TECHNICAL SPECIFICATION

FOR

GYPSUM DEWATERING SYSTEM

CONFIDENTIAL

CUSTOMER : **NTPC**

PROJECT : **NORTH KARANPURA 3x660 MW TPS**

APPLICATION : **FLUE GAS DESULPHURIZATION SYSTEM**

Flue Gas Desulphurization Group
Air Quality Control Systems
BAP: BHEL: Ranipet

Department	Prepared	Checked	Approved
FGD	S.Shanmuga Sundaram DM/FGD	KM Kabilash SEr/FGD Naveen Reddy MGR/FGD	R.Babu DGM/FGD R. BABU Deputy General Manager EDC - Flue Gas Desulphurisation BHEL / BAP / RANIPET - 632 406.
Revision – 00 Dated 28.01.2019		COMMENTS : -----	

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CLAUSE NO.	DESCRIPTION		
1.0.00	**PROJECT INFORMATION**		
a)	Address	:	
b)	Districts	:	Chatra
c)	State	:	Jharkhand
d)	Country	:	India
	Site Condition		
a)	Ambient Temperature	:	27 Deg C
b)	Ambient Temperature (Design)	:	45 Deg C
c)	Relative Humidity	:	60%
d)	Project Owner	:	NTPC
e)	Buyer	:	BHEL-Ranipet
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/International (ASME/EN/Japanese) Standards.		
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 North karanpura 3x660MW project in Jharkhand. The following points may be noted.		
b)	Bidder shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.		
c)	There are three (3) units of each 660 MW and each unit is envisaged with one (1) FGD system. Two (02) Sets of Gypsum Dewatering system (1 working + 1 standby) common for all three units shall be provided.		
d)	The Bidder shall offer only proven design of the capacity specified in the input parameters indicated		
e)	In case, deviations are considered essential by the Bidder (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 ".		
f)	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.		
g)	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.		

	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)**	
	Bidder should have previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured at least one vacuum belt filter of minimum 80% of offered capacity and which are in satisfactory operation for a period of not less than one year as on the original scheduled date of techno commercial bid opening in Wet Limestone based FGD application in Coal fired power plant. Refer to Annexure-1 for detail on Qualification Requirement (QR).	
4.1	**IMPORT CONTENT CRITERIA** The Bidders are required to meet the Import Content Requirement (ICR) for Gyspsum Dewatering System to be restricted to 30% of the total value as per Govt norms.	
5.0.0	**TECHNICAL INFORMATION**	
1.	Quantity of gypsum dewatering system	Two (2) Numbers (one working +one standby)
2.	Capacity of gypsum dewatering system	82.5 tones per hour (wet cake)
3.	Moisture content	10%
4.	Gypsum purity	95%
5.	Voltage level for Motors	a. Up to 0.2KW – Single phase 240V AC/ 3phase 415V AC b. Above 0.2 KW and up to 200 KW- 3phase 415V AC c. Above 200 KW and up to 1500 KW- 3phase 3.3kV AC d. Above 1500KW-11 kV
6.	Inspection & Testing	One (1) number Vacuum Belt Filter (VBF) system will be tested at Vendor's works.
7.	Service engineer site visit	Vendor shall include number of working days per Gypsum dewatering system for supervision of E&C in the offer.
8.	Surface Preparation	1) Vacuum Pump- SSPC SP3 Finish 2) All other Equipment's- Blast cleaning to SA2 ½
9.	Painting	**a) <u>For Other Equipment's</u>** **PRIMER COAT :** a. Self-curing inorganic Zinc Silicate- (Solid by Volume min 60%) b. DFT= 75 micron per coat c. No of coats 1. d. Primer paint thickness 75

		micron. **INTERMEDIATE COAT:** a. Polyamide cured pigmented TiO2 or MIO epoxy based paint (Solid by volume min 60%) b. DFT= 75 micron per coat c. Polyamide cured color pigmented epoxy based paint (Solid by volume min 60%) d. DFT= 75 micron per coat e. Intermediate paint thickness 150 micron. **FINISH COAT :** a. Polyurethane based color pigmented paint (Solid by volume min 40%) b. No of coats 1. Finish coat thickness 25 micron. c. Gray shade – RAL 9002. d. Total DFT : 250 micron. **b) For Vacuum Pump** **PRIMER COAT:** a. Zinc Phosphate Primer b. DFT= 30 micron per coat c. No of coats 2. Primer paint thickness 60 micron. **FINISH COAT :** a. 2K Epoxy Paint or equivalent b. DFT= 20 micron per coat c. No of coats 2. Finish coat thickness 40 micron. d. Shade – RAL 5015. f. Total DFT : 100 micron.
10.	Guarantee & Warranty	Vendor shall Guarantee Belt filter capacity 82.5 TPH-wet cake The filter cloth shall be guaranteed for a minimum life of not less than 7000 hrs. The liners in hydro-cyclone shall have a minimum wear life of not less than 7000 hrs. The noise level shall not exceed 85 dBA overall sound pressure level

