
TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

CONFIDENTIAL

CUSTOMER : NTPC
PROJECT : DADRI 2 x 490MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM



BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)
Flue Gas Desulphurization Group
Ranipet



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM
NTPC DADRI 2X490MW TPS

DADRI:FGD:GDS:R00

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PART –I

MAIN SUPPLY



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1.0 PROJECT INFORMATION:

a.	Owner	NTPC
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization system

A) SITE CONDITIONS

1.	Ambient Temperature and Relative Humidity		
a.	Average Site Condition ASC		
	Ambient Temperature	:	27 deg C
	Ambient Temperature (Design)	:	45 deg C
	Relative Humidity	:	60 %

Note:

- 1) Reference site 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.

B) PROJECT LOCATION AND APPROACH

a.	Country	India
b.	State/Division	Uttar Pradesh
c.	District	Gautam Buddha Nagar

2.0 APPLICABLE CODES & REGULATIONS

The design and materials shall conform 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 (AISI/ASME/EN/Japanese) Standards.

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection & commissioning and performance guarantee testing, 10 year AMC of Gypsum Dewatering system (GDS) along with accessories for the Flue Gas Desulphurization plant of DADRI 2 x 490 MW TPS. The following points may be noted.

- a. There are 2 units of each 490 MW and each unit is envisaged with one FGD system. The FGD system will be provided with common gypsum dewatering system for both FGD units. Common gypsum dewatering system consists of two (2 x100%) streams i.e. 1 working + 1



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standby. Gypsum dewatering system will be installed in Gypsum Dewatering Building. Each stream of gypsum dewatering system shall consist of following as a minimum requirement

- i. One set of primary hydro cyclones
 - ii. One vacuum belt filter and accessories
 - iii. One no. vacuum receiver
 - iv. One no. vacuum pump with motor
 - v. One set of Secondary Hydro-cyclones
 - vi. 2 nos. (1W+1S) Belt filter cloth wash pump with motor
 - vii. 2 nos. (1W+1S) cake wash pump with motor
 - viii. Complete piping and valves of the system.
- b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- c. 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 (**Annexure-IV**)".
- d. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall be considered as null and void.
- e. No deviation or exception shall be permitted without the written approval of the purchaser.
- f. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- 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 equipment, the same shall be recommended along with reasons in a separate section and include the same in 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 PROVENNESS CRITERIA:

The Bidder shall offer only proven design which meets the Provenness criteria indicated in the Annexure-I. Necessary document evidences as per Attachment-3K for qualification shall be submitted along with the bid. If bidder doesn't meet the specified Provenness criteria, they are denied to participate in this tender.

The Bidders are required to meet the Qualification Requirement (QR) for Gypsum Dewatering System as per **Annexure-I & submit the Annexure to qualification requirement (Attachment-3K)**



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5.0 TECHNICAL INFORMATION

S. No.	Description	Requirement
1.	Quantity	
	Quantity of Gypsum dewatering system	2 streams (1 working + 1 standby)
2.	Parameters	
	Vacuum belt filter design capacity	32.10 TPH (wet cake) each
	Duty	Continuous
	Location	Inside Building

5.1 GYPSUM DE-WATERING SYSTEM: -PROCESS DESCRIPTION

A common gypsum dewatering system for both FGD units is envisaged. Gypsum slurry is produced in the FGD plant. Two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum slurry from FGD plant up to less than 10% moisture is envisaged.

Gypsum slurry produced by FGD plant is collected in primary hydro cyclone feed tank. Primary hydro cyclone feed pump (**BHEL scope**) supplies gypsum slurry to Primary Dewatering Hydro-cyclones.

The primary hydro-cyclone shall be installed above the belt filters.

The underflow from primary hydro cyclone is fed to vacuum belt filter for final stage of dewatering gypsum slurry to produce gypsum cake with moisture content less than 10%.

The overflow from the primary set 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 feed.

