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- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

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

6.03.04 Select an adhesive:

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

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

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- e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

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

6.04.01 Surface Preparation:

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

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

6.04.03 Coating Application :

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

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

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

6.05.02 Electrical Inspection :

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

7.00.00 INFORMATION/ DATA REQUIRED

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

NOTE-

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

ANNEXURE VI

MANDATORY SPARE LIST

182326/2021/PS-PEM-MAX:


**5X800 MW YADADRI THERMAL POWER
STATION**
**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

 SPECIFICATION NO. PE-TS-417-155A-
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MANDATORY SPARES LIST FOR CONDENSATE POLISHING UNIT

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

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

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

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

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

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

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

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NOTES:

- i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.
- ii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.
- iii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for station, as specified above.
- iv) All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract.
- v) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.
- vi) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- vii) Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment.
- viii) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares.
- ix) In case mandatory spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities in line with list of mandatory spares.

THE VENDOR WARRANTS:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
2. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty-Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the

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

4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
6. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.
7. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
8. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
9. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

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ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

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

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

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

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

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

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

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

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

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

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

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

Note- The drawing/document marked as (*) shall be considered as basic drawings/documents. In addition to above bidder to refer Sub Section-, IA, IB, IC, IIB & IIC for documents related to Electrical & Control & instrumentation respectively.

Notes:

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

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- b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.
 - f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
 - g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
 - h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing no.
 - i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
 - j) Bidder to follow the following the drawing submission schedule:
 - k) 1st submission of drawings from date of LOI as per the submission schedule.
 - l) Every revised submission incorporating comments – within 10 days.
 - m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.
5. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:
- Internet explorer version – Minimum Internet Explorer 7
 - Internet speed – 2 mbps (Minimum preferred)
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 - Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

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ANNEXURE VIII
WATER ANALYSIS

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CLARIFIED WATER ANALYSIS

S.No.	CONSTITUENTS	As	CONTENT
1.	Calcium	CaCO ₃	121.9 ppm
2.	Magnesium	CaCO ₃	74.1 ppm
3.	Sodium	CaCO ₃	184.4 ppm
4.	Potassium	CaCO ₃	1.1 ppm
5.	Iron in Soln.	Fe	Nil
	TOTAL CATIONS	CaCO₃	381.5 ppm
6.	Bicarbonate	CaCO ₃	134.8 ppm
7.	Sulphate	CaCO ₃	80.9 ppm
8.	Chloride	CaCO ₃	161.0 ppm
9.	Nitrate	CaCO ₃	3.5 ppm
10.	Phosphate	CaCO ₃	Nil
11.	Fluoride	CaCO ₃	1.3 ppm
	TOTAL ANIONS	CaCO₃	381.5 ppm
12.	Reactive Silica	SiO ₂	14.1 ppm
13.	Colloidal Silica	SiO ₂	Nil
14.	Total Silica	SiO ₂	14.1 ppm
15.	Nitrites	NO ₂	Nil
16.	Total Hardness	CaCO ₃	196 ppm
17.	Total Suspended Solid		15 ppm
18.	pH value at 25°C	-	8.0
19.	Turbidity		15 NTU

Note:

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

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ANNEXURE IX

LIST OF TOOLS & TACKLES (AS APPLICABLE)

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

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ANNEXURE X

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

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

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

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

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

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ANNEXURE XI

SITE STORAGE AND PRESERVATION

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CONTENT

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- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

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1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

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

- a. Rust preventive fluid (RPF)
- b. Rust protective paints
- c. Tarpaulin covers, in case of outdoor storage
- d. De-oxy aluminate for weld-ments

c) **GENERAL INSPECTION REQUIREMENTS**

1. Period inspection of materials with specific reference to –

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

2. Any damages to equipment / materials.

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

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4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



ii Semi-closed storage. (S)

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



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iii Open storage (O)

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

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

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



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

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

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**5X800 MW YADADRI THERMAL POWER
STATION**
**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

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SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