		the Facilities or twelve (12) months from the date of Operational Acceptance of the Facilities
12.	Vibration	The overall vibration level shall be as per ISO 10816-1
6.0.0	**BIDDER'S SCOPE OF WORK**	
1.	Primary hydrocyclone	Two (2) sets
2.	i. Hydrocyclone clusters	
3.	ii. Anchor bolts, nuts and washers	
4.	iii. Companion flanges for inlet and overflow	
5.	iv. A variety size of vortex finders for all the hydro cyclone	
6.	v. Accessory piping within the skid	
7.	Secondary hydrocyclone	Two (2) sets
8.	i. Hydrocyclone clusters	
9.	ii. Anchor bolts, nuts and washers	
10.	iii. Companion flanges for inlet and overflow	
11.	iv. A variety size of vortex finders for all the hydro cyclone	
12.	v. Accessory piping within the skid	
13.	Vacuum belt filters & driving motors with inverter panel	Two (2) numbers
14.	Vacuum receivers	Two (2) numbers
15.	Vacuum pumps with driver	Two (2) numbers
16.	Vent fan including enclose and its arrangement	Two (2) numbers
17.	All Interconnected piping (slurry and water pipes)	One (1) set *
18.	Complete valves required for the system along with wash water line.	One (1) set *
19.	Arrangement for cloth and cake washing, including tanks, spray nozzles, etc.	One (1) set*
20.	Companion flanges with gaskets and fasteners	One (1) set*
21.	Coupling with guards	One (1) set*
22.	INSTRUMENTS: a) Pressure transmitter with root valve (PT) b) Pressure indicator with root valve (PI) c) Flow indicator (FI) d) Flow indicator switch (FIS) e) Level transmitter (LT) f) Pull cord (EMERGENCY SWITCH) g) Plow h) Flow indicator switch alarm (FISA) i) Belt sway switch (off track alarm) (ZSA) j) Cloth sway switch (off track alarm) (ZSA) k) Cloth cutting switch (ZSA)	 9 No's 9 No's 3 No's 1 No 1 No 1 No 1 No 1 No 2 No's 2 No's 2 No's

23. VALVE LIST:

Slno	Description	Size	Qty
a)	Butterfly valves with pneumatic o/c actuator	DN 125	4
b)	Butterfly valves with pneumatic o/c actuator	DN 100	2
c)	Butterfly valves with non-intrusive type actuator sil 2	DN 80	5
d)	Check valve	DN 80	2
e)	Check valve	DN 125	2
f)	Globe valve	DN 100	1
g)	Globe valve	DN 80	2
h)	Gate valve	DN 80	5
i)	Gate valve	DN 65	1
j)	Gate valve	DN 100	1
k)	Gate valve	DN 250	2
l)	Gate valve	DN 25	1
m)	Gate valve	DN 50	1
n)	Ball valve tentative (any extra valves vendor to decided)	DN 25	7
o)	Y- strainer	DN 80	2
p)	Drain gate valve	DN 25	12

24. VALVE MATERIALS LIST:

S.no	Description	Valve size	Body material	Trim material	Lining/seat ring
1	Butterfly valve	DN 125	SA105/WCB 216	13GR/A351 CF8M	EPDM
2	Check valve	DN 125,DN 80	WCB	13GR/A351CF8M	EPDM

25.	Complete set of instruments required for the each Gypsum Dewatering System	One (1) set*
26.	Local control panel including inverter and PLC, junction box	One (1) set*
27.	Cabling and wiring from local instrument to JB.	One (1) set*
28.	Foundation bolts required for complete gypsum dewatering system	One (1) set*
29.	Mechanical Running and performance test at shop for one complete vacuum belt filter.	One (1) set*
30.	Special tools & Tackles as applicable	One (1) set*
31.	Start-up & Commissioning spares as applicable	One (1) set*

