



BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)

Flue Gas Desulphurization Group-FGD,
Ranipet

TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING SYSTEM

CONFIDENTIAL

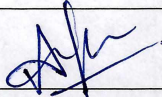
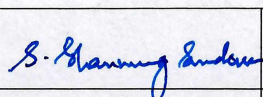
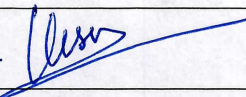
BUYER : BHEL BAP RANIPET

END-CUSTOMER : UPRVUNL

PROJECT : PANKI 1x660 MW TPS

APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM

SPECIFICATION NO. : PANKI:FGD:GDS:R00

00	30.08.2020	Fresh Release	 Arun Kumar /SE-FGD	 Shanmuga Sundaram S /DM-FGD	 V Kesavan / DGM- FGD
REV	Date	Description	Prepared	Checked	Approved

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(A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	Purpose
1.	Completely filled & signed 3K-form with all supporting documents for meeting the qualification requirement (as per Annexure-I).	Qualification Requirement (QR)
2.	Reference list of similar projects executed	QR
3.	Signed & Sealed tender specification	Technical evaluation of Bid (TEB)
4.	Completely filled & signed Data Sheet (Annexure-II)	TEB
5.	Completely filled & signed Schedule of Guarantees (as per enclosed Annexure-III)	TEB
6.	Deviation List (if any)	TEB
7.	P&ID diagram	TEB
8.	Gypsum dewatering building GA	TEB
9.	Vacuum Pump Sizing & Power calculations for motor selection	TEB
10.	Vacuum Belt filter sizing calculations	TEB
11.	GA drawing of Vacuum Belt Filter with complete bill of materials including foundation plan & loading details	TEB
12.	GA drawing of Vacuum Pump with bill of materials including foundation & loading details	TEB
13.	GA drawing of Primary & Secondary Hydrocyclones with bill of materials including foundation & loading details	TEB
14.	Electrical power consumption & motor power list for all GDS equipments	TEB
15.	LT motors datasheet as per enclosed annexure	TEB
16.	Water and Air consumption list	TEB
17.	Vacuum Receiver, Cake Wash Pump & Belt Wash Pump sizing calculations	TEB
18.	T-S curve and Performance curves for Vacuum Pump	TEB
19.	Mandatory Spares list	TEB
20.	Start-up & Commissioning Spares	TEB
21.	List of Special Tools	TEB
22.	Quality Plan	TEB
23.	Latest Catalogues of Vacuum Belt Filter & accessories	TEB
24.	List of makes and vendors for bought out items	TEB
25.	Training program and schedule for BHEL/UPRVUNL personnel	TEB



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(B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT FOR DRAWING APPROVAL:

Sl. No.	Description	Delivery Time
1.	Datasheet of Vacuum Belt Filter & all accessories of GDS	2 weeks after contract
2.	Sizing calculations of VBF, Vacuum Receiver , Vacuum Pump, Belt Wash Pump, Cake wash Pumps and other accessories	2 weeks after contract
3.	GA drawings of VBF including cross sectional details, foundation plan and loading details in Autocad & Pdf formats	2 weeks after contract
4.	GA drawings of Vacuum Pump, Hydrocyclones, Belt Wash Pump, Cake Wash Pump & Vent Fan including cross sectional details, foundation plan and loading details in Autocad & Pdf formats	2 weeks after contract
5.	P&ID diagram in Autocad & Pdf formats	2 weeks after contract
6.	GDS Building drawing showing vendor equipments in Autocad & Pdf formats	2 weeks after contract
7.	Utility Consumption List	2 weeks after contract
8.	T-S & Performance curves for Vacuum Pump	2 weeks after contract
9.	Approximate weight of each skid	3 weeks after contract
10.	Hoist/Crane requirement	3 weeks after contract
11.	Catalogues	4 weeks after contract
12.	Sub-vendors List	4 weeks after contract
13.	List of All Motors with GA & Datasheet	4 weeks after contract
14.	Electrical Load List	4 weeks after contract
15.	Local Panel Control Circuit Diagram	4 weeks after contract
16.	Control Philosophy Of GDS along control logic & control drawings	6 weeks after contract
17.	Complete List of Valves	6 weeks after contract
18.	Complete List of Instruments	6 weeks after contract
19.	All Piping Arrangement Drawings (Water,Slurry,Instrument Air) in Autocad & Pdf format	10 weeks after contract
20.	Mandatory Spare List	10 weeks after contract
21.	Lubricating oil list & Lubrication schedule	12 weeks after contract
22.	Quality Plan with Inspection & Performance Test Procedure at site	12 weeks after contract
23.	Manufacturing Schedule	12 weeks after contract
24.	Material Test Certificates	12 weeks after contract
25.	Pre Commissioning Check List	12 weeks after contract
26.	Special tools list	14 weeks after contract
27.	Start-up & Commissioning Spares	14 weeks after contract
28.	Installation and assembly procedure	14 weeks after contract
29.	Operation and Maintenance Manual	14 weeks after contract
30.	Erection Manual & Commissioning Manual	14 weeks after contract
31.	Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment.	14 weeks after contract
32.	Packing List	16 weeks after contract



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CLAUSE NO.	DESCRIPTION
1.0.00	PROJECT INFORMATION
a)	Address : Panki
b)	Districts : Lucknow
c)	State : Uttarpradesh
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 : UPRVUNL
e)	Buyer : BHEL-Ranipet
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.	
2.0.0	APPLICABLE CODES AND 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 (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 be furnished in the Flue Gas Desulphurization plant of Panki 1x660MW project in Uttar Pradesh. 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)	Two (02) Sets of Gypsum Dewatering system (1 working + 1 standby) shall be provided for this project.
d)	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.
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 separately as per annexure- titled as -"List of Deviations/Exceptions to the Enquiry Document". 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.