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

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

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

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5. CONCLUSION

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

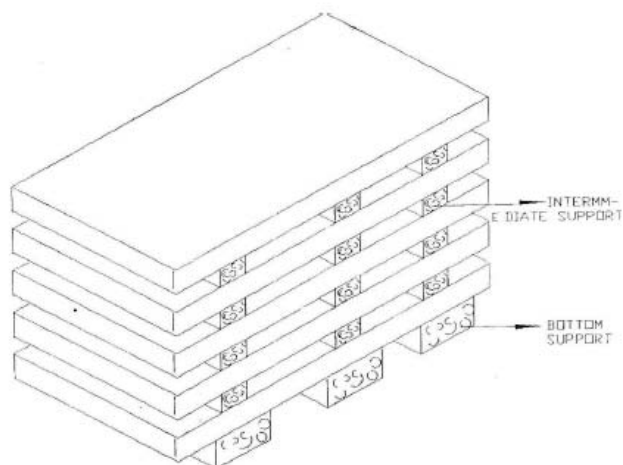


Figure – 1 – PLATE STACKING ARRANGEMENT

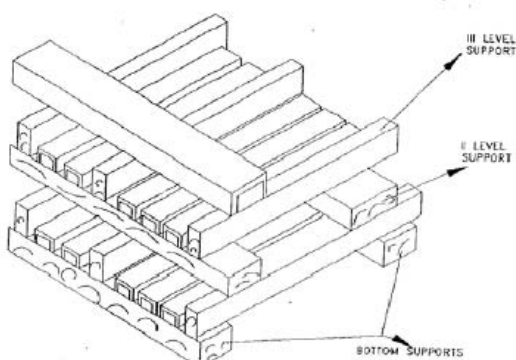


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

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ANNEXURE XII

GENERAL TECHNICAL REQUIREMENTS (GTR)

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	RESPONSIBILITY FOR DESIGN
3.00.00	NAME PLATES (RATING PLATES)
4.00.00	SAFETY AND SECURITY
5.00.00	GUARDS
6.00.00	LOCATION AND LAYOUT REQUIREMENTS
7.00.00	OPERATION, MAINTENANCE AND AVAILABILITY CONSIDERATIONS
8.00.00	MATERIALS
9.00.00	LUBRICATION
10.00.00	LUBRICANTS & CONTROL FLUIDS
11.00.00	OPERATION AND MAINTENANCE
12.00.00	PLANT LIFE AND MODE OF OPERATION
13.00.00	PACKAGING & MARKING
14.00.00	PROTECTION
15.00.00	ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT
16.00.00	INSPECTION AND TESTING
17.00.00	TRAINING OF OWNER'S PERSONNEL
18.00.00	DEVIATIONS
	ATTACHMENTS
ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE
ANNEXURE-II	CRITERIA FOR LAYOUT

SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 **CODES AND STANDARDS**

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

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

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

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

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

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

2.00.00 **RESPONSIBILITY FOR DESIGN**

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

- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.
- 3.00.00 **NAME PLATES (RATING PLATES)**
- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.
- 4.00.00 **SAFETY AND SECURITY**
- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

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

- 4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.
- 4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.
- 4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.
- 5.00.00 **GUARDS**
- 5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.
- 5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.
- 5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.
- 5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.
- 5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00

LOCATION AND LAYOUT REQUIREMENTS

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

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

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

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

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 **OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS**

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

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

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

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

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

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

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

8.00.00 **MATERIALS**

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

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

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

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

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

9.00.00 **LUBRICATION**

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

9.02.00 Non ferrous capillary tubing shall be used throughout.

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

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

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

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

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

- 10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.
- 10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
- 10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

- 11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.
- The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.
- 11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.
- 11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.
- 11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 PLANT LIFE AND MODE OF OPERATION

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

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

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

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

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

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

13.00.00 PACKAGING & MARKING

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

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

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

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

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

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

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

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

14.00.00 **PROTECTION**

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

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

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

piping, tubing and conduit shall be sealed and taped.

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

15.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

15.01.00 **Environment Protection**

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

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

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

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

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

15.02.00 **Noise Level Requirement**

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

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

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

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

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

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

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

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

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

consultant for record purpose.

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

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

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

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

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

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

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

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

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

16.02.00 **Performance Tests at Site**

- 16.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

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

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

17.01.00 Training at Contractor's Premises

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

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

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

60 heads

60

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

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

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

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

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

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

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

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

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

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

The Contractor shall provide qualified English speaking instructors and training

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

17.02.00 **Operation and Maintenance Training at Site**

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

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

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 **On-the-Job Training**

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

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

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

18.00.00 **DEVIATIONS**

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

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

ANNEXURE-I**LIST OF STANDARDS FOR REFERENCE**

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).

- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) The Air Prevention and Control of Pollution Act.
- jj) The Environmental Protection Act
- kk) The Public Liability Insurance Act.
- ll) The Forest Conservation Act
- mm) The Wildlife protection Act.
- nn) The EIA Notification, 1994.
- oo) IS: 14665-Specification for Electric Traction Lift
- pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

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

ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres
b) Soil coverage over underground pipes	1.0 Metre (minimum)
5. Railway Wagon clearance	Rules of the Indian Railways
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm above FGL
b) all outdoor paved areas	100 mm above FGL
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d) Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

A. Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1. Horizontal, in all directions	
a) Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm
b) Adjacent to any other plant facilities (including walls/structures)	1000 mm
2. Vertical (head-room clearance)	
a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.5 Metre
b) Under any other plant facilities (including structures, pipes etc.)	2.5 Metre

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

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

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

182326/2027/PS-PEM-MAX :



5X800 MW YADADRI THERMAL POWER
STATION

TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT

SPECIFICATION NO. PE-TS-417-155A-
A001

SECTION : I

SUB-SECTION:

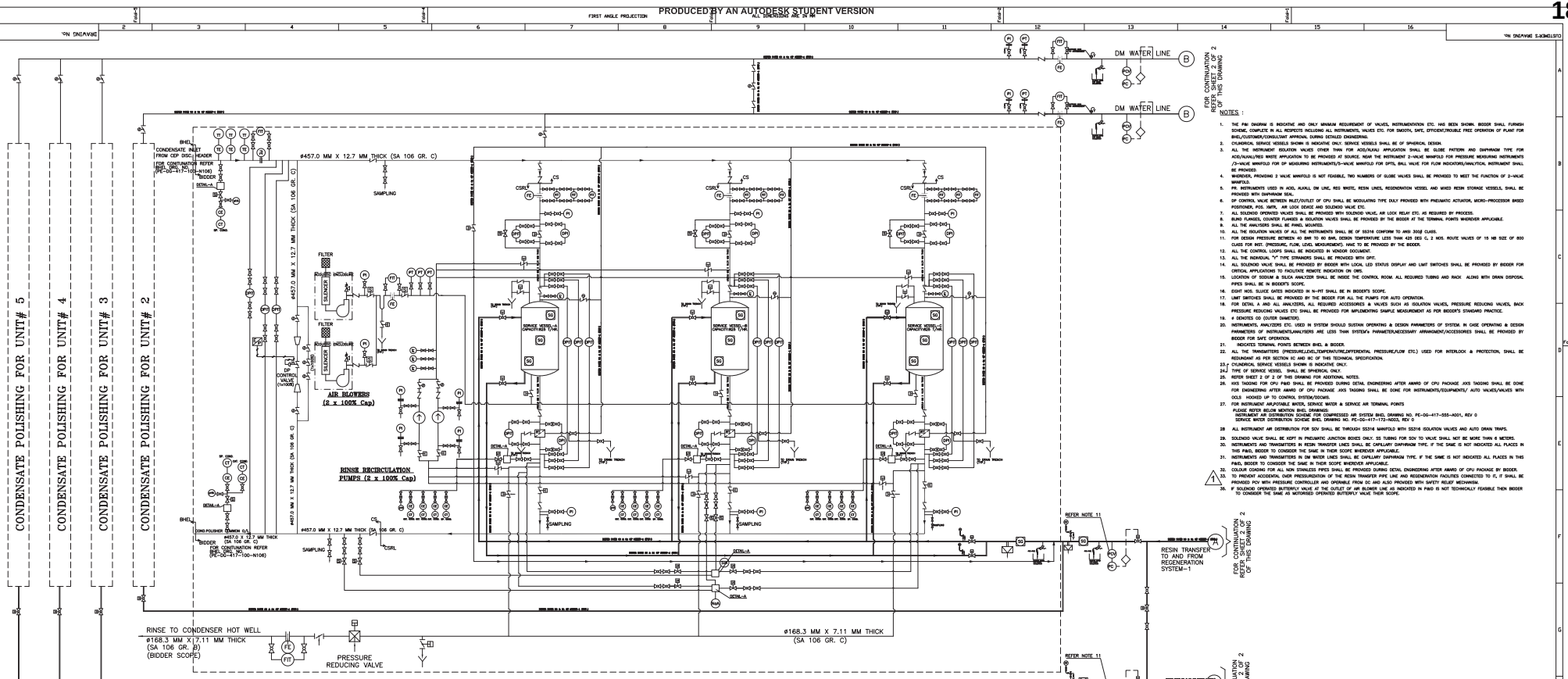
REV. NO. 00

DATE :