32.	Expansion Joints at suction & discharge of each pump and also for other equipment wherever applicable	One (1) set*
33.	Pressure Gauges shall be furnished for at suction & discharge of each pump. Pressure gauges of class 1.6 or better must be used wherever applicable in the dewatering system.	One (1) set*
34.	**Flow Measurement & Control:** Flow indicator shall be Rotameter type. All wetted parts shall be 316 SS or equivalent. Output signal shall be Contact (SW Form: SPDT) for Vacuum Pump Seal water flow. No such output signal required for flow indicator used in Cake and cloth wash water lines.	
35.	**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.	
36.	**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.	
37.	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.	
38.	Supervision of erection / commissioning of both the gypsum dewatering system. 30 Days per system and 60 Days for Two Systems.	
39.	Mandatory spares with breakup price	
40.	Painting and rust prevention during shipment and construction	
41.	Seaworthy packing & forwarding to project site-refer clause 1.0.0 for project information	
42.	Recommended spare parts (for 3 years operation) with break up price.	
43.	This is only partial scope of work, if any item(s) is required for the completeness of the system; same shall be included in the offer and shall be supplied by the Bidder/supplier.	
44.	*** One set mean complete requirement for both the gypsum dewatering system**	
7.0.0	**PROCESS DESCRIPTION**	
1.	Common gypsum dewatering system is envisaged for all three FGD units. The dewatering system shall receive the gypsum slurry from each absorber through gypsum bleed pumps. Gypsum dewatering system shall be suitable for handling slurry from all three FGD units.	
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 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 (BHEL Scope). The over flow from the secondary hydro-cyclone shall be taken to a waste	

	water tank (BHEL Scope)
4.	Belt filter washing tank and pump and its accessories for cloth and cake washing is common for both the belt filters (Vendor Scope)
5.	Clarified water Tank and Pump and its accessories for cake washing and Vacuum pump sealing is common for both the belt filters (Vendor Scope)
8.0.0	**DETAILED SPECIFICATION**
a)	Bidder/Contractor shall supply three 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.
b)	Bidder/Contractor shall supply 2x100% gypsum dewatering system with each stream sized to dewater 82.5 TPH (Wet cake) produced by the all three 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**
a)	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 with an additional 10% margin.
b)	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause (9.0.0) shall be met with spare hydro-cyclones out of service
c)	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the primary hydro-cyclones shall be taken to secondary hydro-cyclone feed.
d)	Two (2) sets of secondary hydro cyclones are to be installed, each sets shall be sized to dewater the gypsum slurry produced by all three FGD units operating at design point with an additional 10% margin.
e)	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.
f)	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.**
8.2.0	**Vacuum Belt Filters**
a)	Two (2) numbers of vacuum belters each of capacity **82.5 TPH (Wet cake)** is envisaged. Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: ▪ Outlet Moisture 10% max. ▪ Gypsum Purity 90% (minimum) ▪ Chloride content < 100 ppm
b)	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. Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor. The elevation of discharge point of vacuum belt filter shall be at least 5.0 m above GL.

c)	Platform of minimum two (2) meters wide shall be provided around each belt filter for easy approach & maintenance. Details on handling facilities requirement for replacement of heavy components of the belt shall be provided in the offer.
8.3.0	**Vacuum System**
a)	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 vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity.
b)	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.
c)	The seals shall be of proven design.
d)	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.
e)	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.
f)	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.
g)	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. Two (02) 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.
h)	One (01) no. of Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump for each vacuum Belt filter. Two (02) no's of Flow indicator shall be provided for cloth washing line of each vacuum belt filter. Two (02) no's of Flow indicator shall be provided for cake washing line of each vacuum belt filter.
i)	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.
j)	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.
k)	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.

l)	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.	
m)	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.	
n)	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.	
o)	Provide double nuts for anchor bolts.	
p)	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.	
q)	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.	
r)	Bidder shall provide the mating flanges with the necessary gaskets.	
s)	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.	
t)	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.	
u)	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**
a)	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.	
b)	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design	
c)	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.	
d)	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.	
e)	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.	
f)	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.	
g)	Local control panel shall have display on the front panel, inverter, PLC controller and necessary electrical parts.	
h)	The service factor of the gear unit (if any) shall be minimum 1.5.	
i)	Piping and wiring within the skid should be in the vendor's scope.	
j)	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.	
k)	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.	
III.	**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.	
IV.	**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.	
V.	**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.	
VI.	**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.	
VII.	**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.	
VIII.	**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.	
IX.	**Mechanical Seals**	
a)	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.	
b)	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.	
X.	**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.	
XI.	**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.	
XII.	**Drive Motor (Prime Mover)**	
	The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.	

