

Form No:	 PE&SD	TECHNICAL SPECIFICATION FOR	PY 52 283
		GYPSUM DEWATERING SYSTEM PACKAGE	Rev. No. 00
		MAHAGENCO BHUSAWAL 1 X 660 MW TPS - FGD	Page 2 of 60

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CLAUSE NO.	DESCRIPTION
1.0.00	PROJECT INFORMATION
a)	Client Name : Maharashtra State Power Generation Co. Limited
b)	Plant Name : Bhusawal Unit-6: 1X660
c)	Project Name : Bhusawal 1X660 MW.
d)	Consultant Name : DCPL.
e)	Plant capacity : 1X660 MW
f)	Plant location : Deepnagar, Bhusawal, Maharashtra 425307
g)	Buyer : BHEL-PE&SD (HYD)
	Site Condition
a)	Ambient Temperature(Guarantee) : 27 Deg C
b)	Ambient Temperature (Design) : 45 Deg C
c)	Relative Humidity : 60%
d)	Project Owner : Maharashtra State Power Generation Co. Limited
	Note: 1) Guarantee point conditions shall apply for the Guarantee Values as well as for the Guarantee test/Performance test 2) Equipment and Material must be suitable for the range of ambient site conditions. 3) Vendor to submit the GA drawings of the vacuum belt filter and associated equipment along with his offer. The dimensions indicated by the bidder in his GA'S shall be binding, and any change of the same shall not be admissible after the award of PO 4) Vendor to quote all the listed items and any incomplete offer will be liable for rejection. 5) In case of any queries on the Technical matters, non-availability of specifications etc., bidder shall contact BHEL within 3 days of receipt of Enquiry for seeking clarifications. This will not be used for extending technical bid submission due date or delay of procurement cycle time. No queries will be entertained after Bid submission is completed. 6) All the documentation and communication shall be in English language only.
2.0.0	APPLICABLE CODES AND REGULATIONS
	The design and materials shall confirm to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the gypsum dewatering system shall follow the latest applicable Indian/ASME/BS EN Standards. Other standards are not acceptable.
3.0.0	INTENT OF SPECIFICATION
a)	This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, delivery at site, supervision of erection & commissioning and performance testing of Gypsum Dewatering System along with accessories which is to furnished in the Flue Gas Desulphurization plant of BHUSAWAL 1X660MW project.
b)	Bidder shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
c)	It is not the intent to completely specify all the details of supply. Nevertheless, the finished product shall confirm to highest standards of Engineering & Manufacturing and shall be capable

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	of performing in continuous commercial operation in a manner acceptable to the Purchaser and end customer	
d)	There is (1) units of 660 MW and this unit is envisaged with one (1) FGD system. Two (02) Sets of Gypsum Dewatering system (1 working + 1 standby) shall be provided.	
e)	The Bidder shall offer only proven design, which meets the Provenness criteria indicated in the clause no: 4.0. Necessary document evidences as per Annexure-I shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, they are denied to participate in this tender.	
f)	In case, the Bidder considers deviations essential (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document" (Annexure-V). Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable. No deviation or exception shall be permitted without the written approval of the purchaser.	
g)	In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the system, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.	
h)	All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.	
4.0.0	QUALIFICATION REQUIREMENT (QR)	
	Refer to Annexure-I for detail on Qualification Requirement (QR).	
5.0.0	TECHNICAL INFORMATION	
1.	Quantity of gypsum dewatering system	Two (2) Numbers (one working +one standby)
2.	Capacity of gypsum dewatering system	20.1 tones per hour (wet cake) for each belt filter
3.	Moisture content	10%
4.	Gypsum purity	90%
5.	Electrical Power Supply Details: i. Available Power supplies List: a). Medium Voltage: 11KV/3.3KV AC $\pm$ 6% b). Low Voltage: 415V/240 AC $\pm$ 10% c). Frequency : 50 Hz $\pm$ 5% d). Combined variation of voltage and frequency: 10% (Absolute sum) d) DC Voltage : 220V DC, -15% to +10% f) System fault level: -11KV System: 44KA per 1 Sec --3.3KV System: 44KA per 1 Sec -415V System: 50KA per 1 Sec g) System grounding:HT System: Resistance ground & Lt System: Solid grounding	

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	ii. Power Distribution Philosophy: a). Motors ≥ 1000KW: 11KV AC b). Motors >160KW to <1000KW: 3.3KV AC c) Motors ≥ 0.20KW to ≤ 160KW: 415V/240V AC s± 10% d) Motors <0.2KW :1-Phase,240V AC e) 1-Phase,240V AC ,Power outlet for welding receptacles, portable tools, Lighting Distribution, normal lighting, emergency lighting. f). Switchgear Control supply : 220V DC (-15% to +10%) g). Panel space heater & Illumination: 240V ± 10%	
6.0.0	BIDDER'S SCOPE OF WORK	
	Scope for the bidders shall include Design, Engineering, Manufacturing, Packing, Supply, Supervision of Erection & Commissioning, Performance Guarantee Test, handing over of the Gypsum Dewatering System to final Customer. Design: Includes complete engineering, preparation and submission of drawings / calculations / datasheets/quality assurance documents/ quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from customer Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing. Supervision of Erection & commissioning: Includes supervision of erection & commissioning, supervision of trial operation, PG test, training of customer's O&M Personnel and handing over to customer. The scope of supply for Gypsum Dewatering System shall include but not limited to the following.	
1)	Primary hydro cyclone	Two (2) sets
	i. Hydrocyclone clusters	
	ii. Anchor bolts, nuts and washers	
	iii. Flanges for inlet and overflow	
	iv. A variety size of vortex finders for all the hydro cyclone	
	v. Accessory piping within the skid	
2)	Secondary hydrocyclone	Two (2) sets
	i. Hydrocyclone clusters	
	ii. Anchor bolts, nuts and washers	
	iii. Companion flanges for inlet and overflow	
	iv. A variety size of vortex finders for all the hydro cyclone	
	v. Accessory piping within the skid	
3)	Vacuum belt filters complete with Accessories including discharge chute, Drivers (VFD with LCP) and driving motors(IE3) with inverter panel	Two (2) numbers
4)	Vacuum receivers with Anchor bolts, nuts and washers	Two (2) numbers

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5)	Vacuum pumps with driver(IE3 motor), All connection bolts/nuts/washers for installation, Required instruments and any safety device. Necessary vibration isolator shall be provided to prevent the transmission of the dynamic loads on to the building structure.	Two (2) numbers
6)	Vent fan including enclosure and its arrangement	Two (2) numbers
7)	All Interconnected piping (slurry, air and water pipes), which includes the requisite pipe support materials, fitting's, gasket, flange materials, Bolting.	One (1) set *
8)	Complete valves required for the system along with wash water line wherever necessary as per P&ID	One (1) set *
9)	Arrangement for cloth and cake washing, including , spray nozzles	One (1) set*
10)	Cake wash pump with motor (IE3)	Refer sl.no 11
11)	Belt filter washing pump with motor(same pump is to be used for the cake wash and sealing of the vacuum pump also).	2 Nos (i.e. one working and one standby)
12)	Companion flanges with gaskets and fasteners	One (1) set*
13)	Belt filter washing tank (tank to be sized to include the requirements of the cake wash, and the water requirements of vacuum pump also)	Type : Vertical Cylinder Qty : one no's
14)	Coupling with guards	One (1) set*
15)	INSTRUMENTS for the entire Gypsum Dewatering System((Minimum Requirement for each gypsum dewatering system as given in the P&ID)	One (1) set*
16)	Valves for the entire Gypsum Dewatering System(Minimum Requirement for each gypsum dewatering system is given in the P&ID)	One (1) set*
17)	Electrics for complete package including but not limited to	
	i. LV/HV Motors	As required for package
	ii. Cable Adapter chamber for higher size cables if required	As required.
	iii. Electric Actuators	As required for package
	iv. VFD & LCP for Vacuum Belt Filter	As required for package
	v. Cable glands, Lugs & Bimetallic washer for Power and control cables at Vendor's supplied equipment.	As required for package
18)	vi. OEM specific Local Control starter	As required for package
19)	vii. Paint Shade-Outside surface of Motors and other electrical	--

