ± 5 Gr.A
7) External protection : Epoxy painting as per painting schedule
8) Agitator : Motor driven slow speed agitator with
reduction gear unit, Stirrer of AISI – 316L
9) Provision for Level Indicator : 25NB flange as per ANSI B16.5 #150
   Class
10) Provision for Level Transmitter : 80NB flange as per ANSI B16.5 #150
    Class
   To be provided on the top lid of CDT
11) Support Legs
    - Quantity : 4 Nos
    - Size : Channel - suitable size with necessary base plate & gusset plates
12) Vent, Overflow & drain connection : Required

NOTE : CDT inlet nozzle height shall be limited to 1.5m due to finalized
elevation of Bulk chemical storage tank outlet nozzle (Gravity flow)

4.3.6.4 BULK ACID STORAGE TANK
1) Application : To hold acid for MB regeneration requirement
2) Quantity : 2 Nos.
3) Net Capacity (Usable) : 15 Cum each
4) Location : Outdoor
5) Type & pressure class : Horizontal, Cylindrical, Atmospheric with
   dished ends (Tori spherical)
37) Material : ASTM standard (equivalent to IS - 2062
   Gr-A)
6) 7) Internal protection : Rubber lining min. 4.5 mm thick as per
   International std (equivalent to IS 4682),
   shore hardness 65 ± 5 Gr.A
8) External protection : Epoxy painting as per painting schedule
9) Design Code : API 650
10) Tank shell thickness : 6 mm (min) Bidder to specify
11) Tank dished end thickness : 8 mm (min) Bidder to specify
12) Corrosion allowance for shell & dished end : 1.5 mm
13) Thinning allowance for dished end : 2.0 mm
14) Vessel size: (dia - Length) : Bidder to provide (as per BS:2594)
15) Provision for Level Indicator : 25NB flange as per ANSI B16.5 #150
16) Provision for Level Transmitter : 80NB flange as per ANSI B16.5 #150
   Class
   To be provided on the top
17) Fume absorber : 1 No for each tank
18) Fume absorber MOC : FEP / MSRL ( HDPE is not acceptable)
19) Accessories : Necessary manholes, inlet / outlet / drain & vent nozzles, valves, access ladder with
   safety cage, platform and, hand rails for manhole access etc.

4.3.6.5 BULK ALKALI STORAGE TANK
1) Application : To hold alkali for MB regeneration requirement
2) Quantity : 2 Nos.
3) Net Capacity (Usable) : 10 Cum each
4) Location : Outdoor
5) Type & pressure class : Horizontal, Cylindrical, Atmospheric with dished ends (Tori spherical)
38) Material : ASTM standard (equivalent to IS - 2062 Gr-A)
6) Internal protection : Rubber lining min. 4.5 mm thick as per International std (equivalent to IS 4682), shore hardness 65 ± 5 Gr.A
8) External protection : Epoxy painting as per painting schedule
9) Design Code : API 650
10) Tank shell thickness : 6 mm (min) Bidder to specify
11) Tank dished end thickness : 8 mm (min) Bidder to specify
12) Corrosion allowance for shell & dished end : 1.5 mm
13) Thinning allowance for dished end : 2.0 mm
14) Vessel size: (dia - Length) : Bidder to provide (as per BS:2594)
15) Provision for Level Indicator : 25NB flange as per ANSI B16.5 #150 Class
16) Provision for Level Transmitter : 80NB flange as per ANSI B16.5 #150 Class
17) Level Transmitter : 1 No.
18) Fume absorber : 1 No for each tank
19) Fume absorber MOC : FEP / MSRL (HDPE is not acceptable)
20) Accessories : Necessary manholes, inlet / outlet / drain & vent nozzles, valves, access ladder with safety cage, platform and, hand rails for manhole access etc.

4.3.6.6 ACID UNLOADING PUMPS
1) Application : To transfer the acid (HCl 30-33%) from Tanker to acid bulk storage tanks
2) Quantity : 2 Nos.(1W + 1S)
3) Operation : Intermittent
4) Installation : Outdoor
5) Type : Horizontal Centrifugal type
6) Suction condition : Flooded
7) Suction strainer : Required
8) Discharge Flow rate m³/hr : 10 Cu.m / hr
9) Discharge head mlc : 20 mlc
10) Speed rpm : Not more than 1500 rpm
11) MOC of all wetted parts : Polypropylene
12) Shaft Seal : Mechanical seal
13) Coupling : Spacer type with coupling guard
14) Bearing : Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL)
15) Lubrication : Oil / Grease
16) All fasteners : Stainless steel
17) Base Frame for pump & Motor : Carbon steel with epoxy painting  
18) Additional requirements : Check valve and foundation bolts  
19) Motor : As detailed in ROS: 4191  
20) Reinforced rubber hose with coupling & isolation valves  
   - Quantity : 2 Nos  
   - Size : 100 mm (can be decided DDE)  
   - Length : 10 m (Minimum)  
   - Material : Reinforced rubber & chemical resistant

4.3.6.7 ALKALI UNLOADING PUMPS  
1) Application : To transfer the acid (NaOH 48%) from Tanker to acid bulk storage tanks  
2) Quantity : 2 Nos.(1W + 1S)  
3) Operation : Intermittent  
4) Installation : Outdoor  
5) Type : Horizontal Centrifugal type  
6) Suction condition : Flooded  
7) Suction strainer : Required  
8) Discharge Flow rate : 10 Cu.m / hr  
9) Discharge head : 20 mlc  
10) Speed : Not more than 1500 rpm  
11) Pump MOC  
   - Casing : SS 316  
   - Impeller : SS 316  
   - Shaft : SS 410 / SS 329  
   - Shaft sleeve : SS 316  
   - All other wetted parts : SS 316  
12) Shaft Seal : Mechanical seal  
13) Coupling : Spacer type with coupling guard  
14) Bearing : Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL)  
15) Lubrication : Oil / Grease  
16) All fasteners : Stainless steel  
17) Base Frame for pump & Motor : Carbon steel with epoxy painting  
18) Additional requirements : Check valve and foundation bolts  
19) Motor : As detailed in ROS: 4191  
20) Reinforced rubber hose with coupling & isolation valves  
   - Quantity : 2 Nos  
   - Size : 100 mm (can be decided DDE)  
   - Length : 10 m (Minimum)  
   - Material : Reinforced rubber & chemical resistant

4.3.6.8 BULK SODIUM HYPO CHLORIDE STORAGE TANK  
1) Application : To hold NaOCl for UF RO plant requirement  
2) Quantity : 2 Nos.  
3) Net Capacity (Usable) : 3.0 Cum each  
4) Location : Outdoor  
5) Type & pressure class : Horizontal, Cylindrical, Atmospheric with dished ends (Tori spherical)
39) Material : ASTM standard (equivalent to IS - 2062 Gr-A) 
6) 
7) Internal protection : Rubber lining min. 4.5 mm thick as per International std (equivalent to IS 4682), shore hardness 65 ± 5 Gr.A 
8) External protection : Epoxy painting as per painting schedule 
9) Design Code : API 650 
10) Tank shell thickness : 6 mm (min) Bidder to specify 
11) Tank dished end thickness : 8 mm (min) Bidder to specify 
12) Corrosion allowance for shell & dished end : 1.5 mm 
13) Thinning allowance for dished end : 2.0 mm 
14) Vessel size: (dia - Length) : Bidder to provide (as per BS:2594) 
15) Provision for Level Indicator : 25NB flange as per ANSI B16.5 #150 Class 
16) Provision for Level Transmitter : 80NB flange as per ANSI B16.5 #150 Class 
17) Level Transmitter : 1 No. 
18) Fume absorber : 1 No for each tank 
19) Fume absorber MOC : FEP / MSRL (HDPE is not acceptable) 
20) Accessories : Necessary manholes, inlet / outlet / drain & vent nozzles, valves, access ladder with safety cage, platform and, hand rails for manhole access etc. 