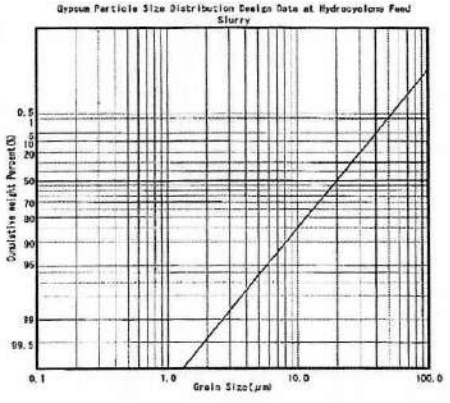
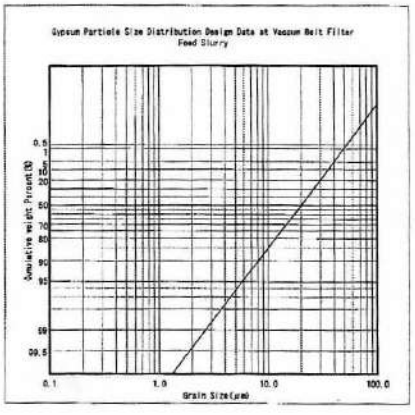
XIII.	**Quality- Tests**	
a)	UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.	
b)	The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.	
c)	The pump rotating parts shall be subjected to static and dynamic balancing.	
d)	Noise and vibration shall be measured during the performance testing at shop.	
e)	For motors-type test requirement refer Annexure-2-motors specification	
XIV.	**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	
e)	Hydro cyclones shall be checked by visual, dimensional etc.	
10.0.0	**BID EVALUATION CRITERIA 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 equipment's shall be considered for Guaranteed Power consumption calculation (GPC). a. Belt Filter Wash Pump -1 No. b. Vacuum Belt Filter - 1 No. c. Vacuum Pump - 1 No. d. Belt Filter Vent Fan- 1 No	
II.	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:** The best of the parameter for auxiliary power consumption quoted by any qualified bidder shall be taken as the base or Ceiling Value(CV). Adjustment factor for excess power consumption in USD = (GPC-CV) X PL X 2 No. of Units. GPC- Guaranteed Power Consumption quoted by bidder in KW CV- Ceiling Value for Guaranteed Power Consumption in KW PL- Power Loading @ 4060 USD/KW Exchange rate as applicable on price bid opening date will be considered.	

III.	**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 USD = (GPC-APC) X P X 4 sets of Equipment's Where ▪ GPC- Guaranteed Power Consumption quoted by bidder in KW ▪ APC- Actual Power Consumption in KW ▪ P- Penalty @ 4060 USD per KW
11.0.0	**Process Flow Diagram**
	The process flow diagram (BHEL DRG NO: 3-FW-738-00886) attached along with this document

12.0.1	PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE			
S.no	Parameters	Primary Hydro Cyclone Feed Slurry	Primary Hydro Cyclone Over Flow	Primary Hydro Cyclone Under Flow
a.	Total Flow (m^3/hr.)	269.7	155.8 *1)	113.9 *1)
b.	Total Flow (t/hr.)	328.2	173.3 *1)	154.8 *1)
c.	Operating Temp (C)	63	63	63
d.	Design Temp (C)	70	70	70
e.	Solid (wt. %)	30	16.6 *1)	> 45 *2)
f.	Density (Kg/m^3)	1217	1112 *1)	1360 *1)
g.	pH	4-7	4-7	4-7
h.	Cl^-(mg/l)	30000	30000	30000