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	equipment located outdoor:RAL7032 (Siemens grey)	
20)	Instrumentation including but not limited to	
	i. Instruments	As required for package
	ii. Junction Box	As required for package
	iii. Instrumentation Cables	As required for package
21)	Expansion Joints at suction & discharge of each pump and also for other equipment wherever applicable	One (1) set*
22)	System control: Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet. Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the equipment's can be controlled from the control console in the FGD Control room.	
23)	Alarm Signal: a) Bearing temperature high b) Bearing Cooling water flow Low (As applicable) Interlock signal: a) Belt filter wash tank level low Bearing Temperature Transmitter for initiating alarm during when "Bearing temperature high" shall be supplied by Bidder. Bearing temperature transmitter shall be provided with local display also. Bearing temperature transmitter(with 2V3 logic) shall be provided for HT motors(> 200 KW) at both the driving and Non-Driving ends. Similarly, Vibration transmitters (with 2V3 logic) for measuring vibration in X&Y axis have to be provided for at the driving and Non-driving end for HT Motors. Bearing Cooling Water Flow switch for initiating alarm during when "Cooling water flow Low" shall be supplied by Bidder for each system. In addition, sight glass also shall also be provided to view the cooling water flow. Bearing cooling water Flow switch shall take the signal to PLC / DCS system.	
24)	First fill lubricants: All the first fill and one year's toppings requirements of consumables such as grease, oil, lubricants, servo fluids etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion to facilities should be provided by contractor/supplier.	
25)	Supervision of erection / commissioning of both the gypsum dewatering system. 30 Days per vacuum belt filter.	
26)	Mandatory spares with breakup price	
27)	Painting and rust prevention during shipment and construction	
28)	Seaworthy packing & forwarding to project site-refer clause 1.0.0 for project information	
29)	Recommended spare parts (for 3 years operation) with break up price.	
30)	Any other items required not covered above but required for the completeness of the system ; same shall be included in the offer and shall be supplied by the Bidder/supplier.	
	* One set means complete requirement for both the gypsum dewatering system	
6.1.0	TERMINAL POINTS	
1.	Primary hydro cyclone feed slurry will be provided by BHEL near the GDW building boundary at ground floor for Primary hydro cyclone. Further piping from terminal point to GDW system is in bidder's scope.	
2.	Primary hydro cyclone overflow shall be terminated by bidder up to the secondary hydro cyclone feed tank flange.	

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3.	Secondary hydro cyclone feed slurry will be provided by BHEL near the GDW building boundary at ground floor for secondary hydro cyclone. Further piping from terminal point to GDW system is in bidder's scope.
4.	Bidder shall terminate secondary hydro cyclone overflow upto waste water tank flange.
5.	Bidder shall terminate filtrate water piping from vacuum belt filter-vacuum receiver up to the filtrate water tank flange.
6.	Bidder shall terminate Wash water piping after belt filter cloth/cake washing up to filtrate water tank flange.
7.	Bidder shall terminate secondary hydro cyclone underflow up to filtrate water tank flange.
8.	Bidder shall terminate Sealing water piping from vacuum pump upto belt filter washing tank flange. Also piping upto vacuum pump from the belt filter wash pump upto the vacuum pump is also in bidders scope (i.e complete vacuum pump supply and return piping).
9.	Process water, clarified water, Service & instrument air will be provided at one location near plant boundary (i.e. near the building boundary at ground floor). Further piping from terminal point to GDS system utilities are in bidder's scope.
10.	Belt filter Vent fan outlet UPTO outside building wall is in vendor scope.
11.	Discharge of gypsum through discharge chute onto the gypsum belt conveyer is in bidder's scope. Please refer enclosed PFD, P&ID typical layout & elevation drawing of GDS for the details in the scope
	<u>Any piping even though not listed above but is coming inside the gypsum dewatering building is in vendor scope.</u>
12.	<u>Electrical Terminal Points:</u> - HT/LT Motor terminal box, Motor Space Heater terminal box of motor for termination of Purchaser's HT / LT power cables. - Equipment earthing terminals. Necessary hardware (nut/bolts/washers etc) at equipment end shall be provided by Vendor -VFD LCP Terminals for termination of purchaser's LT/control cables.
6.2.0	Exclusions
	<u>Electrical:</u> following items are excluded from Bidder scope, same will be supplied by Purchaser. 1. Power cables 2. Control cables 3. Complete below ground and above ground earthing materials 4. Cable Trays & Supports 5. Local Push button stations 6. Termination Kits for HT cables 7. Cable laying & termination 8. Earth strip laying and termination
7.0.0	PROCESS DESCRIPTION
1.	Common gypsum dewatering system is envisaged . The dewatering system shall receive the gypsum slurry from gypsum bleed pumps.
2.	The overflow from the primary sets of hydro-cyclone shall be taken to a secondary hydro-cyclone feed tank (BHEL Scope). Secondary Hydro cyclone feed pumps (BHEL Scope) shall transfer the slurry

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	from tanks to secondary hydro cyclone. Two sets of Secondary hydro cyclones (1 working+1 stand by) and its accessories shall be in vendor scope.
3.	The underflow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water storage tank.
4.	One no. of belt filter washing tank is envisaged for both the belt filters. Each belt filter-washing tank shall be provided with 2 nos (1W+1S) of belt filter wash pump. Belt filter wash pump shall supply water for cloth washing, belt washing & vacuum pump water requirement's .
5.	For maintenance of secondary hydrocyclone, a bypass line will be provided to divert the flow from primary hydrocyclone over flow to filtrate water tank.
8.0.0	DETAILED SPECIFICATION
1.	Bidder/Contractor shall supply two stage gypsum dewatering system consisting of primary hydro cyclones, vacuum belt filters and secondary hydro cyclones for dewatering of gypsum from absorber to less than 10% moisture.
2.	Bidder/Contractor shall supply 2x100% gypsum dewatering system with each stream sized to dewater 20.1 TPH (Wet cake) produced by the FGD units operating at design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.
8.1.0	Hydro-cyclones
1.	Two (2) sets of primary hydro cyclones are envisaged, each set shall be sized to dewater the gypsum slurry produced by the unit operating at design point.
2.	The primary hydro-cyclone shall be installed on a floor directly above the belt filters. The overflow of the primary hydro-cyclones shall be taken to secondary hydro-cyclone feed.
3.	Two (2) sets of secondary hydro cyclones are to be installed, each sets shall be sized to dewater the gypsum slurry produced by primary hydro cyclone overflow.
4.	Each set of primary/secondary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service
5.	Both primary and secondary hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
6.	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber, overflow and underflow chamber shall be made of carbon steel of adequate thickness with a rubber lining of minimum 12 mm thickness. Liners shall have a minimum wear life of not less than 7000 hrs.
7.	All Hydro Cyclones clusters shall be made of polyurethane or urethane material only
8.2.0	Vacuum Belt Filters
1.	The Vacuum Belt Filters shall have the following characteristics: a) Very rigid frame and rolls, no deformation whatsoever may occur. b) All rolls shall be installed perfectly horizontally c) There shall be no vacuum under the slurry deposition zone. d) Deposit thickness control and directional stability control

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	e) The slurry shall be put on the belt in counter current relative to the rotation of the band/belt . f) The vacuum chambers shall be easily opened for inspection and cleaning.
2.	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.
3.	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material .
4.	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.
5.	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
6.	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the bidder's proven practice. The belt filter shall have an automatic cloth tensioning mechanism. Pull chord switches shall be provided for each vacuum belt filter. Four (04) no's of Belt sway switches shall be provided for each vacuum belt filter. Cake thickness sensors with double redundancy shall be provided for each vacuum belt filter which shall control the speed of the vacuum belt filter in turn.
7.	Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump for each vacuum Belt filter. Flow indicator shall be provided for cloth washing line of each vacuum belt filter. Flow indicator shall be provided for cake washing line of each vacuum belt filter as per P&ID attached.
8.	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.
9.	The filtrate from gypsum slurry and from cake washing shall be taken to a separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
10.	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. The elevation of discharge point of vacuum belt filter shall be at least 10.0 m above GL.
11.	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components of the belt shall also be provided. The elevation of discharge point of vacuum belt filter shall be as per Annexure-XIII-GA Drawing of Gypsum Dewatering Building. Any changes shall be suggested by Bidder accordingly.
12.	Local control panel shall have display on the front panel and necessary electrical parts.
13.	The service factor of the gear unit (if any) shall be minimum 1.5.
14.	Piping and wiring within the skid should be in the vendor's scope.
15.	All client end connection flanges shall be ANSI B 16.5/AWWA
16.	The MOC of all the components of the vacuum belt filter shall be as per Annexure-XII
8.3.0	Vacuum System
1.	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a separate receiver tanks as per the supplier's proven practice. Each belt filter shall be provided with an independent

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	vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional 10% margin over the above shall be provided each vacuum pump.
2.	For each vacuum belt filter the vacuum pump shall be installed close to the vacuum belt filter. Each Vacuum pump shall have its own piping system, which connects the pump with the associated vacuum belt filter. Bidder to provide Equipment layout and GA of Gypsum dewatering building along with the offer
3.	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitation under all operating conditions.
4.	The seals shall be of proven design.
5.	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.
6.	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.
7.	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.
8.3.1	COMMON REQUIREMENTS FOR PUMPS (VACUUM PUMP , BELT FILTER WASH PUMPS , CLARIFIED WATER PUMPS)
1.	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer an hi chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.
2.	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy-duty ball/roller bearings.
3.	All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions.
4.	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
5.	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1m to the max NPSH required shall be provided.
6.	All pumps shall be fitted with suction and discharge pressure gauges. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS316 or equivalent
7.	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.
8.	Design pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.
9.	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be minimum 125% of Best Efficiency Point (BEP).