4.3.6.9 NaOCl UNLOADING PUMPS 
1) Application : To transfer the NaOCl (IS 11673 Equivalent) Tanker to acid bulk storage tanks 
2) Quantity : 2 Nos.(1W + 1S) 
3) Operation : Intermittent 
4) Installation : Outdoor 
5) Type : Horizontal Centrifugal type 
6) Suction condition : Flooded 
7) Suction strainer : Required 
8) Discharge Flow rate m³/hr : 10 Cu.m / hr 
9) Discharge head mlc : 20 mlc 
10) Speed rpm : Not more than 1500 rpm 
11) MOC of all wetted parts : Polypropylene 
12) Shaft Seal : Mechanical seal 
13) Coupling : Spacer type with coupling guard 
14) Bearing : Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL) 
15) Lubrication : Oil / Grease 
16) All fasteners : Stainless steel 
17) Base Frame for pump & Motor : Carbon steel with epoxy painting 
18) Additional requirements : Check valve and foundation bolts 
19) Motor : As detailed in ROS: 4191 
20) Reinforced rubber hose with coupling & isolation valves 
   - Quantity : 2 Nos
- Size: 100 mm (can be decided DDE)
- Length: 10 m (Minimum)
- Material: Reinforced rubber & chemical resistant

### 4.3.6.10 CIP NPIT DISPOSAL PUMP

1) **Application**: For Neutralised CIP water disposal
2) **Quantity**: 2 Nos.(1W + 1S)
3) **Operation**: Intermittent
4) **Installation**: Outdoor
5) **Type**: Horizontal Centrifugal type
6) **Suction condition**: Flooded
7) **Suction strainer**: Required
8) **Discharge Flow rate** \( m^3/hr \): 50 Cu.m / hr
9) **Discharge head** \( mlc \): 45 mwc
10) **Speed** \( rpm \): Not more than 1500 rpm
11) **Pump MOC**
   - Casing: SS 316
   - Impeller: SS 316
   - Shaft: SS 410 / SS 329
   - Shaft sleeve: SS 316
   - All other wetted parts: SS 316
12) **Shaft Seal**: Mechanical seal
13) **Coupling**: Spacer type with coupling guard
14) **Bearing**: Anti-friction (SKF/FAG/Equivalent as Acceptable to BHEL)
15) **Lubrication**: Oil / Grease
16) **All fasteners**: Stainless steel
17) **Base Frame for pump & Motor**: Carbon steel with epoxy painting
18) **Additional requirements**: Check valve and foundation bolts
19) **Motor**: As detailed in ROS: 4191
20) **Priming chamber with foot valve & isolation valves**
   - **Quantity**: 2 Nos
   - **Size**: Decided DDE

### 4.3.6.11 NPIT DISPOSAL PUMP

21) **Application**: For Neutralised water disposal
22) **Quantity**: 2 Nos.(1W + 1S)
23) **Operation**: Intermittent
24) **Installation**: Outdoor
25) **Type**: Horizontal Centrifugal type
26) **Suction condition**: Flooded
27) **Suction strainer**: Required
28) **Discharge Flow rate** \( m^3/hr \): 50 Cu.m / hr
29) **Discharge head** \( mlc \): 45 mwc
30) **Speed** \( rpm \): Not more than 1500 rpm
31) **Pump MOC**
   - Casing: SS 316
   - Impeller: SS 316
   - Shaft: SS 410 / SS 329
### 4.4 GENERAL DESIGN REQUIREMENTS

The common requirements for the system are given in the general design requirements. However, the requirements indicated in the equipment specification for mechanical equipment section 4.3 shall be strictly complied with.

#### 4.4.1 COMMON REQUIREMENTS FOR ALL SYSTEM:

1. Only latest revision of standard shall be used.

2. The design pressure of pressure vessel shall be minimum 5% higher than the pressure experienced in the system like pump shut-off operation, higher operating pressure at allowable electrical supply variations etc. (Minimum 6 bar).

3. All the rotating equipment noise level shall be < 85db measured at 1 mtr distance from the equipment.

4. The tanks coming in contact with corrosive fluids should be rubber lined as indicated in the specification of mechanical equipment.

5. All carbon steel pipelines, unless otherwise specified elsewhere-carrying corrosive fluids should be rubber lined inside to a thickness of at least 3 mm.

6. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages of the Unit.

7. All metallic valves shall be rubber lined.

8. The size of the overflow pipes of all storage tanks shall be one size higher than inlet pipe sizes of these tanks.

9. All the valves are to be located to facilitate easy accessibility and operation from the ground level.

10. All the fasteners for pipeline flanges, manhole covers, sight glasses shall be of SS 316 MOC with 2set of washers.

11. Vessel Internal supporting cleats / ‘U’ clamps / fasteners shall be SS 316.
12. The direction of flow shall be indicated by an arrow at regular intervals on all pipelines with luminous paint. The size of arrow shall be suitably selected so that it shall be visible from any direction.

13. Vendor shall procure their sub-system components / equipment from approved Vendor list only.

14. BHEL / Customer inspection at Vendor’s works is applicable for specified components; the list of components will be decided later.

15. All CPVC pipe lines (Industrial grade - piping, fittings, & valves) shall be procured from M/s George Fischer - Switzerland, M/s FIP Industries – Italy, M/s Astral Poly Technik Limited - India or equivalent international supplier, approved by customer.

16. Vendor shall submit detailed process calculations, design calculation of vessel, Resin calculation, tanks and major system drawings for the approval of BHEL / Customer. These documents require approval of customer consultant before commencement of the work.

17. The minimum thickness for shell and dish end of vessels shall be 8 mm.

18. The design temperature of all vessels shall be taken as minimum 65 deg C.

19. All valves and piping shall be supported suitably with cushion / rubber sheet of suitable thickness & bolted with 'U' clamp. The supporting truss must have minimum width of 1.5 times of the pipe diameter and base plate of 12 mm thick (minimum).

20. Necessary access to be provided for all manholes, sight glasses, valve operation, etc.

21. MB vessel shall be provided with two additional nozzles with flange for hydraulic transfer of resin as and when necessary arises. The nozzle shall be provided with manual valves of 100NB. Dummy flange, gaskets and fasteners are bidder’s scope.

22. Suitable platforms, walkways, stairways, cage type ladders etc. for access to all equipment shall be provided by the bidder.

23. All platforms and stairways shall have minimum clear width of 800 mm. All platforms, stairways, landings etc. shall have railings and guards. Platform for interlinking all vessels with cage-ladders shall be provided for more than one vessel. The ladders & platforms shall have handrails for safe climbing and access. All the manholes shall have ladder for approach and platforms for landing.

24. The guaranteed conductivity value must be attained after completion of regeneration and / or during fast rinse of 15 minutes duration maximum.

25. Motor rating shall be minimum of 110% of the duty point requirement and also to meet the maximum power requirement over the operating range at 50 Hz frequency.

26. All the equipment, valves & other items / components shall be tagged with corresponding KKS number as per PID. KKS number will be informed during execution stage.
4.4.2 Vessels & Tanks

All vessels & tanks except those specified otherwise shall be made of steel with suitable rubber lining. All steel tanks furnished by the bidder shall be designed suitable for operating condition. All pressure vessels shall be designed and tested to withstand 1.5 times of the design pressure. All the tanks shall be provided with suitable supporting legs, inlet and outlet connections, hand hole, manholes, nozzle connections for level gauges, vents, drains, overflow, access ladder with safety cage, landing & maintenance platforms, approach ladder for sight glass, handrails, etc. as maybe required. They shall be lined with suitable material capable of satisfactorily withstanding respective fluids to be handled by them.

All the steel tanks & vessels are to be provided with blind flanges of minimum 8 mm thick with carbon steel fasteners during dispatch (to carry out the leak test/hydro test). The SS316 fasteners shall be sent separately which shall be used during erection.

AMT / CDT Design consideration:

AMT / CDT shall be of vertical, cylindrical, (tapered bottom) with level indication. The top cover shall be of single piece, removable and flanged type with suitable reinforcing & bracing. Each tank shall have four support legs with bolt hole & PCD not more than 150 mm beyond the tank diameter.

Each tank shall have inlet, outlet, drain, overflow, service water inlet, level indication nozzles etc. Overflow lines shall be minimum one size higher than tank inlet line. Each tank shall be equipped with a flanged type glass tube level indicator / gauge having indicator board calibrated in mm and 2 Nos. of CPVC isolation valves.

These tanks shall be provided with drain valves and piping, overflow piping and the same shall be led to a nearest drain sump. Top lid shall be provided with adequate number of nozzles for air vent, level switch / level transmitter mountings.

Design of pressure vessels shall conform to IS 2825 and atmospheric tanks shall conform to IS-803. All the nozzles shall be provided with necessary valves for open / close for regeneration operation.

All the manhole doors shall be provided with davit arrangement.

All the vessels nozzles shall be fitted with leak proof dummy flanges along with gaskets before dispatch.

4.4.3 CENTRIFUGAL PUMPS:

1. The pumps shall have stable head Vs capacity characteristic continuous rising towards shut-off with an approximate shut-off head of 15% more than the design head for radial flow type pumps.

2. The characteristic curves of set of pumps shall match other for load sharing in case of parallel operation

3. The critical speed of the pumps shall be well away from the operating speed and in no case less than 130% of the rated speed.
4. Pumps shall be provided with non-return valve & shut off valve on discharge side and shut-off valve on suction side.

5. Vibration level of pump and motor assembly shall be within the satisfactory zone as per ISO 10816-3:1998 (E) for machine group 3 standard for rigid supported base with zone boundary B/C.

6. Tolerance on pump guaranteed efficiency and rated head for the rated flow shall be plus 3%. To minus 2%

7. Each pump suction and discharge shall be installed with an expansion bellow.

8. The pumps shall be designed for continuous operation at its best efficiency to satisfy the performance requirements.

9. The pumps shall be controlled from remote panel and locally.

10. The noise level shall not exceed 85dBA and overall sound pressure level reference 0.0002 microbar at a distance of 1 m from the equipment surface.