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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.	
4.0.0	QUALIFICATION REQUIREMENT (QR)	
	Refer to Annexure-I for details of 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	15.4 tones per hour (wet cake) for each belt filter
3.	Moisture content	10% (maximum)
4.	Gypsum purity	90% (minimum)
5.	Chloride content in Gypsum	100 ppm (maximum)
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 system to final Customer (UPRVUNL). 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 UPRVUNL. 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, training of customer's O&M Personnel and handing over to customer. The scope of supply for each Gypsum Dewatering System (GDS) shall include but not limited to the following. (Note: For scope demarcation, kindly refer enclosed P&ID also.)	
S.No.	Items	Quantity per GDS
1)	Primary hydro cyclone	One (1) set*
	i. Hydrocyclone clusters	
	ii. Anchor bolts, nuts and washers	



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	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	One (1) set*
	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 filter complete with all accessories including Driver (VFD with LCP) and driving motor with inverter panel	One (1) number
4)	Chute from Vacuum Belt Filter Discharge to the required location (approximately 2m below the VBF floor) as per enclosed Building Drawing	One (1) number
5)	Vacuum receiver with Anchor bolts, nuts and washers	One (1) number
6)	Vacuum pump with driver(motor) including base plate, coupling/belt-pulley, all connecting bolts/nuts/washers for installation, required instruments and any safety device	One (1) number
7)	Vent fan with motor and its arrangement including the vent pipe terminated at the building boundary, base plate & all connecting fasteners for installation	One (1) number
8)	All Interconnected piping (slurry, air and water pipes as per P&ID) with all necessary pipe supports	One (1) set *
9)	Complete valves required for the system along with wash water line wherever necessary as per P&ID(minimum requirement is given in the P&ID)	One (1) set *
10)	Arrangement for cloth and cake washing, including spray nozzles	One (1) set*
11)	Cake wash pump with Motor including base plate & all connecting fasteners for installation	2 Nos
12)	Belt filter wash pump with Motor including base plate & all connecting fasteners for installation	2 Nos
13)	Companion flanges with gaskets and fasteners	One (1) set*
14)	Coupling with guards	One (1) set*
15)	INSTRUMENTS for the entire Gypsum Dewatering System((Minimum Requirement for each gypsum dewatering system is given in the P&ID)	One (1) set*



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16)	Electric common including but not limited to	One (1) set*
	i. Local control panel	
	ii. LV Motors	
	iii. Junction Box	
	iv. Instruments	
	v. Push buttons	
17)	Rubber Expansion Bellows at suction & discharge of each pump and also for other equipment wherever applicable	One (1) set*
	* One set means complete requirement for one gypsum dewatering system	
18)	All motors shall be provided with suitable double compression cable gland Bidder shall provide cable glands and lugs for all equipment in his scope. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Bidder shall provide junction box. The Junction box shall have provision for installing glands of suitable size on the bottom of the box.	
19)	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.	
20)	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 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 shall also be provided to view the cooling water flow. Bearing cooling water Flow switch shall take the signal to DCS system.	
21)	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 the vendor.	
22)	Supervision of erection / commissioning of both the gypsum dewatering system. 30 Days per system and 60 Days for Two Systems.	
23)	Mandatory spares with breakup price	
24)	Painting and rust prevention during shipment and construction	



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25)	Seaworthy packing & forwarding to project site-refer clause 1.0.0 for project information
26)	Any other items 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.
6.1.0	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.	Process water pipeline upto inlet of Belt Filter Wash Tank shall be provided by BHEL . Further piping from Belt Filter Wash Tank to GDS system utilities are in bidder's scope.
7.	Instrument air will be provided at one location near the Gypsum Dewatering building boundary. Further piping from terminal point to GDS system utilities are in bidder's scope.
8.	Chute from Vacuum Belt Filter discharge to the required location (approximately 2m below the VBF floor/first floor) shall be in vendor's scope. Please refer enclosed Building drawing of GDS for the details.
7.0.0	PROCESS DESCRIPTION
1.	The dewatering system shall receive the gypsum slurry from Primary Hydro cyclone feed pumps. Gypsum dewatering system shall be suitable for handling slurry from FGD unit. Two sets of primary hydrocyclone (1W+1S) with accessories shall be in vendor scope. Primary hydrocyclone underflow shall be taken to VBF inlet.
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. The over flow from the secondary hydro-cyclone shall be taken to a waste water storage tank.



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4.	For each belt filter, there is one Belt filter washing tank. There are two cake wash pumps and two belt filter washing pumps associated with a belt filter wash tank. Tanks are in BHEL scope and pumps along with valves, instruments, piping, etc are in vendor scope.
8.0.0	DETAILED SPECIFICATION
1.	Bidder shall supply 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 shall supply 2x100% gypsum dewatering system with each stream sized to dewater 15.4 TPH (Wet cake) produced by the FGD unit 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.	One (1) set of primary hydro cyclones is envisaged for each Gypsum Dewatering System, each set shall be sized to dewater the gypsum slurry produced by the unit operating at design point.
2.	Each set of primary hydro-cyclones 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.
3.	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.
4.	One (1) set of secondary hydro cyclones is envisaged for each Gypsum Dewatering System, each set shall be sized to dewater the gypsum slurry produced operating at design point .
5.	Each set of secondary hydro-cyclones 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.
6.	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.
7.	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 25 mm thickness. Liners shall have a minimum wear life of not less than 7000 hrs.
8.	All Hydro Cyclones clusters shall be made of polyurethane or urethane material only.
8.2.0	Vacuum Belt Filters
1.	Two (2) numbers of vacuum belt filters each of capacity 15.4 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% (maximum) ▪ Gypsum Purity: 90% (minimum) ▪ Chloride content : 100 ppm (maximum)



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2.	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 e) The slurry shall be put on the belt in counter current relative to the rotation of the band. f) The vacuum chambers shall be easily opened for inspection and cleaning.
3.	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.
4.	The frame part of the filter which is coming in contact with the gypsum slurry shall be corrosion resistant material of proven design. Other parts of the frame shall be made of carbon steel followed by specified painting.
5.	All parts of the filter in contact with gypsum shall be made of corrosion resistant material.
6.	In case, the bidder 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.
7.	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
8.	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(2) no's of Belt sway switches shall be provided for each vacuum belt filter. Cake thickness sensor shall be provided for each vacuum belt filter which shall control the speed of the vacuum belt filter in turn.
9.	Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump & Cake Wash Pump for each vacuum Belt filter as per P&ID. 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.
10.	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. Minimum one stage of cloth & Belt washing arrangement shall also be provided.
11.	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.
12.	Gypsum cake from each belt filter shall be discharged through a Chute onto Gypsum conveyor being provided by the Employer. The elevation of discharge point of vacuum belt filter shall be at least 10.0 m above GL. The Chute from Vacuum Belt