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10.	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection of Duty point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising its NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and are at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.
11.	External flushing is required to remove the accumulated particles and all related information should be mentioned in data sheet.
12.	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.
13.	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.
14.	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –up on overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
15.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
16.	The sealing areas shall be designed in such a way so that solids do not precipitate in them or affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
17.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
18.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
19.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.
20.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
21.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling shall be of flexible type made of cast steel. The bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the pump and the motor by bidder. The coupling between shafts shall be so designed that they become tight during pump operation.
22.	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.

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23.	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, “Taper wedge” and the necessary fastener for Pump and Motor with Base plate. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem.	
24.	Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities and branch piping to each location. Terminal points for all utilities shall be located at skid edge. The bidder shall specify all terminal points with tie-in number in the P&ID and submit it in the proposal to confirm the scope of supply.	
25.	Nameplate: All equipment shall be provided with name plates indicating the item number and service name. Nameplates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.	
26.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.	
27.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.	
28.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.	
29.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.	
30.	Provide double nuts for anchor bolts.	
31.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.	
32.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.	
33.	Bidder shall provide the mating flanges with the necessary gaskets.	
34.	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.	
35.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.	
36.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.	
9.0.0	TECHNICAL REQUIREMENTS	
I	DESIGN CONSTRUCTION –VACUUM BELT FILTERS	Bidder To Confirm
1.	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.	
2.	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material.	

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3.	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.	
4.	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.	
5.	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.	
6.	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.	
7.	Local control panel shall have display on the front panel, inverter, PLC controller and necessary electrical parts.	
8.	The service factor of the gear unit (if any) shall be minimum 1.5.	
9.	Piping and wiring within the skid should be in the vendor's scope.	
10.	Nozzles and connections The suction and discharge pipes will be flanged and will have the same nominal test procedure as the body of the pump. Threaded connections are not admitted in these pipes.	
11.	The flanges shall comply with the following standards: - Steel flanges as per ANSI B16.5 (raised face type, at least class 150) - Cast iron flanges as per ANSI 16.1 (flat face type, at least class 125) The pipe shall be designed according to API676 with regards to the force.	
II	DESIGN AND CONSTRUCTION OF VACUUM PUMPS	
	Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.	
a)	Pump Casing	
	Pumps shall be radial split casing, close/semi-open, over-hang, end suction type back pull-out design, vertical discharge type for horizontal centrifugal pump. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.	
b)	Impeller	
	Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.	

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c)	Impeller/Casing Wearing Rings	
	Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.	
d)	Shaft	
	The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.	
e)	Shaft Sleeves	
	Renewable type fine finished shaft sleeves shall be provided at mechanical seals. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.	
f)	Bearings	
	Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.	
g)	Mechanical Seals	
	Mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.	
	The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.	
h)	Pump Shaft Motor Shaft Coupling	
	The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.	

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i)	Base Plate	
	A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.	
j)	Vibration isolation system :Complete vacuum pump assembly shall be provided with the vibration isolators to prevent the transmission of the dynamic load on to the civil structure.Refer the layout for checking the location of the pumps on the building.	
k)	Drive Motor (Prime Mover)	
	The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.	
III	GYPSUM DISCHARGE CHUTE	
a.	The minimum valley angle of chutes shall be 60 degrees at the feeding point to guide the material in the direction of belt travel. Transfer chutes shall be adequately sized and sloped to ensure smooth flow of Gypsum without any accumulation anywhere.	
b.	Chutes shall be made of minimum 20 mm thick TISCRAAL / SAILHARD/ LSLAS07 or equivalent material. All chutes should have one inspection door at every floor and for the ones in between the floors (more than 1.5 meter above the operating floor level) suitable access for trouble free maintenance shall be provided. For sealing of inspection doors labyrinth type arrangement to be provided.	
c.	Complete chute work in the region of flap gates shall be fabricated from 20 thk TISCRAAL or equivalent. In case of vertical chute (valley angle more than 80 degree) complete chute, work shall be of 20 mm thick TISCRAAL or equivalent material. While finalizing the chute work inside the building, arrangement for shifting and replacing chute legs, proper handling arrangement/wall openings, trolleys, hoists shall also be provided. While fabricating the chute, no welds in between shall be allowed.	
	CHUTE BLOCKAGE SWITCHES One no. chute blockage switch for each belt filter of proven type (subject to approval of the employer) shall be provided. Chute blockage switch shall trip the feeding conveyor in case of Chute blockage and protect the feeding conveyor equipment.	
	Chute arrangement shall be provided along with flap gate arrangement for parallel -flow or perpendicular flow of gypsum on to the gypsum conveyor.	
IV	PIPING	
a.	The slurry pipes shall be sized to minimize erosion and avoid settling of the gypsum at all load operation. Slurry pipes shall be designed to keep the velocity above the settling velocity underall operating conditions. The bidder may	

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	provide a recirculation line with motorized isolation valve for the above purpose. All the pipes handling slurry shall be provided with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm shall be provided at the bends. The bidder can provide slurry pipes of size lower than 3" made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. All the rubber-lined pipes shall be of flanged connection.	
b.	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.	
c.	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to BHEL	
d.	Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipment etc	
e.	Belt filter washing pumps shall have a minimum flow line to tank with a restriction orifice to control.	
f.	All Lube oil , Instrument Air piping shall be made up of Gr.304 Stainless Steel material	
g.	All process water & Cooling water piping shall be made up of Carbon Steel Pressure Piping	
h.	For details on Pipe schedule kindly refer to P&ID	
V	VALVES	
	For details on Valve schedule kindly refer to P&ID. For valve specification, bidder shall refer to the Annexure-XII-Pipe & valve material specification	
VI	ACCESSORIES:	
1)	Expansion Joints:	
i.	Expansion Joints shall be provided at suction and discharge of each pump and also for other equipment's wherever applicable."	
2)	System control:	
i.	Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.	
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the equipment's can be controlled from the control console in the FGD Control room.	
VII	ELECTRICALS	
i.	Bidder shall provide cable glands, lugs, Bimetallic washers for all equipment in the scope of Bidder. Glands and lugs for power cable, control cable, Space heater	

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	cable and earthing cable (if any) suitable at motor/equipment end has to be supplied along with the main equipment. --Glands shall be weather proof (as per motor category) double compression type Nickel plated Brass (ET) shall be provided with back nut and PVC shroud. --Lugs shall be tinned copper heavy duty lug Cable dimensions shall be furnished during detail engineering, accordingly glands, lugs shall be supplied.	
ii.	HT/LT MOTORS --For Technical specification, refer Annexure-X	
iii.	Electrical Actuators --For Technical specification, refer Annexure-X	
iv.	Bidder should strictly fill the electrical Auxiliary load list as per attached format given in this specification as Annexure-XI	
VIII	Instrumentation	
i.	JUNCTION BOX Bidder to refer to the specification given in Annexure- XI	
ii.	INSTRUMENTS Bidder shall refer to the P&ID for the details on the instruments to be supplied. The instruments indicated are minimum requirements. All instruments & actuators shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 .All instruments shall be as per specification enclosed in Annexure- XI. Vendor to supply all the instruments as given in the P&ID. All electrical actuators shall be with integral starters (non-intrusive with SIL2 certificate)	
iii.	INSTRUMENTATION CABLE: Instrumentation cable upto the junction box is in vendors scope .	
iv.	LOCAL CONTROL PANEL: A PLC based local control panel for the entire Gypsum Dewatering System shall be supplied by the bidder. Bidder shall provide the control logic for the entire system.	
	For sub Vendor list of instrumentation and control refer Annexure -XV	
IX	Sub Vendor List-Electrical	
	1. HT Motors • ALSTOM • BHEL • CROMPTON GREAVES • KIRLOSKAR ELECTRIC CO. LTD. • SIEMENS • MARATHON ELECTRIC • ABB • HHI 2. LT Motors • ALSTOM • BHEL • CROMPTON GREAVES	