4.4.4 DEMINERALISING SYSTEM:

The demineralising system shall comprise of equipments as listed in equipment specification. However, the design criteria shall be as mentioned below:

1. Each MB unit shall be rated for a normal flow rate to meet net output between regeneration. The flow rate shall be sized suitably to meet the guarantee requirement.

2. The air blowers shall be designed to supply the required quantity of oil free compressed air at required pressure for mixing the Anion and Cation resins after regeneration. The supply shall also include all necessary piping, valves, fittings, pressure gauges, suction silencer-cum-filter, belt guard, relief valve etc.

3. Necessary Resin traps, distributor, nozzles, manholes, inlet / outlet / regeneration nozzles, drain, vent, necessary sight glasses for viewing resin level, mounting legs, valves for automatic operation / regeneration of the system in the mixed units shall be supplied with all necessary piping, valves.

4. Resin selection criteria, calculation for arriving at resin quantities and the resin characteristic curves shall be submitted along with the offer.

5. Bidder shall design the MB resin regeneration process based on self-neutralization basis and to furnish the chemical calculations for regeneration of resins.

4.4.5 RESIN REGENERATION SYSTEM:

4.4.5.1 CATION & ANION REGENERATION:

1. The Cation exchange resins shall be regenerated with Hydrochloric acid of ~ 30% concentration as per IS 265 through counter current mode and the Anion exchange resins shall be regenerated with Sodium Hydroxide solution of ~ 48% concentration as per IS 252 technical grade / rayon grade through co-current mode. These chemicals will be drawn from Bulk storage tanks (Bulk storage tanks are included in bidder's scope). The required chemicals are excluded from bidder's scope. The required pump,
valves, pipelines etc. required for the transfer of chemicals will be in bidder’s scope and the details will be provided during ordering.

2. The bidder shall include the required regeneration equipment in their scope.

3. Acid measuring tank for the regeneration of cation resin shall be of sufficient capacity to store the quantity of acid required for at least one regeneration with 25% margin. The tank shall be of MSRL construction with removable top cover- single piece & level indicators to indicate the level. Fume absorbers shall be provided for these tanks. Nozzle shall be provided on the top lid for providing level transmitter.

4. Alkali measuring / dilution tank for the regeneration of anion exchanger shall be of sufficient capacity to store the quantity of alkali required for at least one regeneration with 25% margin. The tank shall be of MSRL construction with removable top covers-single piece & level indicators to indicate the level. Suitable agitator shall be provided to dilute the NaOH solution from 48% to 30 %. Nozzle shall be provided on the top lid for providing level transmitter.

5. Separate hydraulic injector / ejector for anion and cation resins for diluting the alkali / acid to the required level and dosing it to respective resin shall be supplied.

6. The dilution ratio of the ejector shall be properly selected such that the bed can be effectively regenerated employing power water at the available pressure. The ejectors and nozzles shall be suitably designed for acid /alkali service and high velocity of liquid.

7. Safety showers with eye-wash meeting B.I.S specification shall be provided in the acid, alkali handling area (AMT & CDT area).

4.5 PIPING

4.5.1 LINE SIZING

1. Sizes of pipelines shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow:

- Pump Suction : ≤ 1.2 m/sec  
- Pump Discharge & re-circulation : ≤ 2.5 m/sec for GRP & MSRL Pipeline
- Service water : ≤ 1.5 m/sec  
- Compressed air : ≤ 15 m/sec

2. Corrosion allowance of 1.6mm shall be added to the calculated thickness.

3. All high points in piping system shall be provided with air vents along with valves. All low points shall be provided with drains along with valves.

4. Necessary moisture traps shall be provided in the compressor airline at strategic location.
5. The supporting arrangement shall be rigid and properly designed for the systems where hydraulic shocks and pressure surges may arise in the system during operation.

6. Sufficient up stream and down stream lengths shall be provided for flow measuring device, control valves and other specialties.

7. Bidder shall provide suitable sampling points with SS 316 valves to take water samples for testing purpose. The water samples shall be through 20 mm NB dia pipes of SS 316.

8. Test certificate / Compliance certificate to be furnished by the bidder for all the MSRL, UPVC / CPVC, SS, GRP / FRP piping and piping components, etc.
### 4.5.2 MATERIALS OF CONSTRUCTION:

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>SERVICE</th>
<th>SIZE</th>
<th>PIPES</th>
<th>FITTINGS</th>
<th>FLANGES</th>
<th>GASKETS</th>
<th>LINE JOINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>MB Feed pump suction line, MB Feed pump discharge line, common header</td>
<td>All sizes</td>
<td>GRP, PN10 As per AWWA-C950 - 07 standard</td>
<td>GRP, PN10 As per AWWA-C950 - 07 standard</td>
<td>GRP</td>
<td>Neoprene rubber / EPDM</td>
<td>Flange / But and wrap joint using GRP mat with Isophthalic resin</td>
</tr>
<tr>
<td>2.0</td>
<td>, MB frontal piping.</td>
<td>All sizes</td>
<td>ASTM A53 (equivalent to IS 1239) Heavy duty (Rubber lined 3 mm Thick)</td>
<td>ASTM A234 Gr. WPB (or) CPVC, schedule 40 of ASTM</td>
<td>ASTM A105 (Or) UPGF / PP Flange drilling should be ANSI B16.5, 150 Class</td>
<td>Neoprene rubber / EPDM</td>
<td>Flanged (Or) Solvent cemented. Flanged / socket type</td>
</tr>
<tr>
<td>3.0</td>
<td>MB vessel - drain down line, air release line, rinse outlet line, drain line, effluent disposal piping</td>
<td>All sizes</td>
<td>ASTM A53 / IS-1239 Heavy duty (Rubber lined 3 mm Thick)</td>
<td>ASTM A234 Gr. WPB (or) CPVC, schedule 40 of ASTM</td>
<td>ASTM A105 (Or) UPGF / PP Flange drilling should be ANSI B16.5, 150 Class</td>
<td>Neoprene rubber / EPDM</td>
<td>Flanged (Or) Solvent cemented. Flanged / socket type</td>
</tr>
<tr>
<td>4.0</td>
<td>Regeneration line, Concentrated Hydrochloric acid (5 – 30% concentration) Concentrated alkali (5- 48% concentration)</td>
<td>All sizes</td>
<td>CPVC, schedule 40 of ASTM</td>
<td>CPVC, schedule 40 of ASTM</td>
<td>UPGF / PP Flange drilling should be ANSI B16.5, 150 Class</td>
<td>Neoprene rubber / EPDM</td>
<td>Solvent cemented. Flanged / socket type</td>
</tr>
<tr>
<td>5.0</td>
<td>DM water line - from individual MB outlet, common header up to terminal point.</td>
<td>All sizes</td>
<td>SS304</td>
<td>SS304</td>
<td>ASTM A105</td>
<td>Neoprene rubber / EPDM</td>
<td>Flanged</td>
</tr>
<tr>
<td>6.0</td>
<td>Instrument Air &amp; Plant Air line</td>
<td>All sizes</td>
<td>ASTM A53 Galvanised as per IS 1239 Heavy grade</td>
<td>ASTM A234 Gr.WPB Galvanised</td>
<td>ASTM A105 Galvanised / Screwed fitting shall be considered</td>
<td>Neoprene rubber / EPDM</td>
<td>Screwed connections</td>
</tr>
</tbody>
</table>
Notes

1. Outlet DM water piping of all the three Mixed Bed units shall be connected into the common header and terminated outside the RODM building at a with flanged end connection. The common outlet header pressure shall be 2 bar (g). Further piping to DM water tank is under BHEL’s scope.

2. Pipes & Fittings shall be tested for its material composition and certificate shall be enclosed for the same. Each pipeline segment shall be hydro tested at shop as per the codes / standards.

3. Blind flanges on SS Pipe lines shall be to ASTM A 240-TP 316. Stub ends shall be used at flanged connections

4. Cast steel valves shall be provided for compressed air system.

5. All branch connections shall be wrought or forged steel based on the size and availability based on ASTM Standards.

6. All piping from 2nd pass RO permeate tank to mixed bed vessels outlet including frontal piping shall be trial assembled and tested before despatch.

7. All piping & valves supports shall be of dismantling type for easy maintenance using suitable bolted connections.

4.5.3 LAYOUT & DETAILING

1. A good engineering practice must be followed in manufacturing the piping weldments like edge preparation, slope, drain & vents by preparation of detailed layout drawing.

2. Overhead piping shall have a minimum vertical clearance of 2.3 metres above walkways and working areas and 7.5 metres above roadways unless otherwise approved by the BHEL-ENGINEER.