Water from vacuum receiver tank and 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**)

For cake washing only clarified water shall be used. For this purpose, 2x100% cake washing pumps shall be provided for each Vacuum Belt Filter. One stage of cloth washing arrangement shall be provided along with 2x100% cloth washing pumps for each Vacuum Belt Filter. Cake wash tank & cloth wash tank are in **BHEL scope**.



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5.2 PROCESS WATER ANALYSIS FOR CLOTH WASH

Process water is envisaged for belt filter cloth wash.

S.No	Constituents	Unit	Water quality
1.	Total Dissolved Solids	ppm	~2110
2.	Calcium as CaCO ₃	ppm	721
3.	Magnesium as CaCO ₃	ppm	286
4.	Sodium as CaCO ₃	ppm	358
5.	Potassium as CaCO ₃	ppm	
6.	Iron as Fe	ppm	1.7
7.	Fluoride as F	ppm	0.11
8.	Bicarbonate as CaCO ₃	ppm	688
9.	Chlorides as CaCO ₃	ppm	168
10.	Sulphate as CaCO ₃	ppm	512
11.	Nitrate as NO ₃	ppm	0.55
12.	Silica	ppm	121
13.	pH		7.0 – 8.2
14.	Turbidity	NTU	55

5.2 CLARIFIED WATER ANALYSIS FOR CAKE WASH

Clarified water is envisaged for cake wash.

S.No	Constituents	Unit	Water quality
1.	Total Dissolved Solids	ppm	~390
2.	Calcium as CaCO ₃	ppm	131
3.	Magnesium as CaCO ₃	ppm	52
4.	Sodium as CaCO ₃	ppm	65
5.	Potassium as CaCO ₃	ppm	
6.	Iron as Fe	ppm	0.3
7.	Fluoride as F	ppm	0.02
8.	Bicarbonate as CaCO ₃	ppm	125
9.	Chlorides as CaCO ₃	ppm	31
10.	Sulphate as CaCO ₃	ppm	93
11.	Nitrate as NO ₃	ppm	0.1
12.	Silica as SiO ₂	ppm	22
13.	pH		7.0 – 8.2
14.	Turbidity	NTU	10



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6.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Engineering, Manufacturing, Packing, Supply, Supervision of Erection & Commissioning, Performance Guarantee Test, handing over of the system to final Customer (NTPC).

Design: Includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field 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 NTPC.

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:

Sl n	Item Description	Qty
1.	Primary hydro cyclone	2 set
2.	Vacuum Belt Filter with driving motor (VFD), VFD panel and accessories	2 set
3.	Gypsum Discharge chute	2 set
4.	Vacuum receivers	2 set
5.	Vacuum pumps with driver	2 set
6.	Secondary Hydro-cyclones	2 set
7.	Vent fan and its arrangement	2 set
8.	Complete interconnecting piping system	1 lot
9.	Cake wash pumps with motor	4 no's
10.	Cloth wash pumps with motor	4 no's
11.	Complete set of arrangement for cloth and cake washing including spray nozzles, etc.	2 set
12.	Companion flanges with gaskets and fasteners	1 lot
13.	Coupling with guards	1 lot
14.	One complete set of instruments required for the GDS	1 lot
15.	Local control panel	1 lot
16.	Cabling and wiring from local instrument to JB	1 lot
17.	Foundation bolts	1 lot
18.	Factory test	1 lot



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19.	Supervision of erection / commissioning	1 set
20.	Start-up & Commissioning spares	1 set
21.	Special tools & Tackles if applicable	1 set
22.	Painting and Rust Prevention during shipment and construction	1 set
23.	Seaworthy Packing & Forwarding to Project Site office	1 set



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6.1 DESIGN / PROCESS PARAMETERS:

6.1.1 Design Conditions of Primary Hydro cyclones:

Sl.no	Description	Requirement
1.	Number of Hydro cyclone	2 sets (1 Working+1 Standby)
2.	Design Capacity	115 m ³ /hr each
3.	Operating capacity	102.1 m ³ /hr each
4.	Type of hydro cyclone	Vertical
5.	Material (MOC) of Cyclone Clusters	Polyurethane or urethane
6.	MOC of Feed chamber	CS+12 mm rubber lining
7.	MOC of overflow chamber	CS+12mm rubber lining
8.	MOC of under flow chamber	CS+12mm rubber lining

6.1.2 PROCESS PARAMETERS @ OPERATING POINT –PRIMARY HYDRO-CYCLONES

S. No.	Parameters	Primary Hydro Cyclone Feed Slurry	Primary Hydro Cyclone Over Flow	Primary Hydro Cyclone Under Flow
1.	Total Flow (m ³ /hr.)	102.1	59.0 *1)	43.1 *1)
2.	Total Flow (t/hr.)	124.0	65.5 *1)	58.5 *1)
3.	Temp(deg C)	61.3	61.3	61.3
4.	Slurry conc. (wt. %)	30	16.6 *1)	>45 *2)
5.	Density (Kg/m ³)	1215	1111 *1)	1356 *1)
6.	Solid Composition (wt.%)			
	CaSO ₄ .2H ₂ O	90.0	90.0	90.0
	CaCO ₃	3.6	3.6	3.6
	Fly Ash	0.8	0.8	0.8
	Other	5.6	5.6	5.6
	Total	100	100	100
7.	pH	4-7	4-7	4-7
8.	Cl (mg/l)	20,000	20,000	20,000

*1) shall be finalized by vendor

*2) Shall be guaranteed by vendor



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6.1.3 Design Conditions of Secondary Hydro cyclones:

Sl.no	Description	Requirement
1.	Number of Hydro cyclone	2 sets (1 Working+1 Standby)
2.	Design Capacity	60 m3/hr each
3.	Operating capacity	59 m3/hr each
4.	Type of hydro cyclone	Vertical
5.	Material (MOC) of Cyclone Clusters	Polyurethane or urethane
6.	MOC of Feed chamber	CS+12mm rubber lining
7.	MOC of overflow chamber	CS+12mm rubber lining
8.	MOC of under flow chamber	CS+12mm rubber lining

6.1.4 PROCESS PARAMETERS- @ OPERATING POINT -SECONDARY HYDROCYCLONES

Sl No	Parameters	Secondary Hydro cyclone – Feed Slurry	Secondary Hydro cyclone– Overflow	Secondary Hydro cyclone – Under flow
1.	Total flow (m3/hr)	59.0 *1)	36.9*1)	22.1*1)
2.	Total flow (t/hr)	65.5 *1)	37.7*1)	27.8*1)
3.	Temp (° C)	61.3	61.3	61.3
4.	Slurry conc. (wt. %)	16.6 *1)	< 3 *2)	35 *1)
5.	Density (kg/m3)	1111*1)	1022*1)	1259 *1)
6.	pH	4-7	4-7	4-7
7.	Cl- (mg/l)	20,000	20,000	20,000

*1) shall be finalized by vendor

*2) Shall be guaranteed by vendor



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6.1.5 Design Conditions of Vacuum Belt Filter:

Sl.no	Description	Requirement
1.	Number of vacuum belt filters	2 sets (1 Working+1 Standby)
2.	Design Capacity	32.10 TPH (wet cake) each
3.	Operating capacity	29.10 TPH (wet cake) each
4.	Inlet solid concentration	Not more than 45%
5.	Outlet gypsum cake moisture content	<10%
6.	Outlet gypsum cake chloride content	<100 ppm

6.1.6 PROCESS PARAMETERS- @ OPERATING POINT - VACUUM BELT FILTER:

S.No	Parameters	Belt Filter Feed Slurry	Product Gypsum	Filtrate	Washing Water *
1.	Total Flow (m ³ /hr)	43.1 *1)			
2.	Total Flow (t/hr)-Wet	58.5 *1)	29.10		
3.	Temp(deg C)	61.3			
4.	Solid conc. (% wt)	Max 45	> 90 *2)	<0.2	
5.	Slurry density (kg/m3)	1356 *1)			
6.	Solid Composition CaSO ₄ .2H ₂ O CaCO ₃ Fly Ash Other Total	90.0 3.6 0.8 5.6 100	-		
7.	pH	4-7	5~8		
8.	Cl ⁻	20,000 ppm	<100 ppm *2)		