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	Filter discharge to the required location (as per the building drawing) shall be in vendor's scope.
13.	A 2 m (min.) wide platform (BHEL's scope) 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 enclosed GA Drawing of Gypsum Dewatering Building. Any changes shall be suggested by Bidder accordingly.
14.	Local control panel shall have display on the front panel and necessary electrical parts.
15.	The service factor of the gear unit (if any) shall be minimum 1.5.
16.	Piping and wiring within the skid should be in the vendor's scope.
17.	All client end connection flanges shall be ANSI B 16.5 Class 150
8.3.0	Vacuum System
1.	The filtrate from each belt filter and cake 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. An additional 10% margin over the above shall be provided for 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.	Each vacuum receiver tank(s) shall be provided with demister arrangement as per P&ID.
8.4.0	REQUIREMENTS FOR PUMPS (BELT FILTER WASH PUMPS , CAKE WASH PUMPS)
1.	The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent . Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade . Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc.



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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.	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.
5.	For designing the pumps, at least 10% margin shall be considered for flow and head over and above the process requirements of the belt filter operating at its maximum capacity.
6.	All pumps shall be fitted with pressure gauges as per P&ID. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves.
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.	Pumps should not damage 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).
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.	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.
12.	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.



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13.	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.
14.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
15.	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).
16.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.
17.	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.
18.	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.
19.	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.
20.	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.
21.	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.
22.	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.



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23.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
24.	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.
25.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
26.	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.
27.	Provide double nuts for anchor bolts.
28.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
29.	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.
30.	Bidder shall provide the mating flanges with the necessary gaskets.
31.	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.
32.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
33.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
8.5.0	DESIGN AND CONSTRUCTION OF VACUUM PUMPS
a)	The vacuum pump shall be of low speed liquid ring type of proven design. The vacuum pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pump shall be proven for similar application. Design and construction of various components of the pumps shall conform to the following general specifications.
b)	Pump Casing
	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.
c)	Impeller



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	Impeller shall be closed, semi-closed or open type 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.	
d)	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.	
e)	Shaft	
	The critical speed shall be well away from the operating 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.	
f)	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.	
g)	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.	
h)	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	



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	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.	
i)	Pump Shaft Motor Shaft Coupling/Belt-Pulley	
	The pump and motor shafts shall be connected with an adequately sized flexible coupling or belt pulley drive of proven design. Necessary coupling guards shall also be provided.	
j)	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.	
k)	Drive Motor (Prime Mover)	
	The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.	
8.6.0	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 TISCRA / 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.	
	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.	
8.7.0	PIPING	



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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 under all operating conditions. The bidder may provide a recirculation line with motorized isolation valve for the above purpose. All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The slurry pipes shall be lined with replaceable wear resistant rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at 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 bidder 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, equipments etc.	
e.	Belt filter washing pumps shall have a minimum flow line to tank with a restriction orifice to control.	
f.	All Instrument Air piping shall be Galvanized.	
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 . For piping specification, bidder shall refer to the enclosed Annexure.	
8.8.0	VALVES	
	For details on Valve schedule kindly refer to P&ID. For valve specification, bidder shall refer to the enclosed Annexure.	
8.9.0	ACCESSORIES:	
1)	Rubber Expansion Joints:	
i.	Rubber Expansion Joints shall be provided at suction and discharge of each pump and also for other equipments 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.	



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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.	
8.10.0	ELECTRICALS	
i.	The Gypsum Dewatering system consisting of Primary hydro cyclones, Vacuum belt filter associated with washing & Conveying system, Secondary (Waste water) hydro cyclones in closed circuit shall be operated automatically and sequentially. The provision should also be provided to start and stop the equipment by means of the push button switches located on - Local Control Panel - Local Push Button Station	
ii.	All the Rotating machines such as pumps shall be started and stopped manually by means of local push button station.	
iii.	Bidder shall provide cable glands and lugs for all equipment in his scope. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs	
iv.	MOTORS The following voltage levels shall apply: ▪ Above 0.2 kW and upto 200 kW: 3 phase 415 V AC ▪ Above 200 kW and upto 1500 kW: 3.3 KV ▪ Above 1500 kW: 11 KV All the continuous duty motor shall be of premium Efficiency class (IE2). For motor specification , bidder shall refer to the enclosed Annexure. Bidder to submit the motor datasheet as per format given in the specification. Motor shall be sourced only from UPRVUNL approved sources. All motors shall be rated at least 10% above the maximum continuous power demand of the driven equipment.	
v.	JUNCTION BOX Bidder to refer to the specification given in the enclosed Annexure.	
vi.	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 shall be as per specification enclosed in the annexure. Electrical actuator shall have Integral starters with facility to hook-up with plant DCS for positioning of limit and torque switches. All instrument shall have 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. Vendor to supply all the instruments as given in the P&ID	
vii.	POWER, CONTROL CABLE & INSTRUMENTATION CABLE:	



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	All the control cables and instrumentation cable shall be as per specification enclosed in the annexure.	
viii.	LOCAL CONTROL PANEL: A local control panel for the entire Gypsum Dewatering System shall be supplied by the bidder. This control panel shall be suitable to communicate with FGD Plant DCS. Bidder shall provide the control logic for the entire Gypsum Dewatering System.	
9.0.0	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 specification No: PE-TS-888-100-A001. 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 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.(UPRVUNL)	
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	



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	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. UPRVUNL PANKI (1x660MW). UTTRAPRADESH . 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.	
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:	



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	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 safe 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).	
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.	



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10.0.0	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 GDS 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.	One visit for each gypsum dewatering system has been envisaged for supervision and totally 2 visits for both GDS. Bidder shall include 30 working days per visit in the offer. The bidder will be informed well in advance for the visit.	
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in the offer.	
11.0.0	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.)	