3. Provision shall be made while preparing piping layout to accept control valves, flow measurement element and any other on-line specialty or equipment. Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves, and other specialties as required by the respective equipment manufacturer.

4. All the screwed valves and screwed connections on equipment shall be provided with unions to facilitate easy assembly / disassembly. Likewise, unions shall also be provided at suitable points on straight length of screwed pipelines.

5. The hangers and supports shall be spaced in accordance with standard engineering practice as outlined in applicable codes and standards.

4.5.4 DIMENSIONAL STANDARDS

1. Uniform dimensional standards for all piping components shall be employed to ensure compatibility with each other.

2. Nominal pipes sizes and pipe outside diameters shall generally be as per ANSI B 36.10.
4.5.5 WELDING AND HEAT TREATMENT

All heat treatment, welding, post and pre weld temperatures shall be as per the applicable ASME code.

4.5.6 INSPECTION & CLEANING

All pipes shall be thoroughly cleaned & hydro-tested at shops for pressures as per standards and all erected piping shall be cleaned & tested at 1.5 times the design pressure.

All hot bent, forge-formed, fabricated and straight pipes shall be chemically cleaned, pickled or wire brush cleaned and purged with air blast or shot/grit blast to remove all sand and scale from the inner surface as applicable during manufacturing.

The Contractor shall carryout the following cleaning after hydro-test.

a) All piping shall be mass flushed, in addition to the specific cleaning operations as described below, as required.

b) Compressed air piping shall be blown by air.

4.6 VALVES

4.6.1 DESIGN AND CONSTRUCTION FEATURES

The following consideration shall be made during the design / selection of valves for the MB System.

1. For the MB system Butterfly valves and diaphragm type valves shall be used for isolation / regulation purpose.

2. Bidder to select suitable material of construction for the valves based on the system requirement as per clause 4.6.2.

3. The end connection for the diaphragm valves shall be of flanged type as per ANSI B16.5, 150 class.

4. Pressure rating of valves shall be of minimum PN10

5. Necessary pneumatic actuated valves shall be provided for auto operation (option for manual opening and closing shall also be made available), backwashing & regeneration of the plant as per the P & I D

6. The painting shall be as per the requirements indicated in section No: 4.7

7. The check valves and butterfly valves shall be of wafer type suitable for mounting between flanges.

8. The Material of Construction of the body and disc of check valve shall be SS 316.

9. Cast steel valves shall be provided for compressed air system

10. Bidder shall furnish the valves schedule in the attached format-Annexure-4
### 4.6.2 VALVE - MATERIALS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Service</th>
<th>Valve Type</th>
<th>Size</th>
<th>BODY</th>
<th>Disc / Ball / Diaphragm</th>
<th>Stem / Shaft</th>
<th>Valve seat / Seat ring</th>
<th>Valve Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>MB Feed pump suction &amp; discharge line up to MB common inlet header</td>
<td>Butterfly Valve</td>
<td>&gt;65NB</td>
<td>Cast Iron / Cast steel with Epoxy painting</td>
<td>SS 316</td>
<td>SS 316</td>
<td>EPDM</td>
<td>Lugged / Wafer Construction</td>
</tr>
<tr>
<td></td>
<td>Check Valve</td>
<td>&gt;65NB</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td>Lugged / Wafer Construction</td>
<td></td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Mixed Bed Vessel - Service inlet line, service outlet line, Frontal piping, Air release line, drain down line</td>
<td>Manual operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CI/CS FG 200 Rubber lined Diaphragm Valve</td>
<td>EPDM</td>
<td></td>
<td></td>
<td>FLANGED #150PSI</td>
</tr>
<tr>
<td></td>
<td>Pneumatic operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CI/CS FG 200 Rubber lined Diaphragm Valve</td>
<td>EPDM</td>
<td></td>
<td></td>
<td>FLANGED #150PSI</td>
<td></td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>MB Regeneration pumps suction &amp; discharge line up to common header. AMT &amp; CDT area. Bulk storage area - Concentrated Hydrochloric acid (5 – 30%) Alkali – 48%, Drain line, etc.</td>
<td>Butterfly Valve</td>
<td>&gt;65NB</td>
<td>Cast Iron / Cast steel with Epoxy painting</td>
<td>SS 316</td>
<td>SS 316</td>
<td>EPDM</td>
<td>Lugged / Wafer Construction</td>
</tr>
<tr>
<td></td>
<td>Check Valve</td>
<td>&gt;65NB</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td>Lugged / Wafer Construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pneumatic operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CI/CS FG 200 Rubber lined Diaphragm Valve</td>
<td>EPDM</td>
<td></td>
<td></td>
<td>FLANGED #150PSI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual operated Ball Valve (OR) Manual operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CPVC</td>
<td>CPVC</td>
<td>CPVC</td>
<td>Teflon</td>
<td>Socket End</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CPVC</td>
<td>For acid Line: Reinforced Teflon / EPDM For Alkali Line: Reinforced Neoprene / Hypalon</td>
<td>SS 316</td>
<td>---</td>
<td>Flanged End / Socket End / Spigot End</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Degasser and MB air blower discharge line up to MB inlet</td>
<td>Butterfly Valve</td>
<td>≥65NB</td>
<td>Cast Iron / Cast steel with Epoxy painting</td>
<td>SS 316</td>
<td>SS 316</td>
<td>EPDM</td>
<td>Lugged / Wafer Construction</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------</td>
<td>-----------------</td>
<td>-------</td>
<td>---------------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
<td>----------------------------</td>
</tr>
<tr>
<td></td>
<td>Check Valve</td>
<td>≥65NB</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td>SS 316</td>
<td></td>
<td>Lugged / Wafer Construction</td>
</tr>
<tr>
<td></td>
<td>Pneumatic operated Diaphragm Valve</td>
<td>All sizes</td>
<td>CI/CS FG 200 Rubber lined Diaphragm Valve</td>
<td>EPDM</td>
<td></td>
<td></td>
<td>FLANGED #150PSI</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** ***Diaphragm valve shall be of single acting, fail safe to open / close according to the process requirement. As detailed in ROS: 4191***
4.7 PAINTING

4.7.1 GENERAL

a) All the Equipment and steel structures shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze, UPVC pipes, HDPE pipes and non-metallic components shall not be applied with any painting.

b) All painting shall be carried out in conformity with the paint manufacturer's recommendation.

c) Applicable Codes and Standards:

DIN 2403 : Indication of pipe-lines according to flowing material
DIN 4762 : Surface roughness
ISO 8503 : Surface Roughness
DIN 8201 : Part 1-9 tight blasting agents
DIN 50976 : Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing.
DIN 55928 : Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats.
ISO 8501 : Preparation of steel substrates before application of paints and associated products.
ISO 12944 : Paints and varnishes-corrosion protection of steel structures by protective paint systems.
ISO 8501-1 : Preparation of steel substrates before application of paints and related products.
RAL : Colour card

a) Galvanizing work shall confirm in all respects to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

b) All painting shall be performed according to ISO 12944. The durability of all painting shall be “High” which corresponds to 15 years.

c) No painting or filler shall be applied until all repairs, hydrostatic test and final shop inspection are completed.

g) All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks.
4.7.2 CLEANING AND SURFACE PREPARATION

Prior to blasting, areas have to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser or solvent for more severe grease contamination. The cleaning should be to provide a "water break free surface"

Sharp edges have to be rounded off.

Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using universal indicator paper strips prior to continuation with the blasting.

4.7.3 PROTECTIVE COATING

As soon as the painting items have been cleaned, within four hours of the subsequent drying they will be coated with suitable anti-corrosion protection. Immediately after the protective coating all vessels and pipes will be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds.

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

All painting works (including surface preparation) on piping or equipment at site shall be commenced only after the required tests have been completed.

Prior to painting, proper care shall be taken to protect nameplates, lettering, gauges, sight glasses, light fittings and similar such items, to ensure that these are in no way defaced or damaged during the work.

All primers shall be well marked into the, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied as per manufacturer's recommendations.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks.