*1) shall be finalized by vendor

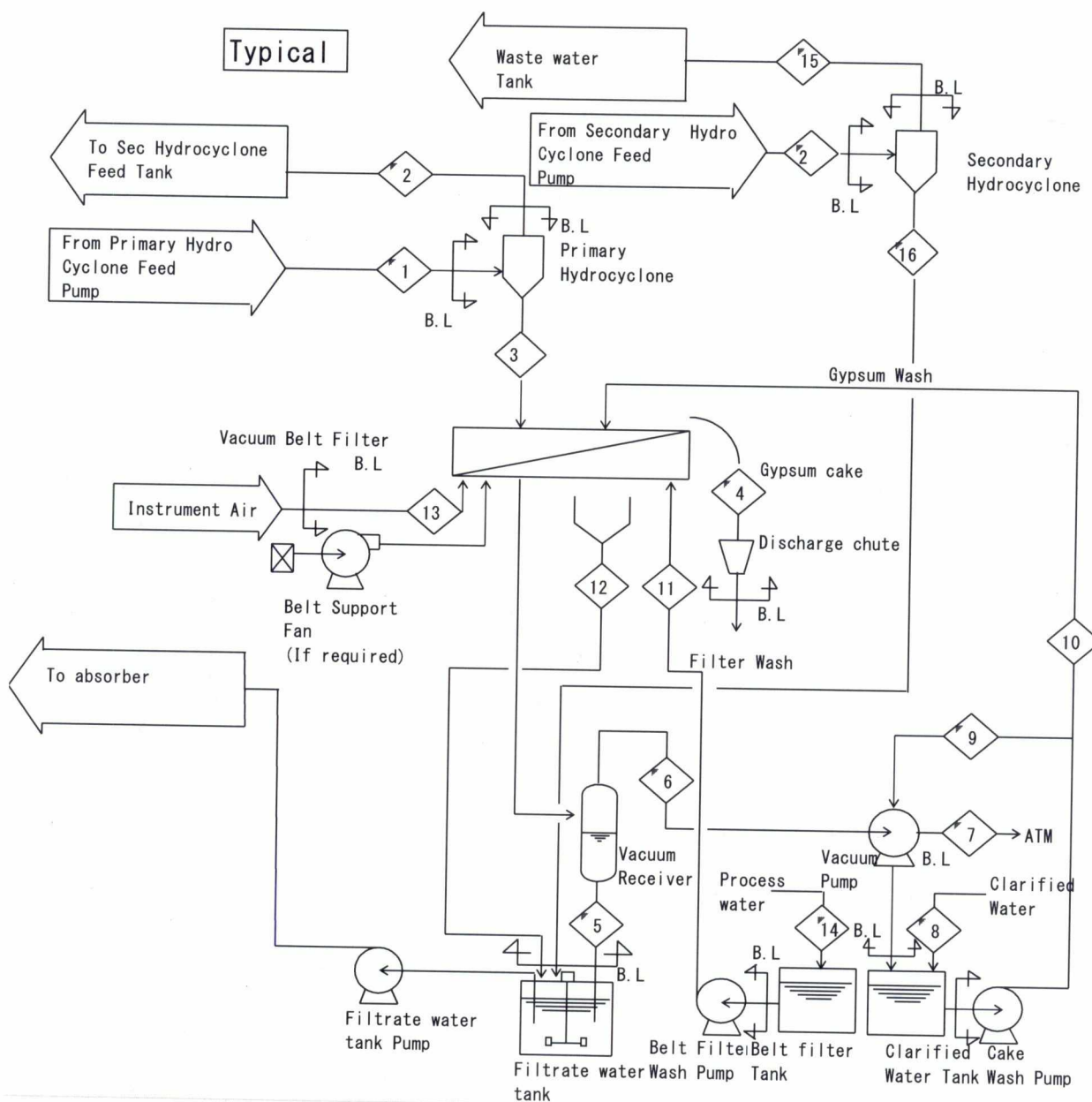
*2) Shall be guaranteed by vendor

Belt filter and the peripherals shall be designed at 32.1 TPH (wet) discharge of product gypsum