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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, 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 & impellar	
			Hydrostatic test		
			Balancing Test	Static & dynamic	
			Performance test	Incl. Noise & Vibration	



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	3.	Motors	Material certificate check		
			Non Destructive Testing		
			Dimensional inspection		
			Balancing Test	Static & dynamic	
			Function test		
	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		



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			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		
	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		



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			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 Specialities shall 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 / UPRVUNL prior to manufacture. Inspection of above mentioned tests by BHEL/ UPRVUNL representative at bidder's works is envisaged				
6.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/ UPRVUNL.				
7.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/ UPRVUNL 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.				



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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.	
12.0.0	POWER CONSUMPTION	
	Bidder has to specify the total power consumption at motor input terminal of all equipments for one Gypsum Dewatering system in the technical offer. The following equipments shall be considered for Power consumption calculation:- 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 e. Cake wash pump – 1 No.	



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13.0.0	P&ID Diagram				
	The Piping and Instrumentation Diagram (P&ID) is enclosed in the annexure.				
13.0.1	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.)	48.852	28.215 (*1)	20.637 (*1)	
b.	Total Flow (t/hr.)	59.35	31.35 (*1)	28.00 (*1)	
c.	Operating Temp (C)	50.7	50.7	50.7	
d.	Design Temp (C)	60	60	60	
e.	Solid (wt. %)	30	16.6 (*1)	> 45 (*2)	
f.	Density (Kg/m ³)	1215	1111 (*1)	1357 (*1)	
g.	pH	4-7	4-7	4-7	
h.	Cl ⁻ (mg/l)	20000	20000	20000	
13.0.2	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)	28.215	17.632 (*1)	10.583 (*1)	
c.	Total flow (t/hr)	31.35	18.02 (*1)	13.32(*1)	
d.	Operating Temp (° C)	50.7	50.7	50.7	
e.	Design Temp (C)	70	70	70	
f.	Solid (wt %)	16.6	3 (*2)	35 (*1)	
g.	Density (kg/m ³)	1111	1022	1259	
h.	pH	4-7	4-7	4-7	
i.	Cl ⁻ (mg/l)	20000	20000	20000	
13.0.3	DATA SHEET OF BELT FILTER:				
	Parameters	Belt Filter Feed Slurry	Product Gypsum	Filtrate	Washing Water **
a.	Total Flow (m ³ /hr)	20.637 (*1)			
b.	Total Flow (t/hr)-Wet	28.00 (*1)	13.92		
c.	Temp(deg C)	70.0			
d.	Solid(% wt)	45 (*2)	>90 (*2)	<0.2	
e.	Slurry conc.(%wt)	1357(*1)	>90		

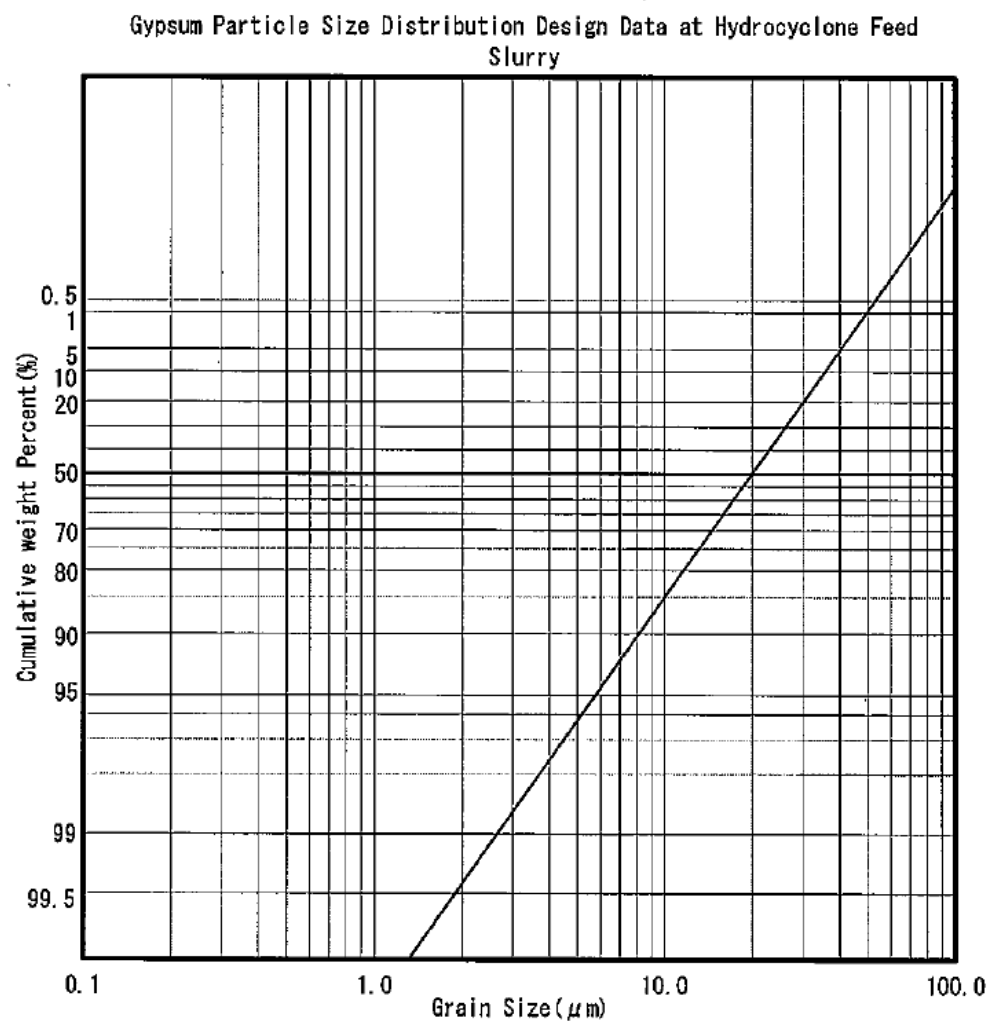


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f.	pH	4~7	5~8		
g.	Cl	<20000	<100 ppm (*2)		
h.	Belt filter and the peripherals shall be designed at 15.4 TPH (wet cake) discharge of product gypsum a. **Quantity of water shall be finalized by the vendor. b. *Property of water is as below.				
i.	(*1) shall be finalized by vendor. (*2) Shall be guaranteed by vendor				