12.0.2	PROCESS PARAMETERS FOR SECONDARY HYDROCYCLONE			
a.	Parameters	Secondary Hydro cyclone – Feed Slurry	Secondary Hydro cyclone– Overflow	Secondary Hydro cyclone – Under flow
b.	Total flow (m^3/hr)	155.8	97.4 *1)	58.4 *1)
c.	Total flow (t/hr)	173.3	99.7 *1)	73.7 *1)
d.	Operating Temp (° C)	63	63	63
e.	Design Temp (C)	70	70	70
f.	Solid (wt %)	16.6	3 *1)	35 *2)
g.	Density (kg/m^3)	1112	1023	1261
h.	pH	4-7	4-7	4-7
i.	Cl^- (mg/l)	30000	30000	30000

12.0.3	DATA SHEET OF BELT FILTER:				
12.0.3	Parameters	Belt Filter Feed Slurry	Product Gypsum	Filtrate	Washing Water **
a.	Total Flow (m^3/hr)	113.9 *1)			
b.	Total Flow (t/hr)-Wet	154.8 *1)	85.2		
c.	Temp(deg C)	70.0			
d.	Solid(% wt)	>45 *2)	>90 *2)	<0.2	
e.	Slurry conc.(%wt)	1360*1)	>90		
f.	pH	4~7	5~8		
g.	Cl	<27000	<100 ppm *2)		
h.	Belt filter and the peripherals shall be designed at 82.5 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.
i.	*1) shall be finalized by vendor. *2) Shall be guaranteed by vendor
12.0.4	**GYPSUM PARTICLE SIZE AT HYDRO CYCLONE FEED SLURRY IS SHOWN BELOW**
	
12.0.5	**Gypsum particle size at belt filter feed slurry is shown below**
	

13.0.0	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	:	280 m3/hr
4.	Secondary hydrocyclone capacity	:	160 m3/hr
5.	Type of hydro cyclone	:	Vertical
6.	Material (MOC) of Cyclone Clusters	:	CS+12mm rubber lining
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

13.1.0 **PROCESS WATER CHARACTERISTICS**

S.no	Constituents	Unit	Water quality
1.	Total cations as $caco_3$	Ppm	209
2.	Total anions as $caco_3$	Ppm	209
3.	Calcium as $caco_3$	Ppm	65
4.	Magnesium as $caco_3$	Ppm	41
5.	Sodium as $caco_3$	Ppm	98
6.	Potassium as $caco_3$	Ppm	5
7.	Iron as fe	Ppm	1.2
8.	Total alkalinity as $caco_3$	Ppm	150
9.	Chlorides as $caco_3$	Ppm	25
10.	Sulphate as $caco_3$	Ppm	34
11.	Silica	Ppm	9
12.	Ph		7.6 – 8.2
13.	Turbidity	Ntu	200

Note: 1) Process water will be used for Gypsum & Cloth washing
2) Clarified water will also be used for Gypsum washing and Vacuum Pump sealing.

14.0.0	**MANDATORY SPARES**		
14.0.1	**Vacuum Belt Filter**		
1.	Filter Cloths	6 Sets	
2.	Belt	3 sets	
3.	Vacuum box seals	2 sets	
4.	Drive motors	1 number	
14.0.2	**Vacuum Pumps**		
1.	Pump Impeller Assembly	3 numbers	
2.	Pump Bearing	3 sets	
3.	Seals	3 sets	
4.	Motor	1 numbers	
14.0.3	**Vacuum Breaker Valves**		
1.	Valve Assembly	3 numbers	
2.	Actuator	1 numbers	
14.0.4	**Slurry Valves (applicable in Gypsum dewatering area)**	4 number of each type	
14.0.5	**Slurry Line Bends(applicable in Gypsum dewatering area)**	4 number of each type	
14.0.6	**Hydro-cyclones (Primary & Secondary)**		
1.	Hydro-cyclone isolation valve	10% of each type or 1 no whichever is higher	
2.	Hydro-cyclone	10% of each type or 1 no whichever is higher	
3.	Hydro-cyclone rubber lining	10% of each type or 1 no whichever is higher	
15.0.0	**DOCUMENTATION**		
A	**Document required along with the offer**	**NO of copies**	**Vendor to comply**
1.	Process and Instrumentation diagram (PID)		
2.	Terminal points details		
3.	Performance curve		
4.	Rotor GD^2 (kg-m2) for Vacuum Pump		
5.	General Arrangement (GA) drawing of complete gypsum dewatering building.		
6.	GA Drawing of all components with civil loads and pocket details.		
7.	T-S Curve of Vacuum Pumps		
8.	VBF Sizing Calculation		
9.	Procedure for shop / site performance tests		
10.	Power consumption & Utility consumption details (Instrument & Service Air, Cooling water, Seal water etc.)		
11.	Time schedule for delivery.		