P & ID

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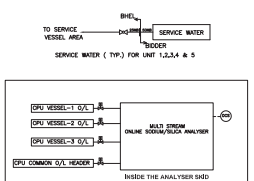
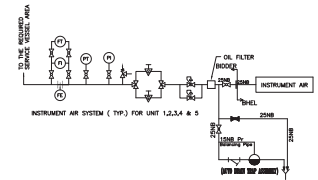
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CONDENSATE POLISHING SERVICE VESSEL AREA FOR UNIT-1 (TYPICAL)

LEGEND			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE		DRAIN
	BUTTERFLY VALVE		OVERFLOW SEAL POT/CO ₂ ABSORBER
	GLOBE VALVE		RUPTURE DISC
	DIAPHRAGM VALVE		PRESSURE REDUCING VALVE
	MOTORISED VALVE		CONDENSATE LINE
	PRESSURE RELIEF VALVE		D.M.WATER/DRAIN LINE
	NON RETURN VALVE		RINSE WATER LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ACID SOLUTION LINE
	SOLENOID VALVE		ALKALI SOLUTION LINE
	RESIN TRAP		RESIN TRANSFER LINE
	SIGHT GLASS		FIELD MOUNTED INSTRUMENT
	DOUBLE ACTING P.N.I.CYLINDER OPERATOR		CONCENTRATION ANALYSER
	PNEUMATICALLY OPERATED CONTROL VALVE		PULSATION DAMPER
	"Y" TYPE STRAINER		DIAPHRAGM SEAL
	PRESSURE CONTROL VALVE		AUTO DRAIN TRAP

	CATION CONDUCTIVITY ANALYSER		LIT	LEVEL INDICATING TRANSMITTER
	SPECIFIC CONDUCTIVITY ANALYSER		LI	SODIUM ANALYSER (MULTI CHANNEL)
	CONTROL SYSTEM		CIT	CONDUCTIVITY INDICATING TRANSMITTER
	LS		DI	DENSITY INDICATOR
	TE		TE	TEMPERATURE ELEMENT
	PI		LI	LEVEL INDICATOR
	PT		PHE	pH ELECTRODE
	TI		pHk	pH ANALYSER
	F1		SI	SILICA ANALYSER (MULTI CHANNEL)
	CE		Ⓟ	ORIFICE (Pressure Breakdown)
	FIT		LT	LEVEL TRANSMITTER
	DPh		SC	SAMPLE COOLER
	DPT		AF	AIR FILTER REGULATOR
	FT			
	FE			
	CT			
	DPT			
	FS			
				



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

[illegible]

CUSTOMER:	 TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, NALGONDA
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	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT Noida	Date: _____ Page: _____
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TITLE	P & ID FOR CONDENSATE POLISHING UNIT		
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182326/2021/PS-PEM-TMAX

	5X800 MW YADADRI THERMAL POWER STATION		SPECIFICATION NO. PE-TS-417-155A-A001	
			SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