**Dry film Thickness:** Each coat of paints will be allowed to harden before the next is applied as per manufacturer's recommendation. The requirements for the dry film thickness (DFT) of the paint and materials to be used for different items will be as per the "schedules of finishes indicated below."
### 4.7.4 Paint Coating Systems and Schedule of Finishes

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Surface Location</th>
<th>Temp Deg.C</th>
<th>Surface Preparation</th>
<th>Coating System</th>
<th>No. of Coats</th>
<th>Generic Type</th>
<th>DFT per coat (µm)</th>
<th>Total DFT (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Structural steel works, piping, vessels, tanks INDOOR</td>
<td>Up to 120</td>
<td>SA 2.5</td>
<td>Primer</td>
<td>1</td>
<td>Zinc - Epoxy</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>1</td>
<td>Epoxy High Solid</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Structural steel works, piping, vessels, tanks OUTDOOR</td>
<td>Up to 120</td>
<td>SA 2.5</td>
<td>Primer</td>
<td>1</td>
<td>Zinc - Epoxy</td>
<td>80</td>
<td>290</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intermediate</td>
<td>1-2</td>
<td>Epoxy High Solid</td>
<td>2 x 80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>1</td>
<td>2Component Polyurethane</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pumps, motors, other equipment INDOOR</td>
<td>Up to 120</td>
<td>SA 2.5</td>
<td>Primer</td>
<td>1</td>
<td>Zinc - Epoxy</td>
<td>80</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>2</td>
<td>Epoxy High Solid</td>
<td>2 x 50</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pumps, motors, other equipment OUTDOOR</td>
<td>Up to 120</td>
<td>SA 2.5</td>
<td>Primer</td>
<td>1</td>
<td>Zinc - Epoxy</td>
<td>80</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intermediate</td>
<td>1</td>
<td>Epoxy High Solid</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>1</td>
<td>2Component Polyurethane</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Steel surfaces permanently in contact with water also river water splash zone</td>
<td>Up to 60</td>
<td>SA 2.5</td>
<td>Prime and Finish coat in One</td>
<td>1</td>
<td>Glass flake reinforced High Solid Epoxy</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>6</td>
<td>Plant / cooling water pipes</td>
<td>GRP or steel lined concrete pipes with cathodic protection and coating according to AWWA C203</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.0 TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION

Electrical, Controls & Instrumentation requirements for the MB system is attached separately along with this specification ROS : 4191

6.0 TECHNICAL DETAILS FOR CIVIL WORKS:

Construction of civil building, foundation and flooring etc for the MB system is not in bidder scope. However, the bidder shall provide the equipment layout drawing along with bid.

The approximate area of the MB building is indicated in the enclosed preliminary drawing. (Drg.No.2-WT-220-00268 Rev.01).

Detailed construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipment & tanks, flooring requirements, protective coatings, trenches for pipe routing & drains, cable routing etc. shall be furnished to BHEL for further construction immediately after order.

Any special requirement like handling arrangement, 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 MB system boundary.

Foundation bolts, nuts & washers for all equipment shall be supplied by the bidder as per their offered equipment requirement.

The approximate area & location are indicated in the enclosed layout drawing. Bidder to accommodate the MB system with in the stipulated area only as indicated in the typical layout drawing attached along with this specification.

7.0 PERFORMANCE GUARANTEE

The system performance guarantee and applicable penalty are detailed in this section.

7.1 PERFORMANCE GUARANTEE

The bidder shall guarantee all equipment for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole. On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified. All instruments, gauges installed for the normal operation of equipment shall, be made use of during the acceptance test as far as possible. If additional instruments are required for the
tests, these shall be brought by the supplier on free of cost and shall be taken back after completion of performance test. All the calibrations and consumables, hardware etc. required for calibration of these additional instruments are in bidder’s scope.

7.1.1 The Performance guarantee tests shall be conducted & cover the following but not be limited to the rated parameters for smooth operation of complete MB system:

a) Degasser outlet water quality as per Annexure - 1
b) MB system outlet Water quality as per annexure-1
c) MB system net output and gross output between regeneration as per Annexure – 1
d) MB regeneration Chemical consumption including neutralizing chemical as per annexure – 1
e) Power consumption for continuous operating equipment as per annexure – 2
f) MB Regeneration cycle time.
g) Vibration and noise level of rotating equipment.

7.1.2 Minimum 3 performance test run shall be conducted between regeneration for the guaranteed value of treated water quality and chemical consumption of which, 2 consecutive test results shall meet the guaranteed values specified above (a to g).

7.1.3 General

In addition to the guarantees mentioned above, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

The equipment supplied shall be guaranteed for a minimum period of 12 (twelve) months from the date of successful commissioning of the plant (or) 18 months from the date of receipt of all materials at site, whichever is earlier. The date of receipt of last item at site will be reckoned for this purpose. Resins guarantee shall be as per equipment specification refer clause No: 4.3.3

Any part which proves defective either in design, materials / and / or manufacture within the above guarantee period shall be replaced at free of cost to the owner at site and the provision of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of the guarantee period or from the date of replacement whichever is later.
8.0 MANDATORY SPARES (Mechanical, Electrical, C&I)

8.1 Initial Spares:
The Initial spares shall be delivered at site in due time and at least two (2) months before COD / PAC of first unit. Exact date of delivery will be informed to the successful bidder during ordering. The Cost of initial spares shall be indicated separately and the same is considered for Bid Evaluation.

The list of initial spares are given below:

8.1.1 MB EXCHANGER:
List of spares for Mixed Bed Exchanger is given below :-

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Name of Items</th>
<th>Unit</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Middle collector assembly for Mixed Bed</td>
<td>No</td>
<td>1No. for each MB Unit</td>
</tr>
<tr>
<td>2)</td>
<td>Strong Acid Cation resin</td>
<td>1 Set</td>
<td>One (1) full charge of one(1) Mixed Bed Vessel +10%</td>
</tr>
<tr>
<td>3)</td>
<td>Strong Base Anion resin</td>
<td>1 Set</td>
<td>One (1) full charge of one(1) Mixed Bed Vessel +10%</td>
</tr>
<tr>
<td>4)</td>
<td>Strainer for MB exchanger or Header / Lateral</td>
<td>Nos.</td>
<td>Minimum 50 Nos or 1 set whichever is more</td>
</tr>
</tbody>
</table>

8.1.2 VALVES:
List of spares for Valves are given below:-

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Name of Items</th>
<th>Unit</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Manual Diaphragm valves and Pneumatic operated diaphragm valves with actuators</td>
<td>No</td>
<td>10% of total population or minimum 1 No. whichever is higher for each type / size / rating</td>
</tr>
<tr>
<td>2)</td>
<td>Diaphragm for above valves</td>
<td>No</td>
<td>20% of total population or minimum 2 Nos. whichever is higher for each type / size / rating</td>
</tr>
<tr>
<td>3)</td>
<td>Butterfly valves</td>
<td>No</td>
<td>5% of total population or minimum 1 No. whichever is higher for each type / size / rating</td>
</tr>
</tbody>
</table>
4) Check valve / Non-return valve  No  5% of total population or minimum 1 No. whichever is higher for each type / size / rating

8.1.3 PUMPS

8.1.3.1 Horizontal Centrifugal Pumps:

The list of spares for the following Horizontal centrifugal water pumps are given below:
1. Acid Unloading Pump
2. Alkali unloading Pump

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Name of Items</th>
<th>Unit</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Impeller with nuts &amp; other accessories</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>2)</td>
<td>Wearing rings - Impeller (If applicable)</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>3)</td>
<td>Wearing rings - Casing (If applicable)</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>4)</td>
<td>Shaft</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>5)</td>
<td>Shaft Sleeves</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>6)</td>
<td>Mechanical Seal</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>7)</td>
<td>Coupling between Pump &amp; Motor, bushes, pins, with all fastenners &amp; coupling guards</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>8)</td>
<td>Pump bearings</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
</tbody>
</table>

One set consists of quantity required for complete replacement for one pump

9) Motor

   a) Acid Unloading Pump Motor  No  1 for each application
   b) Alkali Unloading Pump Motor  No  1 for each application
8.1.3.2 Horizontal Centrifugal Pumps:

The list of spares for the following Horizontal centrifugal water pumps are given below:

1. N-Pit and CIP N-pit disposal pumps (N-Pit)
2. Degassed water pumps (MB Feed Pumps)
3. MB Regeneration pumps

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Name of Items</th>
<th>Unit</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Impeller with nuts &amp; other accessories</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>2)</td>
<td>Wearing rings - Impeller (If applicable)</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>3)</td>
<td>Wearing rings - Casing (If applicable)</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>4)</td>
<td>Shaft</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>5)</td>
<td>Shaft Sleeves</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>6)</td>
<td>Mechanical Seal</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>7)</td>
<td>Coupling between Pump &amp; Motor, bushes, pins, with all fasteners &amp; coupling guards</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>8)</td>
<td>Pump bearings</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>9)</td>
<td>Motor Bearings</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>10)</td>
<td>Motor</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Waste water recirculation pump motor (N pit)</td>
<td>No</td>
<td>1 for each application</td>
</tr>
<tr>
<td>b)</td>
<td>Degassed water pump(MB feed pump) motor</td>
<td>No</td>
<td>1 for each application</td>
</tr>
<tr>
<td>c)</td>
<td>MB Regeneration pump motor</td>
<td>No</td>
<td>1 for each application</td>
</tr>
</tbody>
</table>

8.1.4 BLOWERS

The list of spares for the following Blowers are given below:

1. Degasser Blowers
2. Mixed Bed Blowers
### SPECIFICATION FOR MIXED BED SYSTEM

**SPEC. No:** ROS :6186  
**REV:** 02

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th><strong>Name of Items</strong></th>
<th><strong>Unit</strong></th>
<th><strong>QTY.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Impeller with nuts &amp; other accessories</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>2)</td>
<td>Shaft</td>
<td>Set</td>
<td>1 set of each type &amp; size</td>
</tr>
<tr>
<td>3)</td>
<td>Bearings of Blowers</td>
<td>Set</td>
<td>1 sets of each type &amp; size</td>
</tr>
<tr>
<td>4)</td>
<td>Suction Filter Assembly</td>
<td>Set</td>
<td>2 sets of each type &amp; size</td>
</tr>
</tbody>
</table>

#### 8.1.5 AGITATORS:

List of spares for Agitator is given below :-

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th><strong>Name of Items</strong></th>
<th><strong>Unit</strong></th>
<th><strong>QTY.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Agitator assembly with gear box for alkali measuring tank</td>
<td>Set</td>
<td>1</td>
</tr>
</tbody>
</table>

#### 8.1.6 DOSING EJECTORS:

List of spares for Dosing ejector is given below :-

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th><strong>Name of Items</strong></th>
<th><strong>Unit</strong></th>
<th><strong>QTY.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Complete Ejector Assembly for regeneration of MB resins</td>
<td>No</td>
<td>1 No. for Acid application</td>
</tr>
<tr>
<td>2)</td>
<td>Complete Ejector Assembly for regeneration of MB resins</td>
<td>No</td>
<td>1 No. for Alkali application</td>
</tr>
</tbody>
</table>

#### 8.1.7 MEASURING INSTRUMENTS & PROCESS CONNECTION PIPING

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th><strong>Name of Items</strong></th>
<th><strong>Qty</strong></th>
<th><strong>Remarks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Solenoid Valves</td>
<td>No</td>
<td>10% or 1 No for each type and model whichever is more</td>
</tr>
<tr>
<td>2)</td>
<td>Limit switches (for pneumatic valves and manual valves)</td>
<td>No</td>
<td>2 Nos. of each Type</td>
</tr>
<tr>
<td>3)</td>
<td>Air filter Regulator</td>
<td>No</td>
<td>1 No of each type, class, size &amp; model</td>
</tr>
</tbody>
</table>
8.2 Commissioning Spares:

The bidder shall provide the list of commissioning spares and it shall be delivered along with the main supply well in time before the start-up & commissioning of the plant. The commissioning spares list is indicated in this section.

Over and above of the list provided, if any additional items are required for trouble free commissioning of the equipment / system shall also be included in the list. The price for the commissioning spares shall be included in the main supply and the list shall be provided along with the bid, this price will be included for bid evaluation. Any unutilized commissioning spares shall be handed over to the Customer.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Item Description</th>
<th>Qty.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical seal for Pumps</td>
<td>1 Sets</td>
<td>For each type / size / rating of pump</td>
</tr>
<tr>
<td>2</td>
<td>'V' Belts for Degasser Blowers</td>
<td>1 Set</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>'V' Belts for MB Blowers</td>
<td>1 Set</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Strainer Nozzles for collector</td>
<td>1 set</td>
<td>10% of total installed strainer nozzles in all the three MB Units</td>
</tr>
<tr>
<td>5</td>
<td>Strainer Nozzles for distributors</td>
<td>1 set</td>
<td>10% of total installed strainer nozzles in all the three MB Units</td>
</tr>
<tr>
<td>6</td>
<td>Any specific requirement</td>
<td></td>
<td>Bidder to include</td>
</tr>
</tbody>
</table>

8.3 Recommended Spares for 3 Years O&M:

The bidder shall provide the list of recommended O&M spares for the first three (3) years of normal operation along with price details as per the format in Annexure-5. Customer reserves the right to buy any of the recommended spares as considered necessary by them during later stage. The price of recommended spares will not be considered for bid evaluation.

The prices of recommended spares shall be consistent with those of the Initial spares. The validity of prices for these spares shall be up to 1 year from the date of handing over & taking over of the plant.
9.0 TECHNICAL ADVISORY SERVICES FOR SUPERVISION OF ERECTION, COMMISSIONING ASSISTANCE AND SUPPORT FOR PG TEST:

a. Technical advisory services for supervision of erection, commissioning assistance and support for conducting the PG test of Mixed Bed system shall be as per the requirement mentioned in the specification.

b. Minimum no. of man-days shall be 30 (minimum 6 site visits). The man-days shall be exclusive of travel & holidays / weekends. Also the bidder shall provide the per diem rate for supervisory assistance. This will be utilized, if required in future.

c. Erection of all the equipment, piping & valves and instrumentation are in the scope of BHEL. The bidder shall complete the installation / assembly of all the Internals such as headers, laterals, strainer nozzles, distributors, collectors, etc. BHEL will complete the erection of MB Vessels by positioning the MB Vessels on the foundation. Any of the items in the Mixed Bed unit supplied as loose to site shall be assembled by the bidder at site.

d. Bidder to provide necessary technical support and supervision during the erection period and appropriate stage checks shall be carried out to ensure proper erection and for smooth commissioning of MB system.

e. Resin loading is in the scope of Customer / BHEL under the supervision of bidder.

f. For the items (sent to site as loose item) which are to be installed / erected by the bidder within the MB Vessel shall be received and kept under the custody of BHEL site stores. Transportation of materials from Site stores to the RODM building will be handled by BHEL under the supervision of Bidder.

10.0 DOCUMENTATION:

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
10.1 DOCUMENTS TO BE SUBMITTED ALONG WITH BID:

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

1. Complete confirmation to our specification by signing in each page with seal.
2. Duly filled up data sheets as called in the specification Annexure – 1 to 6
3. Technical write-up giving details of equipment.
4. Resin quantity calculations along with resin literature / catalogue and characteristic curves
5. Resin regeneration calculations along with regeneration chemical requirement
6. Resin regeneration sequence with flow rate, duration, effluent details etc.
7. Preliminary P& I diagram along with instrument list.
8. Preliminary Equipment layout drawing
9. Typical internal arrangement drawing.
10. Utility requirements like instrument air, service air and service water for regeneration and rinse etc.
11. Pump performance curves with marked duty point
12. Blower performance curves with marked duty point
13. Sub vendor list for mechanical, electrical and C&I items
15. Preliminary civil requirements
16. Electrical load details Filled up as per Annexure -2
17. Details of Pneumatic Actuator
18. Deviation schedule duly filled, if any as per Annexure- 6. Any deviation should have cost of withdrawal for our evaluation in the commercial bid
19. Un-priced commercial offer on the scope of supply
20. Un-priced commercial offer for the recommended spares list

Note:
In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in Annexure - 6. If there is no deviation “NIL” statement shall be furnished. In the absence of the non-attachment of this Annexure-6, it will be construed that the bid confirms strictly to the specification. Acceptance or rejection of the offer with or without deviations (either fully or partially) is sole discretion of the purchaser without seeking further clarification from the bidder.

10.2 DOCUMENTS TO BE SUBMITTED AFTER ORDER

The following documents/Drawings and data to be furnished for BHEL / customer approval.
Phase – I (for approval) within 3 weeks from the date of purchase order receipt:
1. Technical Write-up and design basis
2. P & ID diagram including pipe sizes and terminal points.
3. Activity chart / Bar Chart and schedules for drawing submission, manufacturing and dispatch of materials.
4. Electrical Load List Filled as per Annexure -2
5. Filled up equipment datasheets for approval as per Annexure – 3
6. Equipment layout showing building details, headroom, equipment.
7. MB system “Control Description” write-up including Valve Sequence Chart.
8. Resin quantity calculations along with resin literature / catalogue and characteristic curves
9. Resin regeneration calculations and resin regeneration sequence with flow rate, duration, effluent details etc.
10. Sizing calculation for all equipment and thickness calculations for all major vessels and tanks.
11. Quality Plan and field quality checks, stage inspection etc. for the above equipments & system
12. Manufacturing drawing of the vessels and equipments, including internal arrangements with Bill of material (BOM)

Phase – II (for review & approval) within 6 weeks from the date of purchase order receipt:
1. Piping and Valve schedule
2. Foundation Design drawings indicating foundation design, load data, anchor bolt location, pocket details, floor & trenches etc.
3. General arrangement drawings for all the equipment showing dimensions and details of materials.
4. Isometric drawing of pipe segments.
5. Cross sectional drawing of pump & blowers etc with BOM
6. Datasheets of Diaphragm operated pneumatic valve, model number, quantity, size, LT motor datasheets etc.
7. Valve schedule Filled up as per Annexure- 4
8. Wiring drawings & GA drawings for Solenoid Valve Enclosure boxes
9. Performance curves for pumps, blowers & motors
   a. Flow Vs Head
   b. Flow Vs efficiency
   c. Flow Vs Power
   d. Flow Vs NPSH

Phase – III (For information & Review)
1. Erection Manual indicating
   a. Erection / Installation instruction of equipment.
   b. Log sheet containing stage check parameters & clearance
   c. Log sheets for alignment Check of pump & motor
d. Field quality checks
2. Performance Test procedure
3. Pump & Blower performance test reports
4. Pump & Blower performance guarantee certificate
5. Operation and maintenance manual indicating, operating procedure for start-up, normal operation, shut down and emergency shut down.
6. Maintenance instruction & assembly
7. Lubrication chart.
8. Test Certificates for all the supplied motors, solenoid valve enclosure boxes.