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



13.0.5	Gypsum particle size at belt filter feed slurry is shown below																								
	Gypsum Particle Size Distribution Design Data at Vacuum Belt Filter Feed Slurry <table border="1"> <caption>Approximate data points from the Gypsum Particle Size Distribution graph</caption> <thead> <tr> <th>Grain Size (μm)</th> <th>Cumulative weight Percent (%)</th> </tr> </thead> <tbody> <tr><td>0.1</td><td>0.5</td></tr> <tr><td>0.5</td><td>1.0</td></tr> <tr><td>1.0</td><td>5.0</td></tr> <tr><td>2.0</td><td>10.0</td></tr> <tr><td>5.0</td><td>20.0</td></tr> <tr><td>10.0</td><td>35.0</td></tr> <tr><td>15.0</td><td>50.0</td></tr> <tr><td>20.0</td><td>60.0</td></tr> <tr><td>30.0</td><td>75.0</td></tr> <tr><td>50.0</td><td>85.0</td></tr> <tr><td>100.0</td><td>99.5</td></tr> </tbody> </table>	Grain Size (μm)	Cumulative weight Percent (%)	0.1	0.5	0.5	1.0	1.0	5.0	2.0	10.0	5.0	20.0	10.0	35.0	15.0	50.0	20.0	60.0	30.0	75.0	50.0	85.0	100.0	99.5
Grain Size (μm)	Cumulative weight Percent (%)																								
0.1	0.5																								
0.5	1.0																								
1.0	5.0																								
2.0	10.0																								
5.0	20.0																								
10.0	35.0																								
15.0	50.0																								
20.0	60.0																								
30.0	75.0																								
50.0	85.0																								
100.0	99.5																								
13.0.6	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 : 53.9 m ³ /hr each																								
4.	Secondary hydrocyclone capacity : 29 m ³ /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																								



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13.0.7	PROCESS WATER CHARACTERISTICS		
S.no	Constituents	Unit	Water quality
1.	Total cations as CaCO_3	Ppm	191.4
2.	Total anions as CaCO_3	Ppm	191.4
3.	Calcium as CaCO_3	Ppm	113.9
4.	Magnesium as CaCO_3	Ppm	40
5.	Sodium as CaCO_3	Ppm	37.2
6.	Potassium as CaCO_3	Ppm	0
7.	Iron as Fe	Ppm	0.3
8.	Total alkalinity as CaCO_3	Ppm	97
9.	Chlorides as CaCO_3	Ppm	27.1
10.	Sulphate as CaCO_3	Ppm	66.4
11.	Silica	Ppm	10
12.	Ph		7.0-8.5
13.	Turbidity	Ntu	<15
Note: 1) Process water will be used for Belt, Gypsum , Cloth washing & Vacuum pump sealing			
14.0.0	SPARES,TOOLS & TACKLES		
14.1.0	START UP & COMMISSIONING SPARES		
	Start-up & Commissioning Spares shall be part of the main supply of the GDS. 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 GDS 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.		
14.2.0	MANDATORY SPARES		
	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		



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	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. Wherever the quantity is Mentioned in "sets" the bidder has to give the item details and prices of each item. b) Wherever 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. 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.	
i.	Mandatory Spare for Vacuum Belt Filter	Please refer enquiry/indent.
ii.	Mandatory Spare for Vacuum Pumps	Please refer enquiry/indent.
iii.	Mandatory Spare for Vacuum Breaker Valves	Please refer enquiry/indent.
iv.	Mandatory Spare for Slurry Valves (applicable in Gypsum dewatering area)	Please refer enquiry/indent.
	Mandatory Spare for Slurry Line Bends(applicable in Gypsum dewatering area)	Please refer enquiry/indent.
v.	Mandatory Spare for Hydro-cyclones (Primary & Secondary)	Please refer enquiry/indent.
vi.	Mandatory Spare for Horizontal Centrifugal Pumps (Belt filter wash pump, Cake wash pump)	Please refer enquiry/indent.
14.3.0	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	



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15.0.0	PERFORMANCE GUARANTEE & TESTING
(A)	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) Bidder shall Guarantee and demonstrate each Vacuum Belt Filter capacity of 15.4 TPH wet gypsum cake with an inlet solid concentration of not more than 45% wt. 3) The Bidder 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 and average target availability of 95% for 1 year. 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/ UPRVUNL 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.
(B)	1) Bidder shall make his own arrangements for conducting Performance guarantee test at site. 2) Any number of visits required for performance testing shall be arranged by vendor only. 3) All TA/DA, lodging/boarding required at the time of visit for performance guarantee test shall be vendor's responsibility only. Note : 10% balance payment of the main supply value will be released after performance guarantee (or Prove out) test only.
16.0.0	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,



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	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, UPRVUNL/BHEL reserves the right to reject the equipment. However, UPRVUNL/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
17.0.0	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 UPRVUNL/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.
18.0.0	TRAINING
	Successful bidder shall provide comprehensive training for UPRVUNL/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the GDS system - Operation & Maintenance, Troubleshooting etc.
19.0.0	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 UPRVUNL 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.
20.0.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all required documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial



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	evaluation. The 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. Drawings that are reviewed by the UPRVUNL/ 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. UPRVUNL/ 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 UPRVUNL 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 UPRVUNL 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.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



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ANNEXURE- I-QUALIFICATION REQUIREMENT (PROVENNESS CRITERIA) & 3K-FORMAT

The Bidder is required to meet the provenness criteria and/or qualification requirement for critical equipment and bought out items as per criteria stipulated below:

Vacuum belt filter for the Wet Limestone based Flue Gas Desulphurization (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previous experience of manufacturing and supplying the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year as on 02nd Nov 2015.

Name of Equipment	Type of Equipment	Application	Equipment Rating
Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant	Capacity (dry) 15 T/hr (Min)

Bidder shall offer and supply only the type of above equipment (s) for which he himself is qualified.

Bidder shall furnish the 3K- form as per the enclosed format along with all supporting documents. Bidder's offer will be considered only after obtaining approval from the customer (UPRVUNL).