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	- KIRLOSKAR ELECTRIC CO. LTD. - SIEMENS - MARATHON ELECTRIC - ABB - BHARAT BIJLEE - LAXMI HYDRAULIC LTD. 3. VFD for LT Motors - ABB - SIEMENS - L&T - ALLEN BRADLEY - GE FANUC 4. Electric Actuators - ROTORK - AUMA - LIMITORQUE - ANTIREB 5. Cable Glands - COMET - ELECTRO MAG - COSMOS - POWER ENGG 6. Cable lugs - DOWELS	
10.0.0	PACKING AND FORWARDING	
1.	Proper packing to be ensured. Indigenous Supply: Gypsum Dewatering System & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the pump internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure - VIII. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.	
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.	
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject	

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	to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.	
4.	The entire system have to be supplied in containers and it should be suitable for storing in the outer yard of the plant for a minimum period of 12 months. Crates and packing material used for shipping will become the property of owner.	
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.	
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.	
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking	
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. BHEL SITE OFFICE : BHUSAWAL, 1X660 MW. Deepnagar, Bhusawal, Maharashtra 425307. INDIA EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, INDIA" In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.	
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.	
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.	
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.	

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12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care", "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)	
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for handling)	
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.	
15.	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of pump & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.	
16.	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.	
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.	
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.	
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).	

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20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.	
11.0.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING	
1.	The erection of Gypsum Dewatering System will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per VACCUM BELT FILTER boiler for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.	
2.	There will be one visit for each system and totally 2 visits . The bidder will be informed well in advance for the visit. Bidder shall include 60 Man Days and 2 Visits to site.	
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.	
12.0.0	INSPECTION REQUIREMENT	
1.	Hydro cyclones visual, dimensional etc.	
2.	Pumps :	
a.	All pressure parts shall be hydraulically tested at 150% of the shut-off head or 200% of rated head, whichever is higher for 30 minutes. No leakage is allowed	
b.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).	
c.	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. (as already stated above.)	
d.	List of Non-Destructive test over and above the material test are as follows: Casing: Material test, Magnetic particle (MPI), DP and Hydro test as applicable Impeller- DPT and MPI as applicable Shaft- Ultrasonic (UT), DPT and MPI Sleeve- DP and Hardness test/ Manufacturer's recommendation Mechanical Seal- Manufacturer's recommendation. Base Plate- Stress relieving of weld. Replaceable Rubber liner- Shore Hardness, Class and Type certificate	
e.	Vibration test and Noise level test shall be witnessed at shop. (as already stated above.)	
f.	Mechanical running and the performance test shall be conducted for Pump at the Bidder's works before dispatch or where the test facilities are available. All pumps to be performance tested as per Hydraulic Institute Standard/Indian Standard. Performance test to include check for noise,	

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	vibration level and temperature rise.				
g.	The Bidder shall conduct performance test for the remaining pump and submit the reports.				
3.	Vacuum Belt Filters:				
a.	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.				
b.	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.				
c.	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.				
d.	Filter cloths and belts shall be tested for physical properties as per relevant Standard.				
4.	General Inspection requirements to be considered are as below:				
1.	S.No	Item	Inspection & Test item	Remarks	
	1.	Hydrocyclones	Material certificate check		
			Dimensional Inspection		
	2.	Pumps	Material certificate check	Shaft & impeller only	
			Dimensional inspection		
			Non destructive testing	DPT on shaft & impeller	
			Hydrostatic test		
			Balancing Test	Static & dynamic	
			Performance test	Incl. Noise & Vibration	
	3.	Motors	Material certificate check		
			Non Destructive Testing		
			Dimensional inspection		
			Balancing Test	Static & dynamic	
			Function test		

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	4.	Vacuum Belt filter (with Accessories)	Material certificate check		
			Dimensional inspection		
			Function test	Short time no load test	
		5. Vacuum Receiver	Material certificate check		
			Dimensional inspection		
			Hydrostatic Test		
		6. Belt Filter Vent Fan	Material certificate check		
			Dimensional inspection		
			Performance Test		
		7. Conveyor & Silo Extraction Device	Material certificate check		
			Dimensional inspection		
			Function Test	Short time no load test	
		8. Rubber lining Pipe	Dimensional inspection		
			Visual Inspection		
			Spark Test		
		9. Butterfly Valve	Material certificate check		
			Non destructive testing		
			Hydrostatic test		
			Operation test	Motorized valve only	
	10.	Control Panel	Insulation Resistance Test		
			Dielectric Strength Test		
			Function Test		
			Dimensional Inspection		

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	11.	Control valve & valves	Material certificate check		
			Hydrostatic test		
			Seat leak test		
			Function test		
			Dimensional Inspection		
	12.	RTD	Material certificate check		
			Performance test		
			Hydrostatic test		
	13.	Shut off valve	Material certificate check		
			Hydrostatic test		
			Seat Leak test		
			Function Test		
			Dimensional Inspection		
	14.	Flow meter	Material certificate check		
			Calibration Test		
			Dimensional Inspection		
			Hydrostatic test		
	15.	Flow Nozzles	Material Certificate check		
			Dimensional Inspection		
2.	Valves and Specialitiesshall be tested as per relevant standards / codes. Seat Leakage and hydraulic test to be carried out as per relevant standards /codes.				
3.	Pipes and fittings shall be tested as per relevant standards/ codes				
4.	MQP (Manufacturing Quality plan) shall be submitted by the bidder along with the technical offer. Above mentioned item-wise inspection requirement is tentative only and shall be mutually discussed and finalized during detail engineering.				
5.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BHEL / BHEL APPROVED AGENCY prior to manufacture. Inspection of above mentioned tests by BHEL/ BHEL APPROVED AGENCY representative at bidder’s works is envisaged				

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6.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/ BHEL APPROVED AGENCY.	
7.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/ BHEL APPROVED AGENCY within one (1) week of the successful completion of balancing.	
8.	Vibration levels shall be measured during shop running/performance tests.	
9.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.	
10.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.	
11.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.	
12.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.	
13.	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.	
14.	Equipment shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.	
15.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment's.	
16.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.	
17.	Bidder to arrange all calibrated gauges, Instruments during inspection at works and also during performance test at site. All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.	
18.	Mechanical running test shall be carried out for Vacuum Belt Filter, Vacuum Pump & Belt Filter wash Pump. Bidder to arrange Motor for the shop test and inspection.	
19.	In case of order placed on foreign vendors(i.e. supplies from outside India), vendor has to finalize Inspection agency from the List enclosed in Annexure IX at their	