Note:
Bidder to confirm in their offer that these details called in 10.1 & 10.2 will be provided.

Bidder shall follow the P&ID approved by BHEL’s customer.

Actual P&ID drawing and actual Layout drawing will be provided to the successful bidder after getting the approval from customer.

Bidders are informed that all the requirements such as Valves, instruments, equipment, piping, etc. as per approved P&ID and Layout drawing shall be supplied by the bidder.

Bidders are requested to take a special note of this requirement- ‘there may be some minor change in the P&ID (Preliminary) provided along with this tender for final supply, based on the BHEL’s customer requirement’.

11.0 ATTACHMENTS:
1. Tender P & ID Drg No. : 1-WT-220-01098 Rev.01 (Sheet 1 & Sheet 2)
2. Typical layout Drawing No. : 2-WT-220-00268 Rev.01
3. Specification for Electrical, Control & Instrumentation ROS:4191 , Rev 01
4. Seaworthy packing instructions(Annexure-A).

12.0 DATA SHEETS TO BE SUBMITTED BY BIDDER

The enclosed Data sheet format shall be filled by the bidder along with bid, for scrutiny other wise the bid will be treated as incomplete.

1. Guarantee Data sheet as per Annexure-1
2. Guaranteed Electrical Power Consumption as per Annexure-2
3. Equipment Data Sheet as per Annexure - 3
4. Valves schedule as per Annexure - 4
5. Recommended spares for 3 years O&M with price as per Annexure - 5
6. Technical Deviations as per Annexure - 6
## GUARANTEE DATA SHEET

### I  DEGASSER OUTLET WATER QUALITY

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carbon di Oxide as CO2</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Conductivity</td>
<td>µS/cm</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>pH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### II  MIXED BED OUTLET WATER QUALITY

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Conductivity at 25n Deg. C</td>
<td>µS/cm</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SiO2 as SiO2</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sodium as Na</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Total Hardness as CaCO3</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Organic matter as KMnO4 value</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Carbon di Oxide</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

### III  MB OUTPUT BETWEEN EACH REGENERATION

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NET</td>
<td>Cu.M</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>GROSS</td>
<td>Cu.M</td>
<td></td>
</tr>
</tbody>
</table>

### IV  CHEMICAL REQUIREMENT PER REGENERATION INCLUDING NEUTRALIZATION

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Unit</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HCl - 30%</td>
<td>kg/regen</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NaOH - 48%</td>
<td>Kg/regen</td>
<td></td>
</tr>
</tbody>
</table>

### IV  MIXED BED RESIN

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Unit</th>
<th>Cation / Anion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quantity per vessel</td>
<td>Ltrs</td>
<td>/</td>
</tr>
<tr>
<td>2</td>
<td>Life</td>
<td>Years</td>
<td>/</td>
</tr>
</tbody>
</table>
### ELECTRICAL POWER CONSUMPTION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Eqpt. Description</th>
<th>Qty</th>
<th>Drive rating KW</th>
<th>Conn load. Load KW</th>
<th>Power consumption KW**</th>
<th>Voltage, Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FOR CONTINUOUS OPERATING EQPT.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub total of A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOR INTERMITTENT OPERATING EQPTS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grand Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: **: To be considered for bid evaluation and Guarantee purpose

   W – Working       SB – Standby
ANNEXURE- 3

EQUIPMENT DATA SHEET FOR MIXED BED SYSTEM

1.0 DEGASSER TOWER

1) Application: To reduce CO2 level in the permeate water from R.O. Desalination Plant.
2) Quantity: 
3) Operation: Continuous
4) Tower particulars (Construction):
   - Type: 
   - Make: 
   - Model: 
   - Design Code: 
   - Tower Material of Construction: 
   - Corrosion allowance Shell mm: 
   - Dia x Height mm: 
   - Shell thickness mm: 
5) Surface flow rate design / Max. m3/hr.: / 
6) Specific velocity of water: 
7) Air to water ratio: 
8) Internal Protection: 
9) External protection: 
10) Design Pressure: 
11) Packing material of tower: 
12) Quantity of packing materials: 
13) Packing height: 
14) Inlet Nozzle size, type, rating: 
15) Outlet nozzle size, type, rating: 
16) MOC of Rasching Ring:
2.0 DEGASSER BLOWER

1) Application: To supply air to Degasser Tower
2) Quantity:
3) Operation: Continuous
4) Type:
5) Make:
6) Model:
7) Capacity: m³/hr.:
8) Head: mmWC:
9) Efficiency:
10) MOC of Blower:
    - Casing:
    - Impeller:
    - Shaft:
    - Sleeve:
11) Blower Speed: rpm:
12) Power rating of Motor: KW:
13) Noise level measured at 1 mtr distance:

3.0 MIXED BED UNIT

1) Quantity:
2) Type:
3) Net output, m³/hr:
4) Gross output between regeneration in M³ }:
excluding regeneration hrs.
5) Productive output between each regeneration }:
excluding regeneration hrs. in M³ }
6) Operating cycle excluding regeneration hrs:
7) Duration of regeneration hrs:
    - Regeneration type for Cation:
    - Regeneration type for Anion:
8) Material of Construction of Vessel:
9) Diameter - shell mm :
10) Thickness - shell & Dish Ends mm :
11) Design Flow Velocity m³/hr/m² :
12) Maximum velocity permitted m/s :
13) Internal protection :
   - Shore hardness :
   - Lining Material :
14) External protection :
15) Design Code :
16) Corrosion allowance - Shell / DE mm :
17) Thinning allowance -DE mm :
18) Design Pressure :
19) Test Pressure :
20) Vessel dia x st. height x tot. ht mm :
21) Resin bed ht. Anion / Cation mm :
22) Free Board % :
23) Nozzles size & rating :
   -
   -
   -
   -
24) No.of sight glasses :
25) No of manholes :
26) Details about distributor nozzles :

### 4.0 MIXED BED UNIT RESIN

<table>
<thead>
<tr>
<th></th>
<th>CATION</th>
<th>ANION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Resin make &amp; Model :</td>
<td></td>
</tr>
<tr>
<td>2)</td>
<td>Resin quantity m³ :</td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td>Resin Type :</td>
<td></td>
</tr>
<tr>
<td>4)</td>
<td>Bed Depth m :</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td>Resin Life years :</td>
<td></td>
</tr>
<tr>
<td>6)</td>
<td>Ionic load as CaCO3 mg/l :</td>
<td></td>
</tr>
</tbody>
</table>
7) Regeneration level \( \text{kg/m}^3 \):

8) Operating Exchange Capacity as \( \text{CaCO}_3 \) in \( \text{kg/m}^3 \):

9) Derated Exchange Capacity \( \text{kg/m}^3 \):

10) Qty of Acid 30% & NaOH 48% :

11) Time required / duration for Complete regeneration :

12) Head loss through exchanger \( \text{m} \):

13) Resin Trap provided :

14) Attrition loss of resin per annum :

15) Quantity of DM water required per regeneration with break up cycle :

16) Time required to complete one regeneration : Bidder to provide (max. 4 hrs)

5.0 MIXED BED BLOWER WITH MOTOR

1) Application : To supply air during MB regeneration

2) Quantity :

3) Operation :

4) Type :

5) Make :

6) Model :

7) Capacity \( \text{m}^3/\text{hr.} \):

8) Head \( \text{mmWC} \):

9) Efficiency :

10) MOC of Blower :
    - Casing :
    - Impeller :
    - Shaft :
    - Sleeve :

11) Blower Speed \( \text{rpm} \):

12) Power rating of Motor \( \text{kw} \):

13) Coupling with Guard :

14) Noise level measured at 1 mtr distance :
15) Vibration level : 

6.0 REGENERANT CHEMICAL  
<table>
<thead>
<tr>
<th>:</th>
<th>CATION</th>
<th>ANION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Type &amp; Specification :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Chemical Concentration :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Grade :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Quantity required for each regeneration on % basis :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Protection from outside if any :</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.0 MEASURING TANKS  
<table>
<thead>
<tr>
<th>:</th>
<th>Acid measuring Tank</th>
<th>Alakali measuring Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Quantity :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Type :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Capacity :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Dimensions :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) MOC :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Nozzle size &amp; rating :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) Internal protection :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) Thickness of lining material :</td>
<td></td>
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<td>9) External protection :</td>
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<td>10) Agitator required :</td>
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<td>11) Agitator M.O.C :</td>
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<tr>
<td>12) Level Indicator :</td>
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<tr>
<td>13) Level switches :</td>
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<tr>
<td>14) Fume / CO₂ absorber :</td>
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</tbody>
</table>