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3K-FORMAT FOR PANKI- GYPSUM DEWATERING SYSTEM

Bidder's name with complete address :

We declare that, we have designed,manufactured and supplied at least one (1) number of Vacuum Belt filter of minimum 15 T/hr-Dry, Belt type, working in Wet Limestone based FGD application in Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on 2nd Nov 2015, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether operating in a Wet Limestone based FGD application in Coal fired power plant	-*Yes/*No
5.	Name of equipment manufacturer & address:	
6.	Date of commission of the equipments:	
7.	Model no. of the equipment:	
8.	Brief Technical particulars of the equipments:	
9.	Capacity of the belt filter	TPH
10.	Whether the equipment(s) are in successful operation in atleast one (01) plant for a period not less than one(01) year reckoned as on 02nd Nov 2015	*Yes/*No
11.	Flue gas Desulphurization system details:	*Technical extract/ *paper letter/ *email/
		*Drawing from user or *contract document or *scheme or *any document in public domain enclosed at annexure....
12.	Scope of Work:	*Letter of Award or *Contract or *P.O. enclosed at Annexure.....
13.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....

*** Strike off whichever is not applicable**

SIGNATURE & SEAL OF BIDDER

NAME

DESIGNATION



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ANNEXURE-II-TECHNICAL DATA SHEET

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: UPRVUNL Panki 3X660MW
	c. End Customer	: UPRVUNL
	d. Location	: Uttar Pradesh
	e. Service	: Continuous
	f. Installation	: Inside the Building
	g. Quantity of GDS	: 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 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
	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



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	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 (m ³ /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 m ³ /h	: Bidder to Provide
	l. No. of stages of cloth washing / water flow m ³ /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



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	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	BELT FILTER DRIVE DETAILS		
	i. motor manufacturer		Bidder to Provide
	ii. Motor power (kW)		Bidder to Provide
	iii. Motor speed (rpm)		Bidder to Provide
	iv. rated voltage(V)		Bidder to Provide
	v. gearbox manufacturer		Bidder to Provide
	vi. gearbox Model		Bidder to Provide
	vii. gearbox rotation (rpm)		Bidder to Provide
	viii. VFD manufacturer		Bidder to Provide
	ix. VFD Model		Bidder to Provide
	x. VFD Power(kW)		Bidder to Provide
4.4	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



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4.5	VACUUM PUMP		
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 (m ³ /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 (m ³ /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
4.6	SLURRY PIPES	:	
a.	Pipe size (mm)	:	Bidder to Provide
b.	Type of Joints	:	Bidder to Provide



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW – FGD system

PANKI:FGD:GDS:R00

	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
4.7	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
4.8	CAKE 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
4.9	BELT ACCESSORIES		
4.9.1	Bearing		
a.	Carrying	:	Bidder to Provide
b.	Return	:	Bidder to Provide



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW –
FGD system

PANKI:FGD:GDS:R00

4.9.2	Material		
a.	Roller	:	Bidder to Provide
b.	Spindle	:	Bidder to Provide
4.9.3	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



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW – FGD system

PANKI:FGD:GDS:R00

4.10	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
4.11	Skirt Boards		
a.	Length	:	Bidder to Provide
b.	Height	:	Bidder to Provide
c.	Width	:	Bidder to Provide
4.12	Secondary 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



**TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW –
FGD system**

PANKI:FGD:GDS:R00

	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 (m ³ /hr/Feed Slurry (m ³ /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 -----



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW –
FGD system

PANKI:FGD:GDS:R00

ANNEXURE III- SCHEDULE OF GUARANTEES

Sl. No	Description	Data
1.	Rated capacity of Vacuum Belt Filter TPH	: Bidder to Provide
2.	Guaranteed	
	a) Gypsum cake moisture content %	Less than 10%
	b) Gypsum cake chloride content ppm	Less than 100ppm
3.	Guaranteed life of filter cloth hrs	Bidder to Provide
4.	Guaranteed life of liners in hydro cyclone hrs	Bidder to Provide
5.	Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor dB(A)	: Less than 85 dB(A)
6.	Maximum vibration (peak to peak amplitude at site) microns	: For vacuum pump: For Belt Filter Wash Pump: For Belt Filter Wash Pump:
7.	Equipment Availability %	: 98% for 120 days