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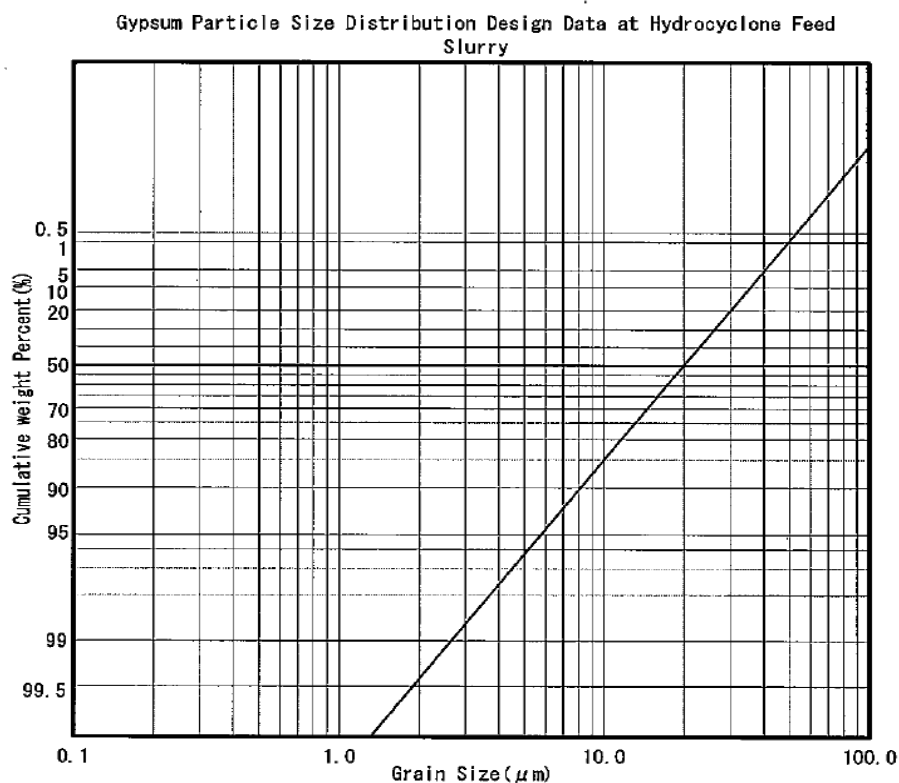
	own cost and carry out inspection as per the approved Quality plan. Vendor has to furnish BHEL the inspection reports and other documents required as per approved Quality plan duly signed by the Inspection Agency after their witness for our review and acceptance.	
13.0.0	GURANTEE AND LIQUIDATED DAMAGES FOR POWER CONSUMPTION	
I.	POWER GUARANTEE Bidder to specify the guaranteed power consumption of per Gypsum Dewatering system as well as individual equipment in their offer. The following equipments (i.e. working system) shall be considered for Guaranteed Power consumption calculation (GPC). - Vacuum Belt Filter - 1 No. - Vacuum Pump - 1 No. - Belt Filter Vent Fan- 1 No - Belt and Cake wash pump – 1 No. The total power consumption for all the above power sources (a to d) put together shall not exceed 161.3 KW .	
II.	LIQUIDATED DAMAGES FOR POWER CONSUMPTION If actual Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in INR = (APC-GPC) X P X 1No of working system ▪ GPC- Guaranteed Power Consumption quoted by bidder in KW ▪ APC- Actual Power consumption during PG test ▪ P- Penalty @4,50,000.0INR per KW	

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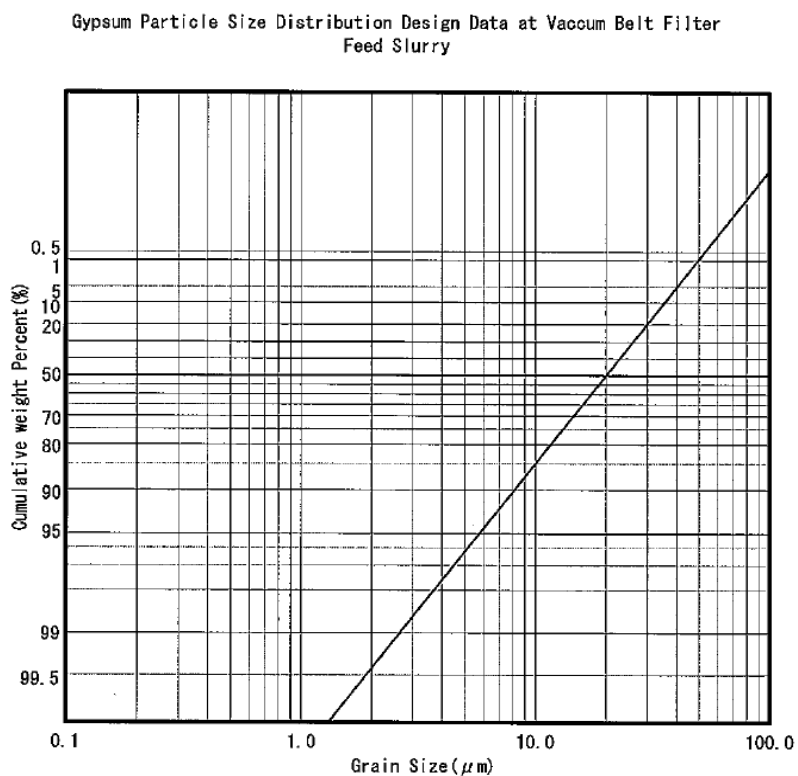
14.0.0	Process Flow Diagram & P&ID Diagram				
	Piping and Instrumentation Diagram are enclosed in Annexure VII.				
14.0.1	PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE AT OPERATING POINT				
S.no	Parameters	Primary Hydro Cyclone Feed Slurry	Primary Hydro Cyclone Over Flow	Primary Hydro Cyclone Flow	Primary Hydro Under Flow
a.	Total Flow (m ³ /hr.)	64.62	37.33 *1)	27.29 *1)	
b.	Total Flow (t/hr.)	77.801	41.091*1)	36.710*1)	
c.	Operating Temp (C)	54.2	54.2	54.2	
d.	Design Temp (C)	70	70	70	
e.	Solid (wt. %)	30	16.6 *1)	> 45 *2)	
f.	Density (Kg/m ³)	1204	1101 *1)	1345 *1)	
g.	Ph	4-7	4-7	4-7	
h.	Cl ⁻ (mg/l)	20000	20000	20000	
14.0.2	PROCESS PARAMETERS FOR SECONDARY HYDROCYCLONE AT OPERATING POINT				
a.	Parameters	Secondary Hydro cyclone – Feed Slurry	Secondary Hydro cyclone– Overflow	Secondary Hydro cyclone – 7Under flow	
b.	Total flow (m ³ /hr)	37.33	23.33*1)	14.0 *1)	
c.	Total flow (t/hr)	41.091	23.623*1)	17.466*1)	
d.	Operating Temp (° C)	54.2	54.2	54.2	
e.	Design Temp (C)	70	70	70	
f.	Solid (wt %)	16.6	3 *2)	35 *1)	
g.	Density (kg/m ³)	1104	1012.5	1247.5	
h.	pH	4-7	4-7	4-7	
i.	Cl ⁻ (mg/l)	20000	20000	20000	
14.0.3	DATA SHEET OF BELT FILTER AT OPERATING POINT				
	Parameters	Belt Filter Feed Slurry	Product Gypsum	Filtrate	Washing Water **
a.	Total Flow (m ³ /hr)	27.29 *1)			
b.	Total Flow (t/hr)-Wet	36.710*1)	20.1		
c.	Operating Temp ©	54.2 Deg C			
d.	Design Temp(deg C)	70.0			
e.	Solid(% wt)	>45 *2)	>90 *2)	<0.2	
f.	Density (Kg/m ³)	1345*1)	-		
g.	pH	4~7	5~8		
h.	Cl	<20000	<100 ppm *2)		
i.	Belt filter and the peripherals shall be designed at 20.1 TPH (wet cake) discharge of product gypsum a. **Quantity of water shall be finalized by the vendor. b. *Property of process & Clarified water is as below.				
j.	*1) shall be finalized by vendor. *2) Shall be guaranteed by vendor				

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14.0.4 GYPSUM PARTICLE SIZE AT HYDRO CYCLONE FEED SLURRY IS SHOWN BELOW



14.0.5 Gypsum particle size at belt filter feed slurry is shown below



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14.0.6	DESIGN CONDITIONS OF PRIMARY & SECONDARY HYDRO CYCLONES:		
1.	Primary hydrocyclone quantity	:	2 sets (1W+1SB)
2.	Secondary hydrocyclone quantity	:	2 sets (1W+1SB)
3.	Primary hydrocyclone capacity	:	71.5 m3/hr each
4.	Secondary hydrocyclone capacity	:	38.0 m3/hr each
5.	Type of hydro cyclone	:	Vertical
6.	Material (MOC) of Cyclone Clusters	:	Polyurethane/Urethane
7.	MOC of Feed chamber	:	CS+25 mm rubber lining
8.	MOC of overflow chamber	:	CS+12mm rubber lining
9.	MOC of under flow chamber	:	CS+12mm rubber lining
14.0.7	PROCESS WATER(CLARIFIED WATER) CHARACTERISTICS		

S.no	Constituents	Unit	PROCESS & CLARIFIEDWATER
1.	Calcium as CaCO_3	Ppm	295
2.	Magnesium as CaCO_3	Ppm	77
3.	Sodium as CaCO_3	Ppm	203
4.	Potassium as CaCO_3	Ppm	10
5.	Total alkalinity as CaCO_3	Ppm	585
6.	Iron as Fe	Ppm	1.0
7.	Chlorides as CaCO_3	Ppm	149
8.	Sulphate as CaCO_3	Ppm	33
9.	Silica	Ppm	36
10.	PH		8.0-8.5
11.	TURBIDITY	Ppm	<15NTU

Note: Process water will be used for both belt/cloth & gypsum cake washing .