DATASHEET – A

1.0	DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of TG units	Five (5) nos.
(ii)	Capacity of each unit	800 MW
(iii)	Total flow in all working service vessels of each units	1650.0 Tons/hr (VWO, 1% Make Up condition)
2.0	CONDENSATE POLISHER SERVICE VESSELS PER UNIT :	
(i)	No. of condensate polisher service vessel per TG unit	Three (3X50%) nos. per TG unit
(ii)	Total Number required for all 5 TG units	15 nos.
(iii)	Capacity of each condensate polisher service vessel	50% of total condensate flow per unit
(iv)	Flow through each condensate polisher service vessel per unit	825 Tones per hour
(v)	Operating pressure of each condensate polisher service vessel	31.27 kg/cm2 (g)
(vi)	CEP shut off pressure	38.8 kg/cm2 (g)
(vii)	Design pressure of each condensate polisher service vessel	47 kg/cm2 (g)
(viii)	Design code of each condensate polisher service vessel	ASME Sec VIII div 1 Latest edition / IS 2825 as applicable
(ix)	Process design Temperature	51.8 °C
(x)	Design temperature of service vessel, its internals and accessories	60 °C
(xi)	Type of vessels	Spherical
(xii)	Percentage deration to be considered on design exchange capacity for design of the system	Minimum 10 %
(xiii)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(xiv)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers] with shore hardness 65 ± 5 in Scale-A.
(xv)	Output between two successive regeneration (each Service vessel)	198000 Tons (Under Normal run condition) 39600 Tons (Under startup condition) 39600 Tons (Under condenser tube leakage condition)
(xvi)	Cycle time	240 hours (Under Normal run condition) 48 hours (Under startup condition) 48 hours (Under condenser tube leakage condition)
(xvii)	Average velocity of condensate through service vessels/Surface flow rate	≤ 120 m/ hour
(xviii)	Resin bed depth (Minimum)	1100 mm
(xix)	Resin traps at the outlet of each condensate polisher service vessel & rinse outlet	SS-316 with SS 316 Internals
2.1	RINSE RECIRCULATION PUMPS PER UNIT:	
(i)	Number	Two (2x100%) nos. per TG unit
(ii)	Total Number required for all 5	10 nos.

182326/2021/PS-PEM-MAX

	5X800 MW YADADRI THERMAL POWER STATION	SPECIFICATION NO. PE-TS-417-155A-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: IA	
		REV. NO. 00	DATE :

	TG units	
(iii)	Type	Horizontal, centrifugal
(iv)	Service/Duty	Intermittent
(v)	Capacity & head	As per System requirement
(vi)	Suction condition	Flooded
(vii)	Material of construction	
	Casing, impeller	SS 316
	Shaft	SS 410
	shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Pump Speed	Maximum 1500 rpm
(x)	Accessories required for each pump	Common base plate, coupling guards, drain plug, vent valve, isolation valves, Y-type strainers etc.
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615
(xii)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xiii)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xiv)	Dynamic Balancing Test	To be provided

2.2 AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER UNIT

(i)	Number per unit	Two (2x100%) nos. per TG unit
(ii)	Total Number required for all 5 TG units	10 nos.
(iii)	Type	Rotary, Twin Lobe, oil free, positive displacement
(iv)	Duty	Intermittent
(v)	Capacity and head	As per System requirement
(vi)	Noise level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Location	Indoor
(ix)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(x)	Accessories	With acoustic enclosure for each blower
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615
(xii)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xiii)	Dynamic Balancing Test	To be provided

3.0 EXTERNAL REGENERATION FACILITIES (Consists of 2 sets of external regeneration)

3.1 REGENERATION VESSELS

a. RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL (FOR BOTH REGENERATION SYSTEM 1ST & 2ND)

(i)	Total Number required	Two (2) nos. vessel
(ii)	Design Temperature	60°C

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

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

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

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(xv)	MOC for piping, valves & fittings in acid handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xvi)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.	
(xvii)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xviii)	Dynamic Balancing Test	To be provided	
3.5	ALKALI UNLOADING / TRANSFER PUMPS(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)		
(i)	PUMPS	Alkali unloading/Transfer pumps for 1st set of Regeneration system	Alkali unloading/Transfer pumps for 2nd set of Regeneration system
(ii)	Number required	Two (2x100%) nos. (1W+1S)	Two (2x100%) nos. (1W+1S)
(iii)	Type	-----Horizontal Centrifugal-----	
(iv)	Location	-----Outdoor-----	
(v)	Service	-----Intermittent-----	
(vi)	Pressure gauge	----- One per pump with Teflon diaphragm seal-----	
(vii)	Capacity and head	-----10 m3 / hr and 10 MLC (minimum)-----	
(viii)	Liquid to be handled	48% NaOH	48% NaOH
(ix)	Material of construction		
	Casing	SS-316	SS-316
	Impeller	SS-316	SS-316
	Shaft	SS-410	SS-410
	Types of shaft sealing	Mechanical seal	Mechanical seal
(x)	Pump speed	1500 rpm	1500 rpm
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xii)	Accessories required	Coupling guard, drain plug, vent valve ,suction hoses, isolation valves, Y- type strainers etc. for each pump.	
(xiii)	Type of coupling between motor and pump	Flexible coupling	
(xiv)	Reinforced rubber house with coupling and isolation valve	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber	Two (2) Nos. of size 80NB, minimum 20 meter length with isolation valve, Reinforced Chemical Resistant Rubber
(xv)	MOC for piping, valves & fittings in alkali handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xvi)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.	
(xvii)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xviii)	Dynamic Balancing Test	To be provided	
3.6	CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM		
a)	ALKALI TRANSFER CUM RECIRCULATION PUMPS WITH MOTOR(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)		
(i)	Total Nos. required	Four (4x100%) (2 W+ 2 SB)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Location	Outdoor	