a. *Quantity of water shall be finalized by the vendor.

b. *Property of process & Clarified water is as below.

6.1.7 PROCESS FLOW DIAGRAM WITH SCOPE DEMARCATION





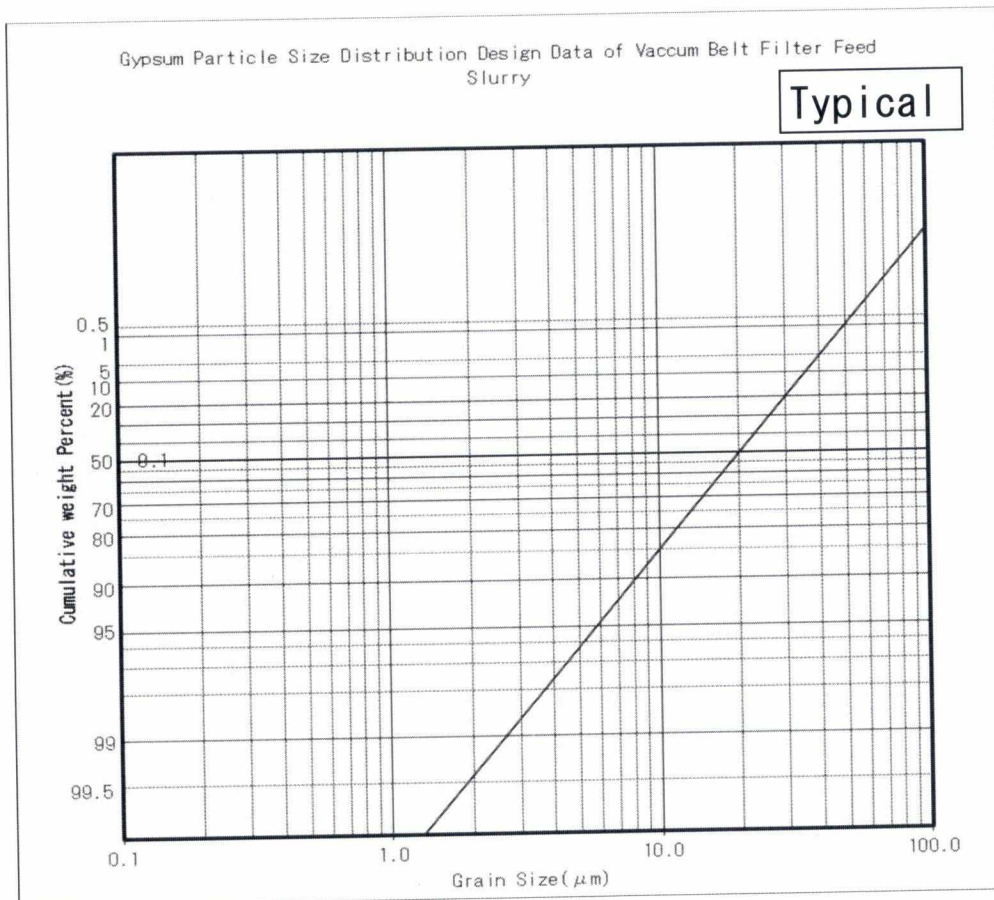
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6.1.8 TERMINAL POINTS

1. Primary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of Primary hydro cyclone.
2. Primary hydro cyclone overflow shall be terminated by bidder at overflow outlet flange.
3. Secondary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of secondary hydro cyclone
4. Secondary hydro cyclone overflow shall be terminated by bidder at overflow outlet flange.
5. Filtrate water from vacuum belt filter, wash water after belt filter cloth/cake washing and secondary hydro cyclone underflow shall be terminated by bidder in filtrate water tank.
6. Service & instrument air will be provided at one location near plant boundary. Further piping from terminal point to GDS system utilities are in bidder's scope.
7. Discharge of gypsum through discharge chute onto the gypsum belt conveyer is in bidder's scope. Please refer enclosed typical layout & elevation drawing of GDS.