12.	Quality Assurance Plan.		
13.	Make of all bought out items		
14.	Deviation & clarification list		
15.	Utility Consumption list		
16.	Reference list of similar projects executed		
17.	Technical Description for Gypsum Dewatering System		
18.	Piping & Valve list and Instrument List		
19.	Project schedule mentioning delivery schedule and commissioning schedule.		
20.	No of man days required for Supervision of Erection & commissioning for both the projects.		
21.	Project schedule mentioning delivery schedule and commissioning schedule		
22.	Handling arrangement will be provided by BHEL. Vendor to provide Handling arrangement type (crane or hoist) and capacity (Tonnes) required in each floor for different equipment's.		
23.	List of recommended spares for 3 years of operation along with unit prices.		
	Attachment-9-Declaration regarding import content		
B	**Document required after award of contract**	**NO of copies**	**Delivery Time**
1.	Drawing Schedule		
2.	Plot Plan & Layout		
3.	Process Flow Diagram		
4.	Equipment List		
5.	Utility Consumption		
6.	Chemical List		
7.	Duly filled technical datasheet		
8.	P &I Diagram		
9.	Operation & Maintenance Manual		
10.	Performance Test Procedure & Report		
11.	Outline Drawing of Equipment		
12.	Fabrication Drawing of Equipment		
13.	Warranted Performance curve of Machinery		
14.	Platform Drawing		
15.	Line Index		
16.	Piping Material Specification		
17.	Piping Arrangement Drawing		

18.	Piping Support Arrangement Drawing		
19.	Isometric Drawing		
20.	Data sheet of Piping Parts		
21.	Valve Drawing		
22.	Instrument Schedule List		
23.	Instrument Function Loop Diagram		
24.	Interlock and Operation Description		
25.	Interlock/ Sequence Logic Diagram		
26.	Instrument Power Supply Diagram		
27.	Instrument Set Point List		
28.	Instrument Data Sheet		
29.	Valve Data Sheet, including On-Off Valve		
30.	Nozzle Elevation Plan for Level Instrument		
31.	Specification and Drawing of Instrument		
32.	Instruction Manual for Instrument		
33.	Local Control Panel Specification		
34.	Local Control Panel Drawing		
35.	Cable Duct/Tray Routing Plan		
36.	Fabrication Drawing for Cabinet Duct/Tray		
37.	Plot Plan of Field Instrument		
38.	Layout of Instrument Wiring		
39.	Layout of Instrument Air Supply Piping and Signal tubing		
40.	Hook-up Drawing for Instrument		
41.	Instrument Connection List		
42.	Instrument Cable Schedule		
43.	Parts Drawing for Instrument Installation Materials		
44.	Calculation Sheet for Flow Instrument		
45.	Motor List		
46.	Motor Data Sheet		
47.	Outline drawing of Motor		
48.	Loading Data		
49.	Planning Drawing of Building		
50.	Planning Drawing of Foundation		
51.	Consumable Parts List		
52.	Lubricant List		
53.	Special Tool List		
54.	Spare Parts List for Erection		
55.	Spare Parts List for Commissioning		
56.	Spare Parts List for 2 years of Warranty Period Operation		
57.	Construction Work Specification		
58.	Construction Manual List		
59.	Painting Specification		
60.	Transportation and Storage Specification		
61.	Shop Inspection Specification		

62.	Shop Inspection Report		
63.	Site Inspection Specification		
64.	Site Inspection Report		
65.	Supply Item List for Package Verification at Site		
66.	Packing List		
67.	Sub-Vendor List		
68.	Manufacturing Schedule		
69.	Progress Report		
70.	Spare Parts List for Erection		
71.	Spare Parts List for Commissioning		
72.	Spare Parts List for 2 years of Warranty Period Operation		
73.	Construction Work Specification		
74.	Construction Manual List		
75.	Painting Specification		
76.	Transportation and Storage Specification		
77.	Shop Inspection Specification		
78.	Shop Inspection Report		
79.	Site Inspection Specification		
80.	Site Inspection Report		
81.	Supply Item List for Package Verification at Site		
82.	Packing List		
83.	Sub-Vendor List		
84.	Manufacturing Schedule		
85.	Progress Report		
86.	Detail drawings indicating the dimensions of the equipments.		
87.	Detail drawings indicating the piping layouts		
88.	Detail drawing of Gypsum dewatering building		
89.	Erection drawings		
90.	Operation & Maintenance (O&M) Manuals		
91.	Civil Loading details		
92.	Performance guarantee test procedure		
93.	Quality plan & Safety Requirement		
16.0.0	**BREAKDOWN PRICE**		
1.	Gypsum Dewatering system & Its accessories	Price Basis Firm for North Karanpura site	
2.	Test & Inspection		
3.	Commissioning spares		
4.	Special tools & tackles		
5.	Packing and Transportation		
6.	Supervision of Erection & Commissioning		
7.	Mandatory Spares		