15.0.0	SPARES,TOOLS & TACKLES
15.1.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the WBM. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of WBM shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipment's are energized.

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15.1.2	Vendor to supply the following items additionally ,along with the main offer : (Note: These items indicated in Sl.no 15.1.2 are not part of startup & commissioning spares, but need to be supplied additionally as part of main supply).
	a. Filter Cloths : 2 sets
	b. Belt : 1 set
	c. Vacuum box seals : 1 set
	d. Pump Bearing (for all pumps) : 2 sets
	e. Pump Seals (for all pumps): 1 sets
	f. Slurry Valves : 2 numbers for each size and type
	g. Slurry Line Bends : 4 numbers for each size and type
	h. Slurry Line pipe : 4 numbers for each size and of each length is 6.0 meter
	i. Hydro-cyclone isolation valve : 2 numbers for each size and type
	j. Vortex finder & Apex inserts: 2 numbers for each size and type
15.2.0	MANDATORY SPARES (If Applicable)
	a) The list of mandatory spares considered essential by the Employer is indicated in the list below. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in their Bid. Whenever the quantity is Mentioned in "sets" the bidder has to give the item details and prices of each item. b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of Bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings. c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly. d) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. e) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. Bidder to provide the split up price for mandatory spares during placement of order.
	There are no other mandatory spares applicable in this enquiry.
15.3.0	Three Years O&M Spares (Recommended Spares):
	Bidder shall provide, based on his own experience of the performance of Equipment, in the form of a schedule , the complete list of recommended spare parts for three (3) years operation of the Equipment covered under the proposal. In the list of recommended spare parts, the bidder shall identify the unit-wise population of each of items recommended and anticipated normal life of the spares. Such list will also indicate item-wise prices on Ex-works basis. The bidder shall further

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	indicate price break-up on FOR Site basis. No other basis of prices will be quoted. The prices of these spare parts shall be on firm price basis and shall have extended validity not less than 12 (Twelve) months after the placement of order for Main Plant Package. The prices of the spare parts thus quoted shall not be taken into consideration for purpose of bid evaluation. Other relevant terms and conditions of these documents shall also be applicable to such spare parts. The spare list will be used by the Owner to decide about the spares to be procured against his spares requirements for the Equipment quoted. The Owner reserves the right for placement of order for O & M spares and shall order these spares within 18 (eighteen) months from the date of placement of Letter of Award for Main Plant package. These spares should be supplied within 12 (twelve) months from the date of Commissioning of the FGD system or date of the issuance of order for these spares whichever is later.
15.4.0	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools
16.0.0	PERFORMANCE GUARANTEE
	All performance tests for GDS shall be carried out in accordance with any latest international codes/standards. 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the GDS and its accessories 2) Vendor shall Guarantee and demonstrate each Vacuum Belt Filter capacity of 20.1 TPH wet gypsum cake with an inlet solid concentration of not more than 45% wt. 3) The contractor shall guarantee and demonstrate that gypsum cake moisture content shall not be more than 10% and chloride content shall not be more than 100ppm. 4) The filter cloth shall be guaranteed for a minimum life of not less than 7000 hrs. 5) The liners in hydro-cyclone shall have a minimum wear life of not less than 7000 hrs. 6) The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days. 7) Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 8) Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. 9) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ END CUSTOMER approval. 10) In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.

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17.0.0	WARRANTY
1.	The Bidder warrants that the equipments/items shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed. The Warranty/Defect Liability Period shall be thirty six(36) months from the date of delivery or twenty four (24) months from the date of commissioning, whichever first occurs. If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Bidder, the Bidder shall promptly, in consultation and agreement with BHEL regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Bidder shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect.
2.	In case of failure of the equipment to meet the guarantee, END CUSTOMER /BHEL reserves the right to reject the equipment. However, END CUSTOMER /BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
18.0.0	FIRST FILL OF CONSUMABLES:
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the END CUSTOMER /BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
19.0.0	TRAINING
	Successful bidder shall provide comprehensive training for END CUSTOMER /BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the GDS system - Operation & Maintenance, Troubleshooting etc.
20.0.0	CONFLICT
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising END CUSTOMER in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.

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21.0.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation as per Annexure VI. Annexure VI documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified under Annexure VI. Drawings that are reviewed by the END CUSTOMER / BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a “hold” on those items or areas of design. END CUSTOMER / BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by END CUSTOMER must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDS shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per END CUSTOMER requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL. Note : The vendor shall submit the drawings / documents for BHEL's review/approval as per the schedule given in Annexure-VI. BHEL shall furnish approval/comments within 2 weeks of receipt of drawings / documents. Turnaround time for submission of revised drawing/document shall be 1 week from receipt of commented drawing/document.

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ANNEXURE-I-QUALIFICATION REQUIREMENT (PROVENNESS CRITERIA)

1.0	QUALIFYING REQUIREMENTS FOR FGD GYPSUM DE-WATERING PACKAGE.
	The Bidder/ Bidder's Sub vendor(s) is required to meet the qualification requirement for Equipment, Auxiliaries, System and Bought out items as per the criteria stipulated below.
2.0	QUALIFICATION REQUIREMENT (QR)
2.1	Bidder should be - An established manufacturer of Vacuum Belt Filters for Gypsum Dewatering Application (or) - A System Integrator of Gypsum Dewatering Package using Vacuum Belt Filter Relevant documentary proof shall be submitted.
2.2	Bidder should have designed, supplied and commissioned at least one Gypsum Dewatering Package using Vacuum Belt Filter (or) Vacuum belt filter for Gypsum Dewatering Application with minimum Rated Output Capacity of 16.1 TPH Gypsum Cake, in the last 10 years as on date of this Enquiry. Package or Equipment supplied vide above supply reference(s), shall be in satisfactory operation for a period of not less than one year as on date of this enquiry in a Wet Limestone based FGD application.
2.3	Details of the supply references made satisfying the above criteria shall be submitted as per Table-1 along with the following mandatory documentary proof: - Purchase order copy - Commissioning / Installation Certificate - Performance Certificate for satisfactory operation

Table-1 Capacity of Vacuum belt filter

Reference as per format below shall be filled and submitted:

Sl.no	Project Name	Wet Limestone Based FGD Yes/No	Model & make	Date of Commissioning	Qty	Capacity
1.						
2.						

Note : If the reference data submitted by bidder doesn't meet the specified qualification criteria (i.e 2.1 & 2.2 above), the offer shall be summarily rejected .

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

BIDDER SIGN WITH SEAL AND DATE

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ANNEXURE-II-TECHNICAL DATA SHEET

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: Maharashtra State Power Generation Co. Limited
	b. Project	: Bhusawal 1X660 MW.
	c. End Customer	: Maharashtra State Power Generation Co. Limited
	d. Location	: Deepnagar, Bhusawal, Maharashtra 425307
	e. Service	: Continuous
	f. Installation	: Inside the Building
	g. Quantity for all FGD units	: 2 sets (1W+1S)
2.0	MANUFACTURER DETAILS	
	a. Model	: Bidder to Provide
	b. Type	: Bidder to Provide
3.0	OPERATING CONDITION	
	Medium to be handled	: Gypsum Slurry
4.0	Technical Data	
4.1.0	PRIMARY HYDRO-CYCLONE	
	i. Stage	Bidder to Provide
	ii. Manufacturer	Bidder to Provide
	iii. Number of Hydro cyclone	Bidder to Provide
	iv. Diameter of Hydro cyclone	Bidder to Provide
	v. Diameter of Vortex Finder	Bidder to Provide
	vi. Diameter of Apex Valve	Bidder to Provide
	vii. Diameter of Feed Inlet	Bidder to Provide
	viii. Design Pressure	Bidder to Provide
	ix. Working Pressure	Bidder to Provide
	x. Feed Flow rate	Bidder to Provide
	xi. Overflow Rate	Bidder to Provide
	xii. Underflow Rate	Bidder to Provide