6.1.9 Gypsum particle size distribution of Belt Filter Feed slurry





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7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	All interconnecting pipes / chutes, pipe supports, trestles, valves, motor (other drives) etc. along with necessary valves between primary hydro cyclone, vacuum belt filter, secondary hydro cyclone and wherever required within the system shall be in the scope of the supplier. Please refer scope demarcation drawing under clause no. 6.1.7
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English
3.	Any item not included above but necessary for safe and reliable operation of the Gypsum Dewatering System shall also be in the suppliers' scope.
4.	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
5.	Noise level produced by any equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. Predicted sound pressure levels for the GDS drive assemblies shall be submitted as part of the proposal data.
6.	The overall vibration level shall be as per ISO 10816.
7.	Suitable drain connections shall be provided.
8.	The equipment shall be suitable for stable operation continuously.
9.	Suppliers shall suitable specify their delivery schedule along with the offer and Standard code specified shall be strictly adhered.
10.	All instruments as per enclosed P&ID and any other instrument required for smooth function of Gypsum dewatering system wherever necessary shall be supplied by the bidder
11.	Supplier shall provide the loading details of equipment and other factors which shall be required for civil construction.
12.	CHUTES: Minimum clear cross section of Discharge chute: approx. 600 mm x 500 mm .
13.	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 GDS and branch piping to each nozzle. Terminal points for all utilities shall be located at single



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S.No	Description
	point. 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.
14.	Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load operating hours whichever is longer.
15.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.
16.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150
17.	Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates 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.
18.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
19.	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 minimum 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.
20.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
21.	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.
22.	Provide double nuts for anchor bolts
23.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
24.	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.
25.	Bidder shall provide the mating flanges with the necessary gaskets.
26.	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.
27.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.



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28.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
29.	Quality Plan to be submitted along with the offer.
30.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
31.	Material of construction for all equipment/components shall be subject to NTPC/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
32.	Bidder to provide sub vendor list and Bidder shall strictly adhere to NTPC approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by NTPC/ BHEL before placing order and bidder shall submit relevant documents.
33.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BHEL / NTPC for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of NTPC/ BHEL, the same may be replaced with another NTPC/BHEL approved sub-vendor only, without any price implications to BHEL.
34.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the NTPC/ BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments



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	f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the NTPC along with BHEL.
35.	Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
36.	During detail engineering, bidder to strictly adhere to BHEL/NTPC drawing formats, document numbering, quality plan & FQP formats
37.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
38.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/NTPC during detail engineering
39.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
40.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/NTPC should be addressed timely by the bidder.
41.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user (NTPC) shall also be in the scope of the bidder.
42.	Bidder shall submit the signed and stamped copy of all the pages of this technical enquiry specification signed by authorized signatory to confirm that all clauses are read and accepted by the bidder without deviation and considered in their scope work except the deviations declared in the deviation schedule.
8.0	DESIGN AND CONSTRUCTION
8.1	PRIMARY HYDRO CYCLONE
a.	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones.
b.	The primary hydro-cyclone shall be installed above the belt filters.
c.	The hydro-cyclone shall be of proven design. Hydro-cyclones shall be of modular construction. The primary hydro-cyclone shall be made up of polyurethane or urethane materials. 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.
d.	The feed chamber shall be provided with a minimum rubber lining thickness of 12mm. The liners shall have a minimum wear life of not less than 7000 hrs.