ANNEXURE-I-TECHNICAL DATA SHEET

Sl. No	Description		Data
1.0	**GENERAL**		
	a. Client	:	BHEL-Ranipet
	b. Project	:	NTPC North Karanpura 3X660MW
	c. End Customer	:	NTPC
	d. Location	:	Chatra,Jharkhand
	e. Service	:	Continuous
	f. Installation	:	Inside the Building
	g. Quantity for all 3 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	**PRIMARY HYDRO-CYCLONE**		
	i. Stage		Bidder to Provide
	ii. Manufacturer		Bidder to Provide
	iii. Number of Hydrocyclone		Bidder to Provide
	iv. Diameter of Hydrocyclone		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
	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

4.2	**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

	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		
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 (mWCl)	:	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
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		
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./mWCl)		
4.7	**WASTE WATER HYDROCYCLONE**		
	i. Stage	:	Bidder to Provide
	ii. Manufacturer	:	Bidder to Provide
	iii. Number of Hydrocyclone	:	Bidder to Provide
	iv. Diameter of Hydrocyclone	:	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
	xiii. Mesh of separation (50% Removed)	:	Bidder to Provide
	xiv. Solid content of feed slurry	:	Bidder to Provide
	xv. Solid content in underflow of Hydrocyclones	:	Bidder to Provide
	xvi. Solid content in Overflow of Hydrocyclones	:	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 Slurry	:	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
4.8	**BELT ACCESSORIES**		
4.6.1	**Bearing**		
a.	Carrying	:	Bidder to Provide
b.	Return	:	Bidder to Provide
4.6.2	**Material**		
a.	Roller	:	Bidder to Provide
b.	Spindle	:	Bidder to Provide
4.6.3	**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
4.7	**Chutes and Hoppers**		
a.	Minimum Valley Angle	:	Bidder to Provide
b.	Material :	:	Bidder to Provide
	i) Chute work	:	Bidder to Provide

	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
4.7.1	**Skirt Boards**		
a.	Length	:	Bidder to Provide
b.	Height	:	Bidder to Provide
c.	Width	:	Bidder to Provide
4.8	**Silo Shut off Gate**		
a.	Type	:	Bidder to Provide
b.	Travel	:	Bidder to Provide
c.	Automatic operation	:	Bidder to Provide
	i) Drive	:	Bidder to Provide
	ii) Minimum Actuator Rating	:	Bidder to Provide
	iii) No. of Operation / Hr.	:	Bidder to Provide
	iv) Protection	:	Bidder to Provide
d.	Manual Operation	:	Bidder to Provide
	i) Maximum effort	:	Bidder to Provide
	ii) Minimum Hand wheel Diameter	:	Bidder to Provide

e.	Flap gate shaft	:	Bidder to Provide
	i) Diameter minimum	:	Bidder to Provide
	ii) Material	:	Bidder to Provide
4.9	**Waste Water Hydrocyclone**	:	Bidder to Provide
	i) Stage	:	Bidder to Provide
	ii) Manufacturer	:	Bidder to Provide
	iii) Number of Hydrocyclone	:	Bidder to Provide
	iv) Diameter of Hydrocyclone	:	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
	xiii) Mesh of separation (50% Removed)	:	Bidder to Provide
	xiv) Solid content of feed slurry	:	Bidder to Provide
	xv) Solid content in underflow of Hydrocyclones	:	Bidder to Provide
	xvi) Solid content in Overflow of Hydrocyclones	:	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 Slurry (m3/hr)	:	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

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

ANNEXURE II- 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	%	:	90%
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.

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

ANNEXURE – III

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.							

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

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

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------