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(v)	Pressure gauge	One per pump with Teflon diaphragm seal	
(vi)	Maximum Pump Speed	1500 rpm	
(vii)	Type of Coupling between pump & motor drive	As per manufacturer's standard practice	
(viii)	Type of Sealing	Mechanical Seal	
(ix)	Type of Suction Strainer	Y- Type	
(x)	Concentration of working media.	44 - 48% Sodium Hydroxide (NaOH)	
(xi)	Capacity & head of each pump	10 m3/hr & 10 MLC (minimum)	
(xii)	Suction condition	Flooded	
(xiii)	Materials of construction		
a.	Casing, impeller	Stainless Steel – 316	
b.	Shaft	Stainless Steel -410	
(xiv)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xv)	Accessories required	Coupling guard, drain plug, vent valve , isolation valves, Y- type strainers etc. for each pump.	
(xvi)	Type of coupling between motor and pump	Flexible coupling	
(xvii)	MOC for piping, valves & fittings in alkali handling	For valve -CPVC PN10 minimum, For piping, flanges & fittings –CPVC Sch. 80 minimum	
(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.	
(xix)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xx)	Dynamic Balancing Test	To be provided	
b)	CHEMICAL TANKS (FOR BOTH REGENERATION SYSTEM 1ST & 2ND)	ALKALI MEASURING CUM PREPEARTION TANK	ACID MEASURING TANK
(i)	Total Number required	Two (2) nos.	Two (2) nos.
(ii)	Type	Vertical cylindrical atmospheric with dished bottom and cover at top	
(iii)	Liquid to be handled	48% NaOH	30-33% HCL
(iv)	Location	----- To be designed for indoor duty -----	
(v)	Useful capacity (each tank)	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	Adequate to hold quantity of acid required (30-33% HCL) for single regeneration of a condensate polisher mixed bed with 20% overall margin.
(vi)	Material (Shell, Dished end & top cover)	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Top cover - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(vii)	Internal protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(viii)	External painting	As per BHEL/ TSGENCO approved painting schedule	
(ix)	Level indicator	Provided	Provided
(x)	Level transmitter per tank	As per CPU P&ID	As per CPU P&ID
(xi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable

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

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(xviii)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.	
(xix)	Type of coupling between Pump & Motor	Flexible Spacer	
(xx)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xxi)	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.	
(xxii)	Hydro-test	As per IS-1520 and IS-5120.	
(xxiii)	Dynamic Balancing Test	To be provided	
(xxiv)	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and CPU tender P&ID Drawings.	
(xxv)	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility.	
(xxvi)	Trip interlock	To be provided.	
d)	Density Meter	Acid	Alkali
(i)	Total Number	One (1) at each mixing tee outlet (Total 2 nos.)	One (1) at each mixing tee outlet (Total 2 nos.)
(ii)	Type	Density indicator (Hydrometer type)	Density indicator (Hydrometer type)
(iii)	Indication	Local	Local
(iv)	Location	Diluted Acid line	Diluted Alkali line
e)	Flow Indicator		
(i)	Number	One in each DM water line(Total 2 nos.)	One in each DM water line(Total 2 nos.)
(ii)	Type	Rotameter	Rotameter
f)	Flow Transmitter	One in each water line (Total 4 nos.) /As per CPU tender P&ID	
g)	Concentration Analyzer	One (1) at each mixing tee outlet (Total 4 nos.)/ As per CPU tender P&ID	
3.7	ACTIVATED CARBON FILTER FOR ALKALI(FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)		
(i)	Total Numbers required	Two (2) nos.	
(ii)	Type	Vertical cylindrical with dished ends	
(iii)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2(g) whichever is maximum	
(iv)	Time Period for each Service Cycle between two consecutive regenerations, in hrs.	24	
(v)	Design Temperature(in °C)	60	
(vi)	Capacity	10 m3/hr (minimum) or Not less than the design capacity of alkali transfer cum recirculation pump	
(vii)	Surface flow rate/Velocity through each ACF	Not more than 15 m3/m2 /hr	
(viii)	Bed depth	1200mm activated carbon + 300 mm Gravel support (Min)	
(ix)	Percentage Free board	75% minimum	
(x)	Pressure gauge	As per CPU tender P&ID.	