8.0 PUMPS: (Separate data sheet shall be filled by the Vendor for all the pumps Viz, MB Feed, MB regeneration, Acid unloading, Alkali unloading)

I. TECHNICAL PARAMETERS  
| 1) Make : |
2) Model :
3) Fluid details
   - Medium handled :
   - pH range :
   - TDS/Chloride range ppm :
   - Temperature range deg.C :
4) Rated flow / Head (at Disch) m³/hr & mwc:
5) Mini. & Max continuous flow m³/hr :
6) Corresponding discharge Head mwc :
7) Shut-off head mwc :
8) NPSH required (minimum) mwc :
9) Design Pressure kg/cm² :
10) Hydraulic test pressure kg/cm² :
11) Pump efficiency at duty point % :
12) BKW reqd. for pump at duty point kw :
13) Maximum KW required kw :
14) Recommended Motor KW kw :
15) Rated speed rpm :
16) Noise level at duty range dbA :
17) Vibration level peak to peak mm :
18) Balancing quality :

II. CONSTRUCTION DETAILS
1) Orientation : Horizontal
2) Suction / Discharge nozzle
   - Size mm :
   - Rating psi :
   - Orientation :
   - Material :
3) Material of Construction / Make
   - Pump Casing :
   - Impeller :
   - Shaft :
# SPECIFICATION FOR MIXED BED SYSTEM

**SPEC. No:** ROS :6186  
**REV:** 02

| - Shaft Sleeve         | : |
| - Fasteners           | : |
| - Others if any       | : |

4) No.of stages :  
5) Impeller type :  
6) Impeller diameter Trimmed / Untrimmed :  
7) Bearings  
   - Type :  
   - Make :  
   - Lubrication oil spec. :  
8) Performance Curve ref Nos. :  
9) Pump dimension L x W x H :  
10) Pump Weight :  

### III. COUPLING
1) Type :  
2) Make, Model No. :  
3) Weight kg :  

### IV. BASE FRAME AND ACCESSORIES
1) Material :  
2) Dimension detail mm :  
3) Weight kg :  
4) Foundation Bolt - Size & Qty mm & Nos  
   - MOC :  

### V. GENERAL
1) Shipping package dimension mm :  
2) Total Assembly / Shipment weight kg :  
3) List of Special tools :  
4) Accessories details :  
5) G.A. Drawing No. :  

Page 53 of 60
9.0 BULK ACID STORAGE TANK

1) Quantity : 
2) Capacity : 
3) Type & Pressure class : 
4) Material of Construction of Vessel :
   - Shell Diameter mm : 
   - Thickness -shell & Dish Ends mm : 
5) Internal protection : 
   - Shore hardness : 
   - Lining Material : 
6) External protection : 
7) Design Code : 
8) Corrosion allowance-Shell/DE mm : 
9) Thinning allowance-DE mm : 
10) Design Pressure : 
11) Test Pressure : 
12) Vessel dia x st. height x tot. ht mm : 
13) Level Indicator : 
14) Nozzles size & rating : 
   - 
   - 
   - 
   - 
15) No of manholes : 
16) Fume absorber : 
17) Accessories : 

10.0 BULK ALKALI STORAGE TANK

1) Quantity : 
2) Capacity : 
3) Type & Pressure class : 
4) Material of Construction of Vessel :
   - Shell Diameter mm : 

- Thickness shell & Dish Ends mm :

5) Internal protection :
   - Shore hardness :
   - Lining Material :

6) External protection :

7) Design Code :

8) Corrosion allowance-Shell/DE mm :

9) Thinning allowance-DE mm :

10) Design Pressure :

11) Test Pressure :

12) Vessel dia x st. height x tot. ht mm :

13) Level Indicator :

14) Nozzles size & rating :
   -
   -
   -
   -
   -

15) No of manholes :

16) CO₂ absorber :

17) Accessories :

11.0 BULK NaOCl STORAGE TANK

18) Quantity :

19) Capacity :

20) Type & Pressure class :

21) Material of Construction of Vessel :
   - Shell Diameter mm :
   - Thickness shell & Dish Ends mm :

22) Internal protection :
   - Shore hardness :
   - Lining Material :

23) External protection :
24) Design Code : 
25) Corrosion allowance-Shell/DE mm : 
26) Thinning allowance-DE mm : 
27) Design Pressure : 
28) Test Pressure : 
29) Vessel dia x st. height x tot. ht mm : 
30) Level Indicator : 
31) Nozzles size & rating :
  - 
  - 
  - 
  - 
  - 
32) No of manholes : 
33) CO₂ absorber : 

Accessories

12.0 DATASHEET FOR LT MOTORS (A.C.)
(To be filled and submitted for approval upon order)
01. Application : Outdoor
02. Type : Premium efficiency class IE3 as per IEC60034-30
03. Frame size :
04. Manufacturer :
05. Rated output in KW : (referred to design temperature)
06. Duty cycle : Continuous, S1
07. Rated voltage, no. of phases and frequency: 415 V, 3 Ph, 50 Hz
08. Allowed voltage variation : □10%.
09. Allowed frequency variation : □5 %
10. Combined voltage and Frequency variation: 10 % (Absolute sum)
11. At rated Voltage and frequency
   a) Full load current (Amps) :
   b) Rated speed :
   c) Full load efficiency :
   d) Full load power factor :
   e) Starting torque in % of FLT :
12. Method of starting : DOL
13. Degree of protection : IP 55
14. Method of ventilation : TEFC
<table>
<thead>
<tr>
<th>Specification Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Class of insulation: &quot;F&quot; (temp. rise limited to cl.B)</td>
</tr>
<tr>
<td>16. Stator winding connection (For continuous run) (Delta / Star)</td>
</tr>
<tr>
<td>17. Full load torque:</td>
</tr>
<tr>
<td>18. Breakdown torque in % of FLT:</td>
</tr>
<tr>
<td>19. Pull up torque in % of FLT:</td>
</tr>
<tr>
<td>20. Locked rotor current in Amps: As per limits of IEC 60034</td>
</tr>
<tr>
<td>21. Motor efficiency and P.F. at 100 % full load:</td>
</tr>
<tr>
<td>22. Locked rotor withstand time under hot/cold condition at 110 % Voltage</td>
</tr>
<tr>
<td>23. Maximum permissible starting time:</td>
</tr>
<tr>
<td>24. No load current in Amps:</td>
</tr>
<tr>
<td>25. Starting time in seconds with driven equipment coupled at 85 % voltage:</td>
</tr>
<tr>
<td>26. Actual temperature rise over an ambient of 40°C when motor is delivering rated output:</td>
</tr>
<tr>
<td>a) By thermometer method:</td>
</tr>
<tr>
<td>b) By resistance method:</td>
</tr>
<tr>
<td>27. Number of successive starts with driven equipment coupled and motor initially at rated load temperature:</td>
</tr>
<tr>
<td>28. Minimum voltage required to bring the driven equipment to rated speed: 80% of RV.</td>
</tr>
<tr>
<td>29. Resistance per phase in ohms at 20 degree:</td>
</tr>
<tr>
<td>30. Direction of rotation viewed from driving end:</td>
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<tr>
<td>31. Make, type and size of bearing:</td>
</tr>
<tr>
<td>a) At drive end:</td>
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<tr>
<td>b) At Non drive end:</td>
</tr>
<tr>
<td>32. Type of mounting and shaft Orientation:</td>
</tr>
<tr>
<td>33. Location of terminal box viewed from driving end: RHS/LHS/TOP</td>
</tr>
<tr>
<td>34. Type and number of terminals brought out:</td>
</tr>
<tr>
<td>35. Type and size of cable gland entry: (type &amp; size will be given during Detail engg)</td>
</tr>
<tr>
<td>36. Cable gland entry (Top / Bottom):</td>
</tr>
<tr>
<td>37. Tropical &amp; fungicidal treatment: Yes/No</td>
</tr>
<tr>
<td>38. GD2 of the motor:</td>
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<tr>
<td>39. Weight of the motor:</td>
</tr>
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### VALVE SCHEDULE – DATA SHEET TO BE FILLED BY THE BIDDER

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Service</th>
<th>Valve Type</th>
<th>Size</th>
<th>BODY</th>
<th>Disc / Ball / Diaphragm</th>
<th>Stem / Shaft</th>
<th>Valve seat / Seat ring</th>
<th>Hinge Pin</th>
<th>Valve Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual valves</td>
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<tr>
<td>2</td>
<td>Pneumatic Valves</td>
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<td>3</td>
<td>Check Valves</td>
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### Annexure- 5

**RECOMMENDED SPARE FOR 3 YEARS O&M WITH PRICE**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of the equipment</th>
<th>Description of spares</th>
<th>Quantity</th>
<th>Price</th>
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ANNEXURE - 6

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