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	xiii.	Mesh of separation (50% Removed)	Bidder to Provide
	xiv.	Solid content of feed slurry	Bidder to Provide
	xv.	Solid content in underflow of Hydrocyclone	Bidder to Provide
	xvi.	Solid content in Overflow of Hydrocyclone	Bidder to Provide
	xvii.	Type of cyclone	Bidder to Provide
	a)	Cyclone Dia/Height (mm)	Bidder to Provide
	b)	Required Liquid Feed Pressure	Bidder to Provide
	c)	Cyclone Connection Number/Dia. (mm)	Bidder to Provide
	d)	Feed	Bidder to Provide
	e)	Overflow	Bidder to Provide
	f)	Underflow	Bidder to Provide
	g)	Rf Value (Underflow Slurry (m3/hr/Feed	Bidder to Provide
	h)	Material	Bidder to Provide
	i)	Shell	Bidder to Provide
	j)	Internal Structure Part	Bidder to Provide
	k)	Lining	Bidder to Provide
	l)	Particle Size Distribution	Bidder to Provide
	m)	Weight	Bidder to Provide
4.1.1	SECONDARY HYDRO-CYCLONE		
	xvii.	Stage	Bidder to Provide
	xviii.	Manufacturer	Bidder to Provide
	xix.	Number of Hydro cyclone	Bidder to Provide
	xx.	Diameter of Hydro cyclone	Bidder to Provide
	xxi.	Diameter of Vortex Finder	Bidder to Provide
	xxii.	Diameter of Apex Valve	Bidder to Provide
	xxiii.	Diameter of Feed Inlet	Bidder to Provide
	xxiv.	Design Pressure	Bidder to Provide
	xxv.	Working Pressure	Bidder to Provide

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	xxvi.	Feed Flow rate	Bidder to Provide
	xxvii.	Overflow Rate	Bidder to Provide
	xxviii.	Underflow Rate	Bidder to Provide
	xxix.	Mesh of separation (50% Removed)	Bidder to Provide
	xxx.	Solid content of feed slurry	Bidder to Provide
	xxxi.	Solid content in underflow of Hydrocyclone	Bidder to Provide
	xxxii.	Solid content in Overflow of Hydrocyclone	Bidder to Provide
	xvii.	Type of cyclone	Bidder to Provide
	n)	Cyclone Dia/Height (mm)	Bidder to Provide
	o)	Required Liquid Feed Pressure	Bidder to Provide
	p)	Cyclone Connection Number/Dia. (mm)	Bidder to Provide
	q)	Feed	Bidder to Provide
	r)	Overflow	Bidder to Provide
	s)	Underflow	Bidder to Provide
	t)	Rf Value (Underflow Slurry (m ³ /hr/Feed	Bidder to Provide
	u)	Material	Bidder to Provide
	v)	Shell	Bidder to Provide
	w)	Internal Structure Part	Bidder to Provide
	x)	Lining	Bidder to Provide
	y)	Particle Size Distribution	Bidder to Provide
	z)	Weight	Bidder to Provide
4.2	VACUUM BELT FILTERS (VBF)		
	a.	Manufacturer	: Bidder to Provide
	b.	Model No.	: Bidder to Provide
	c.	Dimensions (W x L x H) (m x m x m)	: Bidder to Provide
	d.	Cloth Width m	: Bidder to Provide
	e.	Cloth Length m	: Bidder to Provide
	f.	No. Working / Stand-by	: Bidder to Provide

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	g. Capacity (Guaranteed) Gypsum (Dry)	:	Bidder to Provide
	h. Inlet Flow Volume	:	Bidder to Provide
	i. Gypsum Flow (Dry) Kg/hr	:	Bidder to Provide
	j. Moisture Removed %	:	Bidder to Provide
	k. No. of stages of cake washing / water flow m3/h	:	Bidder to Provide
	l. No. of stages of cloth washing / water flow m3/h	:	Bidder to Provide
	m. Design Pressure of Vacuum Chamber	:	Bidder to Provide
	n. Operating Pressure of Vacuum Chamber	:	Bidder to Provide
	o. Material / Thickness mm	:	Bidder to Provide
	i. Casing	:	Bidder to Provide
	ii. Cloth	:	Bidder to Provide
	iii. Gypsum Discharge Hopper	:	Bidder to Provide
	iv. Vacuum Box	:	Bidder to Provide
	p. Life of Cloth hrs	:	Bidder to Provide
	q. Type /Material of Carrying Belt	:	Bidder to Provide
	r. Type / Material of Sealing Belt	:	Bidder to Provide
	s. Life of Carrying Belt hrs	:	Bidder to Provide
	t. Life of Sealing Belt hrs	:	Bidder to Provide
	u. Automatic Cloth Tensioning Mechanism Provided	:	Yes / No - Bidder to confirm
4.3	VACUUM RECEIVER TANK		
a.	No. of Tank for each VBF	:	Bidder to Provide
b.	Capacity (m3)	:	Bidder to Provide
c.	Dimensions (Dia x Height) (mm x mm)	:	Bidder to Provide
d.	Material / Thickness (mm)	:	Bidder to Provide
e.	Lining Material / Thickness mm	:	Bidder to Provide
4.4	Vacuum Pumps		
a.	Manufacturer	:	Bidder to Provide
b.	Make/Model	:	

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c.	Type	:	Bidder to Provide
d.	No. of Pumps for each Vacuum Belt Filter	:	Bidder to Provide
e.	Rated Capacity Flow (m3/hr)	:	Bidder to Provide
	Rated Capacity Head (mWCI)	:	Bidder to Provide
	Rated Capacity Power (KW)	:	Bidder to Provide
f.	Power consumption (KW)	:	Bidder to Provide
g.	Pump Speed (rpm)	:	Bidder to Provide
h.	Motor Rating (KW)	:	Bidder to Provide
i.	Motor Speed (rpm)	:	Bidder to Provide
j.	Margins (Flow/Head) (%/%)	:	Bidder to Provide
k.	Operation Pressure	:	Bidder to Provide
l.	Design Pressure	:	Bidder to Provide
m.	Material/Thickness (mm) of	:	Bidder to Provide
	Base/Lining	:	Bidder to Provide
	Casing	:	Bidder to Provide
	Shaft	:	Bidder to Provide
	Impeller	:	Bidder to Provide
n.	Type of seal	:	Bidder to Provide
o.	Sealing Water Flow (m3/hr)	:	Bidder to Provide
p.	Bearing	:	Bidder to Provide
	No. of Bearings	:	Bidder to Provide
	Type Of Bearings	:	Bidder to Provide
q.	Type of coupling	:	Bidder to Provide
r.	Whether silencer provided at outlet	:	Yes/No
4.5	SLURRY PIPES	:	
a.	Pipe size (mm)	:	Bidder to Provide
b.	Type of Joints	:	Bidder to Provide
	Pipe to Pipe/Pipe to Fittings	:	Bidder to Provide
	Fittings	:	Bidder to Provide
c.	Material / Thickness (mm)of Pipe	:	Bidder to Provide

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d.	Material Thickness of lining	:	Bidder to Provide
e.	Estimated Life of liners (hrs.)	:	Bidder to Provide
f.	Slurry Solid concentration (w/w %)	:	Bidder to Provide
g.	Slurry Settling Velocity (m/s)		Bidder to Provide
h.	Pipe Velocity (m/s)		Bidder to Provide
4.6	BELT FILTER WASH PUMPS		
a.	No. for each VBF		Bidder to Provide
b.	No. of stand-by pumps for each VBF		Bidder to Provide
c.	Make / Model		Bidder to Provide
d.	Impeller Type		Bidder to Provide
e.	Material / Thickness (mm) of Impeller and lining		Bidder to Provide
f.	Casing Type		Bidder to Provide
g.	Material/Thickness of Casing/Lining		Bidder to Provide
h.	Rated Flow/Head (m3/hr./mWCI)		Bidder to Provide
4.7	CLARIFIED WATER/CAKEWASH PUMPS		
a.	No. for each VBF		
b.	No. of stand-by pumps for each VBF		
c.	Make / Model		
d.	Impeller Type		
e.	Material / Thickness (mm) of Impeller and lining		
f.	Casing Type		
g.	Material/Thickness of Casing/Lining		
h.	Rated Flow/Head (m3/hr./mWCI)		
4.8	BELT ACCESSORIES		
4.8.1	Bearing		
a.	Carrying	:	Bidder to Provide
b.	Return	:	Bidder to Provide
4.8.2	Material		
a.	Roller	:	Bidder to Provide
b.	Spindle	:	Bidder to Provide