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

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		gauges -2 nos. (minimum), operating platform, ladders, lifting lugs (4 Nos. minimum) etc.
3.9	CPU REGENERATION CUM RESIN TRANSFER PUMPS FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)	
(i)	Total Numbers required	Four (4x100%) nos. (2W+2SB)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Intermittent
(iv)	Liquid to be handled	DM Water
(v)	Capacity & head	To be selected by the Bidder as necessary to meet the system requirements
(vi)	Suction condition	Flooded
(vii)	Material of construction	
	• Casing & impeller	SS 316/ ASTM A 351 CF 8M
	• Shaft	SS 410
	• Wearing rings	As per manufacturer's Standard
	• Shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Mechanical Seal	To be Provided by bidder
(x)	Pump Speed	Maximum 1500 rpm
(xi)	Pressure gauge	One for each pump with Teflon diaphragm seal
(xii)	Recirculation line with motor actuated valve	Provided
(xiii)	Accessories required for each pump	Common base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.
(xiv)	Drive motor	The drive motor of each Pump will be Energy Efficiency Class IE-3 as per IS : 12615
(xv)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xvi)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
(xvii)	Dynamic Balancing Test	To be provided
3.10	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA) (FOR BOTH REGENEARTION SYSTEM 1ST & 2ND)	
(i)	Total Numbers required	Four (4x100%) Nos. (2W+2SB) with acoustic enclosure
(ii)	Type	Rotary ,Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As per system requirement
(vi)	Noise Level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(x)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.

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(xi)	Dynamic Balancing Test	To be provided
4.0	NEUTRALISING SYSTEM	
4.1	Neutralization Pit for 1st set of Regeneration system	
(i)	Number	One (1) no. Pit with two (2) compartments
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided by bidder in each compartment for effective neutralization of the waste effluent for air agitation
(iii)	Material of Construction	RCC inside lined with PVC sheet (3 mm thick).
(iv)	No. of compartments	Two compartments
(v)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of Condensate Polisher Mixed Bed plus 20% overall margin.
(vi)	Gates	Four Nos. (in bidder's scope) for each neutralization pit. MOC of the gates will be Carbon Steel rubber lined.
4.2	Neutralization Pit for 2nd set of Regeneration system	
(i)	Number	One (1) no. Pit with two (2) compartments
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided by bidder in each compartment for effective neutralization of the waste effluent for air agitation
(iii)	Material of Construction	RCC inside lined with PVC sheet (3 mm thick).
(iv)	No. of compartments	Two compartments
(v)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of Condensate Polisher Mixed Bed plus 20% overall margin.
(vi)	Gates	Four Nos. (in bidder's scope) for each neutralization pit. MOC of the gates will be Carbon Steel rubber lined.
4.3	Neutralization Pit Disposal Pumps for 1st set of Regeneration system	
(i)	Number	Two (2X100%) nos. (1 working + 1 Standby)
(ii)	Type	Vertical Centrifugal
(iii)	Capacity & head	Capacity= 100 M3/Hr min. (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours) Head- As per system requirement (Margins shall be considered as defined elsewhere in this Technical specification under section C1)
(iv)	Duty	Intermittent
(v)	Pump Speed	1500 rpm
(vi)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC ; Energy Efficiency Class IE-3 as per IS : 12615
(vii)	Material of Construction	
	Casing	DUPLEX Stainless steel
	Impeller	DUPLEX Stainless steel
	Shaft	DUPLEX Stainless steel
	Pump Wetted Parts	DUPLEX Stainless steel
(viii)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(ix)	Accessories required for each pump	Base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, Pressure transmitter ,pulsation dampener etc.
(x)	Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum

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		power required by the Pump.	
(xi)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xii)	Dynamic Balancing Test	To be provided	
4.4	Neutralization Pit Disposal Pumps for 2 nd set of Regeneration system		
(i)	Number	Two (2X100%) nos. (1 working + 1 Standby)	
(ii)	Type	Vertical Centrifugal	
(iii)	Capacity & head	Capacity= 100 M3/Hr min. (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours) Head- As per system requirement (Margins shall be considered as defined elsewhere in this Technical specification under section C1)	
(iv)	Duty	Intermittent	
(v)	Pump Speed	1500 rpm	
(vi)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC ; Energy Efficiency Class IE-3 as per IS : 12615	
(vii)	Material of Construction		
	Casing	DUPLEX Stainless steel	
	Impeller	DUPLEX Stainless steel	
	Shaft	DUPLEX Stainless steel	
	Pump Wetted Parts	DUPLEX Stainless steel	
(viii)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615	
(ix)	Accessories required for each pump	Base plate, Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, Pressure transmitter ,pulsation dampener etc.	
(x)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.	
(xi)	Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).	
(xii)	Dynamic Balancing Test	To be provided	
4.5	Chemical Tanks for N-pit	Acid Measuring Tank –N. pit for 1st set of Regeneration system	Acid Measuring Tank –N. pit for 2nd set of Regeneration system
(i)	Number required	One (1) No.	One (1) No.
(ii)	Type	Vertical cylindrical atmospheric with dished bottom and cover at top	
(iii)	Location	----- To be designed for outdoor duty -----	
(iv)	Liquid to be handled	30-33% HCL	30-33% HCL
(v)	Useful capacity for each tank	Suitable to meet the requirement for neutralisation of excess alkali present in the regeneration waste effluent from CPU + 20% margin	
(vi)	Material (Shell, Dished end & top cover)	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Top cover - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(vii)	Internal protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]. with shore hardness 65 ± 5 in Scale-A.	
(viii)	External painting	As per BHEL/ TSGENCO approved painting schedule.	
(ix)	Level indicator for each tank	Provided	Provided

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

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(x)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xi)	Dynamic Balancing Test	To be provided by bidder
4.8	AIR-BLOWERS FOR N-PIT (REGENERATION AREA) (FOR 2nd REGENERATION SYSTEM)	
(i)	Total Numbers required	Two (2x100%) Nos. (1W+1SB) with acoustic enclosure
(ii)	Type	Rotary ,Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As per system requirement
(vi)	Noise Level	85 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
(x)	Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
(xi)	Dynamic Balancing Test	To be provided by bidder
5.0	PIPING & VALVES	
(i)	Resin Transfer piping	ASTM A 312 Gr. TP 304 Schedule 10S; Minimum pipe Size: NB80 Velocity : 2-3 m/s
(ii)	DM water line	ASTM A 312 Gr. TP 304 Schedule 40S for Piping less than and equal to 50 mm NB & ASTM A 312 Gr. TP 304 Schedule 10S for piping equal to greater than 65 mm NB
(iii)	Piping-Service Vessel Inlet	Piping-ASTM A 106 Gr C Ball Valves – SS-(CF8M) BFV – ASTM A 216 Gr. WCB- Body SS-(CF8M) - disc.
(iv)	Piping-Service vessel Outlet	Piping – ASTM A 106 Gr. C BFV – SS-(CF8M) - Body & disc both. Ball Valves – SS-(CF8M)
(v)	Service vessel bypass piping (Butterfly Valves)	Piping – ASTM A 106 Gr. C BFV – ASTM A 216 Gr. WCB – body CF8M -Disc
(vi)	Service vessel Rinse to condenser Hot well line piping & Rinse recirculation pumps suction, discharge , rinse recirculation line	CS to ASTM A 106 Gr. B & CS to ASTM A 106 Gr. C respectively
(vii)	Effluent Transfer Piping	Piping, & Fittings shall be CSRL only & valves shall be minimum PN 10 rating.
(viii)	Acid & Alkali Regeneration piping all concentration (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 80 (minimum) only & valves shall be PN 10 rating (minimum).
(ix)	Acid / Alkali Transfer piping all concentration (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 80 (minimum) only & valves shall be PN 10 rating (minimum).

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

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

10.0 PUMPS AND PIPE SELECTION CRITERIA.

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

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

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

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

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

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