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4.8.3	Pulleys		
i)	General (for all types of Pulleys)	:	Bidder to Provide
a.	Pulley Shaft Diameter	:	Bidder to Provide
ii)	Drive Pulleys		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
c.	Minimum angle of wrap	:	Bidder to Provide
d.	Maximum out of roundness	:	Bidder to Provide
iii)	Other Pulleys		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
iv)	Rubber for lagging		
a.	Type	:	Bidder to Provide
b.	Hardness	:	Bidder to Provide
c.	Elongation	:	Bidder to Provide
d.	Strength	:	Bidder to Provide
e.	Abrasion Loss	:	Bidder to Provide
f.	Specific Gravity	:	Bidder to Provide
g.	Adhesion Strength	:	Bidder to Provide
v)	Bearings for Pulleys		
a.	Type	:	Bidder to Provide
b.	Casing	:	Bidder to Provide
c.	Sealing	:	Bidder to Provide
d.	Lubrication	:	Bidder to Provide
e.	Pulley Material	:	Bidder to Provide
f.	Shaft Material	:	Bidder to Provide
4.9	Chutes and Hoppers		
a.	Minimum Valley Angle	:	Bidder to Provide
b.	Material :	:	Bidder to Provide
	i) Chute work	:	Bidder to Provide

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	ii) Sliding zones & adjacent sides	:	Bidder to Provide
	iii) No striking/ Non sliding zones	:	Bidder to Provide
	iv) Chute with valley angle 80 degree and above	:	Bidder to Provide
	v) In the zone of magnetic field	:	Bidder to Provide
	vi) In the zone of flap gates	:	Bidder to Provide
	vii) Discharge Hoods overhead pulleys	:	Bidder to Provide
c.	Inspection Doors	:	Bidder to Provide
d.	Chute Construction	:	Bidder to Provide
	i) Corners	:	Bidder to Provide
	ii) Joints Bolted	:	Bidder to Provide
	iii) Bolt size	:	Bidder to Provide
	iv) Bolts spacing	:	Bidder to Provide
	v) Fixing Arrangement	:	Bidder to Provide
4.10	Skirt Boards		
a.	Length	:	Bidder to Provide
b.	Height	:	Bidder to Provide
c.	Width	:	Bidder to Provide

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ANNEXURE III- SCHEDULE OF GUARANTEES

Sl. No	Description	Data
1.	Rated capacity of Vacuum Belt Filter TPH	: Bidder to Provide
2.	Guaranteed power consumption of Gypsum Dewatering System at rated capacity kW	: Bidder to Provide
3.	Guaranteed a) Gypsum cake moisture content % b) Gypsum cake chloride content ppm	Bidder to Provide
4.	Guaranteed life of filter cloth hrs	Bidder to Provide
5.	Guaranteed life of liners in hydro cyclone hrs	Bidder to Provide
6.	Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor dB(A)	:
7.	Maximum vibration (peak to peak amplitude at site) microns	: 1) For vacuum pump & Belt Filter Wash Pump:
8.	Equipment Availability for 120 days %	: 98%
9.	Scheduled Maintenance (Minor Overhauls): Recommended intervals between maintenance outages hours	: >25000 hours operation.
10.	Scheduled Maintenance (Major Overhauls): Recommended intervals between maintenance outages shall be hours	: >75000 hours operation.

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ANNEXURE – IV

REFERENCE LIST as per format shown below. (Atleast two reference plant details)

S.no	Project Name Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Model	Capacity of Vacuum belt filter TPH	Year of Coming	Qty
1.							
2.							

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ANNEXURE – V- LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

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ANNEXURE-VI DOCUMENTATION

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	No of copies With proposal
1.	Enquiry Specification (signed)	1
2.	Price Sheet	1
3.	Anchor Plan & Civil foundation Loading details	1
4.	Data Sheet	1
5.	Performance curve	1
6.	P & I Diagram	
7.	Terminal point details.	
8.	Annexure to qualification requirement-	1
9.	Proforma Packing List	1
10.	Shortest Manufacturing Time	1
11.	Approximate weight of each skid	1
12.	Required Electric power & other Utility List	1
13.	Deviation List	1
14.	General Assembly Drawing indicating dimension and civil loading details	1
15.	Gypsum dewatering building GA	1
16.	VBF Sizing Calculation	1
17.	Cross-sectional Drawing	1
18.	Scope of Supply	1
19.	Spare List (Recommended)	1
20.	Start-up & Commissioning Spares	1
21.	List of Special Tools	1
22.	Test Arrangement & Test procedure	1
23.	Rotor GD2 (kg-m2)	
24.	T-S curve	1
25.	Hoist/Crane requirement	1
26.	Catalogue	1
27.	Calculation of Motor rating, Bearing capacity and selection of coupling	1
28.	Bill of material along with material and code	1

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29.	Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment.	1
30.	Erection, Operation & Maintenance manual with lubrication schedule	1
31.	Procedure for shop / site performance tests	1
32.	Time schedule for delivery.	1
33.	Quality Assurance Plan.	1
34.	Make of all bought out items.	1
35.	Deviation list	1
36.	Spares list.	1
37.	Hoist / Crane requirement.	1
38.	Reference list of similar projects executed.	1
39.	List of proposed makes and vendors	1
40.	Training program and schedule for BHEL/END CUSTOMER C personnel	1
41.	Equipment maintenance schedules	1

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B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	No of copies After award of contract(tentative)	Delivery Time
1.	Utility Consumption	10	2 weeks after contract
2.	Foundation Data including Anchor plan	10	2 weeks after contract
3.	Performance curve	10	2 weeks after contract
4.	Assembly drawings of each equipment	10	1 month after contract
5.	Cross section detail drawing	10	1 month after contract
6.	Data Sheet	10	2 weeks after contract
7.	Documents in support of qualification requirement	10	2 weeks after contract
8.	Lubricating oil list	10	2 months after contract
9.	Special tools list	10	2 months after contract
10.	Installation and assembly procedure	10	4 months after contract
11.	Inspection and Test Procedure	10	1 month after contract
12.	Inspection & Test record	10	In 2 weeks after test
13.	Inspection Certificate	10	In 2 weeks after test
14.	Sub vendors List	10	2 weeks after contract
15.	Manufacturing Schedule	10	2 weeks after contract
16.	Progress report	10	Every month
17.	Proforma Packing List	10	2 months prior to shipping
18.	Approximate weight of each skid	10	2 months after contract
19.	Required Electric power	10	2 weeks after contract
20.	VBF Sizing Calculation	10	2 weeks after contract
21.	Material Test Certificates	10	In 2 weeks after test
22.	Pre Commissioning Check List	10	4 months after contract
23.	Scope of Supply	10	2 weeks after contract
24.	Quality Plan	10	1 month after contract
25.	Operation and Maintenance Manual	5 hardcopies and 4 electronic copies in English	4 months after contract
26.	Erection Manual	5 hardcopies and 3 electronic copies in	4 months after contract
27.	Commissioning Manual	5 hardcopies and 4 electronic copies in	4 months after contract

• 5 hardcopies and 3 electronic copies in English
• 5 hardcopies and 3 electronic copies in English

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Sl. No.	Description	No of copies After award of contract(tentative)	Delivery Time
28.	Spare List (Mandatory, Recommended)	10	1 month after contract
29.	Start-up & Commissioning Spares	10	1 month after contract
30.	List of Special Tools	10	1 month after contract
31.	Delivery Schedule	10	2 weeks after contract
32.	Test Arrangement & Test procedure	10	1 month after contract
33.	T-S curve	10	2 weeks after contract
34.	P & I Diagram	10	2 weeks after contract
35.	Catalogue	10	2 weeks after contract
36.	Gypsum Dewatering Building GA	10	1 month after contract
37.	Motor Data	10	1 month after contract
38.	Recommended repair procedure etc.	10	1 month after contract
39.	Any unique installation instructions shall be noted on the submitted drawings or be provided as a separate document prior to the submission of the Operation and Maintenance Manual	10	1 month after contract
40.	Erection schedule and component list.	10	1 month after contract

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Annexure-VII Piping & Instrumentation Diagram

Bidder to confirm to the PFD and P&ID enclosed.

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Annexure-VIII -Sea worthy packing (applicable for supplies from outside India)

Refer to Specification No: PE-TS-888-100-A001 for detailed specification on Seaworthy packing.

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Annexure-IX Inspection and testing requirements

Refer to various clauses of Inspection and Testing Requirements

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Annexure-X Motor data sheet format

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Annexure-XI MOTORS, CABLES, JUNCTION BOX & INSTRUMENTS SPECIFICATION

Refer to the specification enclosed.

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Annexure-XII material specification

Refer to pipe, valve & VBF material specification enclosed.

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Annexure-XIII GA drawing of gypsum dewatering building

Refer to the GA drawing of GDS building enclosed.

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Annexure-XIV Paint schedule

Refer to the paint schedule enclosed.

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Annexure-XV Vendor List

Refer to the Vendor List enclosed.

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