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW –
FGD system

PANKI:FGD:GDS:R00

ANNEXURE – IV

REFERENCE LIST as per format shown below :-

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 -----



TECHNICAL SPECIFICATION OF GYPSUM DEWATERING SYSTEM- PANKI 1x660 MW –
FGD system

PANKI:FGD:GDS:R00

ANNEXURE – V- 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 -----

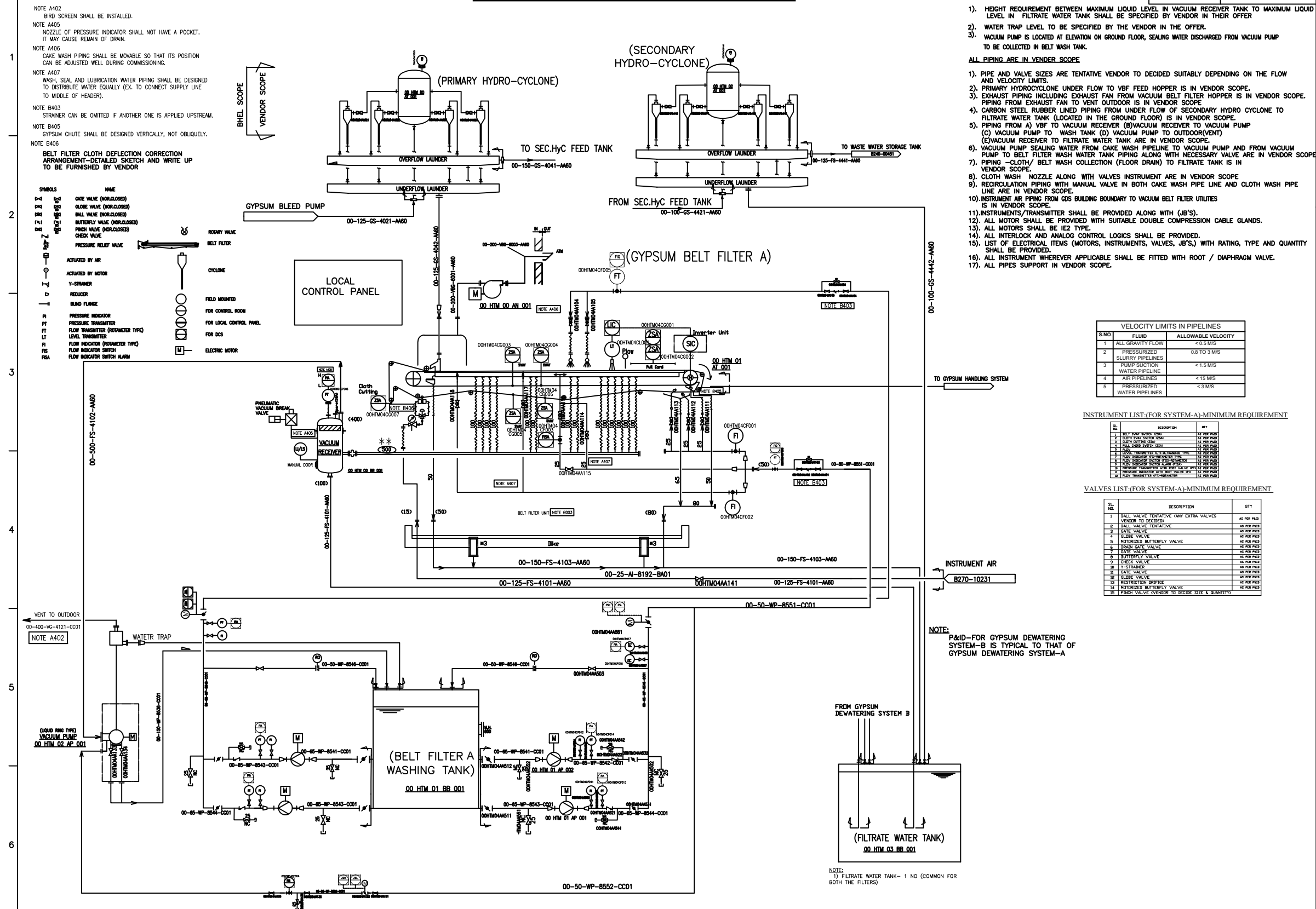
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DESIGNATION -----

Annexure VI- Paint Schedule						
		PRIMER		FINISH		
SURFACE LOCATION	SURFACE PREPARATION	PAINT	DFT (μm min.)	PAINT	DFT (μm min.)	TOTAL DFT IN (μm min.)
Primary Hydro cyclone and accessories Structural items	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238 DFT- 35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35μ/coat. Shade: Light grey Shade no. 631 of IS:5	70	140
Secondary Hydro cyclone and accessories Structural items	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238 DFT- 35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35μ/coat. Shade: Light grey Shade no. 631 of IS:5	70	140
Gypsum belt filter and accessories -Structural Mechanical items	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238 DFT- 35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35μ/coat. Shade: Light grey Shade no. 631 of IS:5	70	140
Process water pipe accessories (Temp<90°C)	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35μ/coat. Shade: Light grey. Shade no. 631 of IS:5	70	140
Slurry pipe accessories (Temp<90°C)	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209. DFT-35μ/coat. Shade: Light grey Shade no. 631 of IS:5	70	140
Service Air pipe accessories (Temp<90°C)	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209. DFT-35μ/coat Shade: Light grey Shade no. 631 of IS:5	70	140
Instrument air pipe accessories (Temp<90°C)	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209. DFT-35μ/coat Shade: Light grey Shade no. 631 of IS:5	70	140
Valves and fittings (Temp <95 deg C)	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209. DFT-35μ/coat Shade: Light grey Shade no. 631 of IS:5	70	140
Water pumps & accessories	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50μm	Primer: Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat	70	Finish: Two coats of Epoxy based Polyamide cured finish paint to IS 14209. DFT-35μ/coat Shade: Light grey Shade no. 631 of IS:5	70	140

The above paint schedule is tentative. Painting shall be as per approved paint schedule which will be intimated during contract stage.

Annexure -VII- P&ID DIAGRAM



CUSTOMER NOS:

CUSTOMER: UPRVUNL
PROJECT: PANKI (1X660MW)
FGD SYSTEM PACKAGE

DEPT	NAME (SHEL)	SRN	DATE
DRN	SHANMUGA SUNDARAM S		03.03.2020
CHD	KARLASH N M		03.03.2020
APPD	KESAVAN V		03.03.2020

P & ID - GYPSUM DEWATERING SYSTEM
(GYPSUM BELT FILTER-A)

SCALE : NTS

TITLE:

SHEL DRG NO

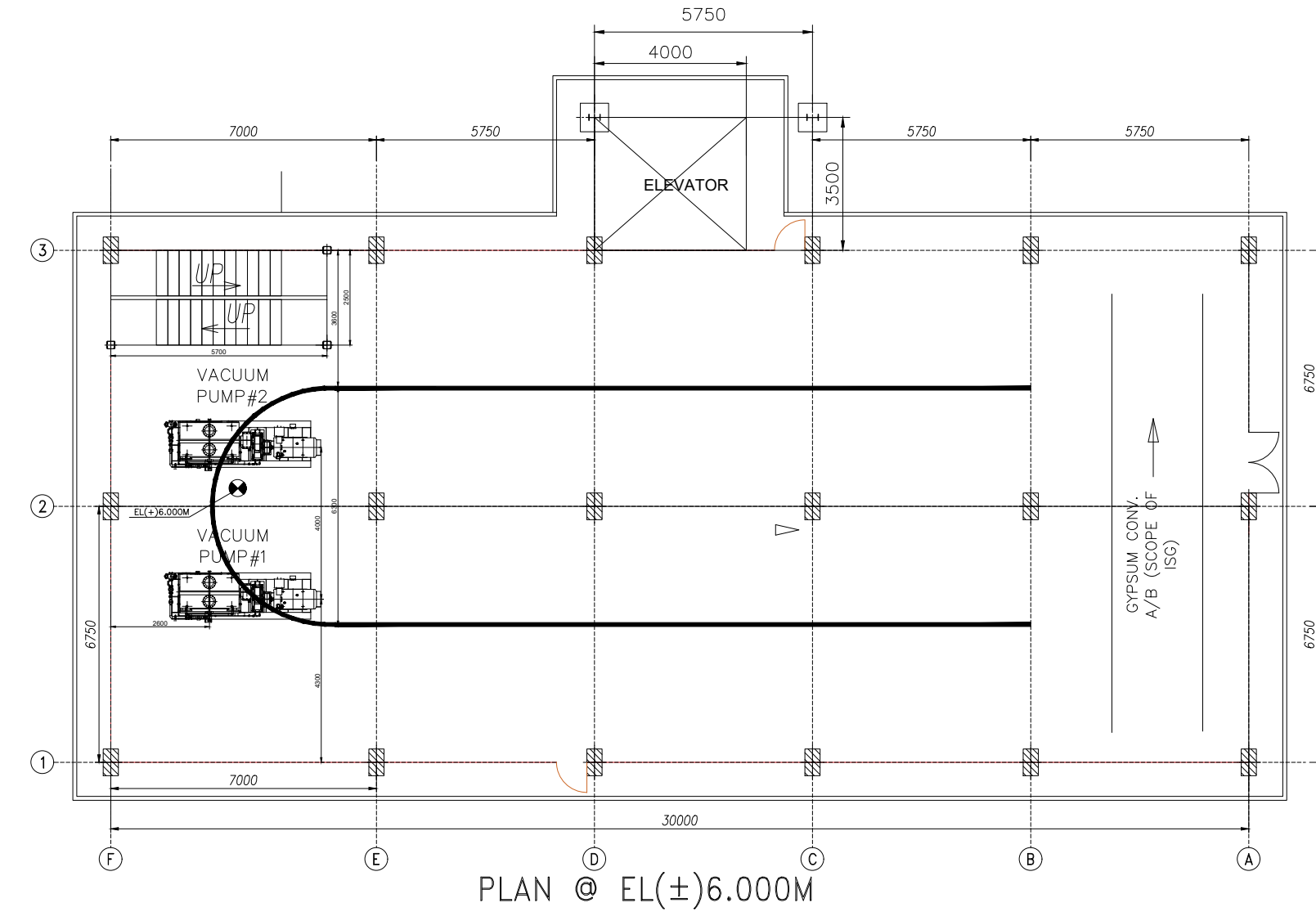
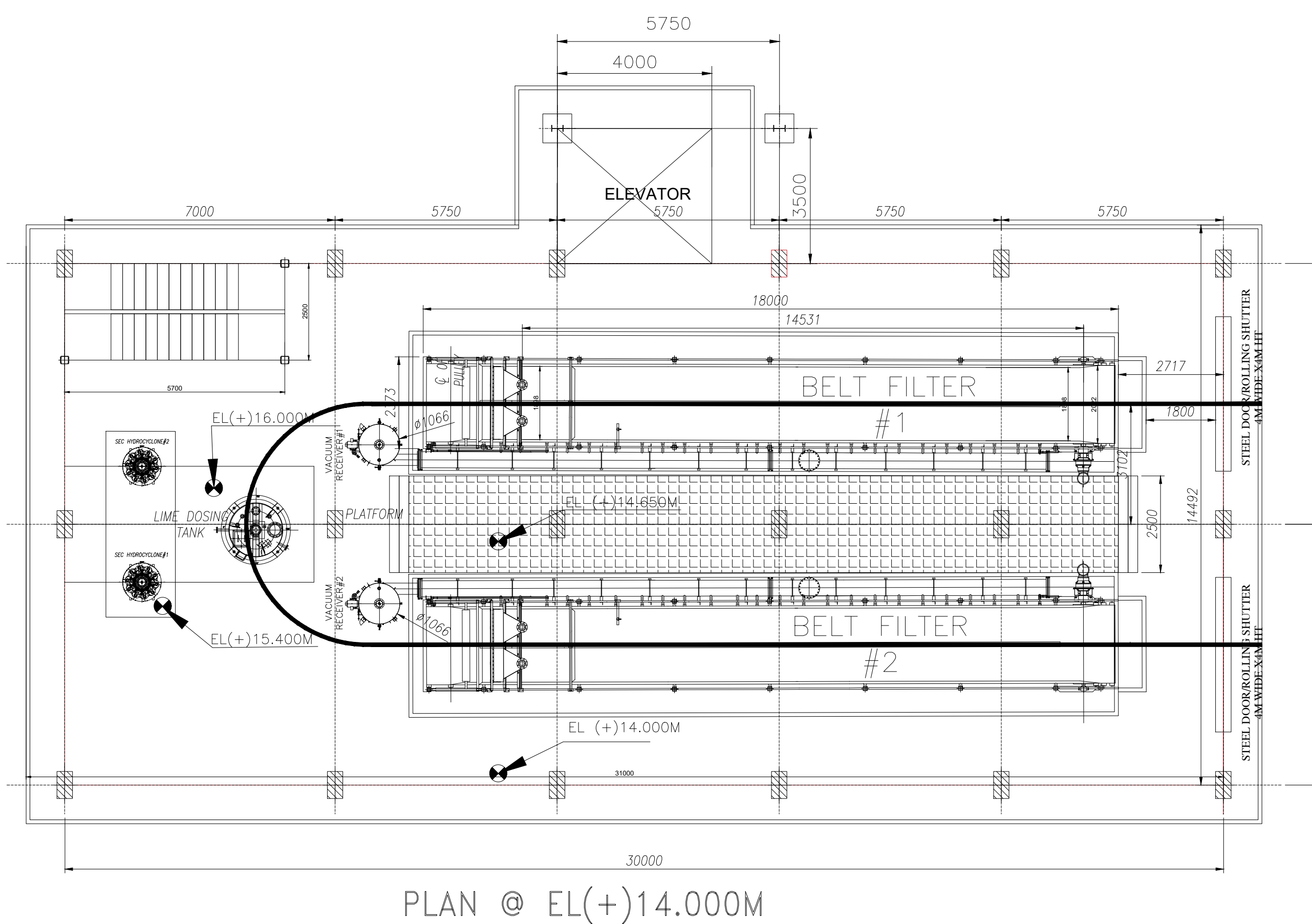
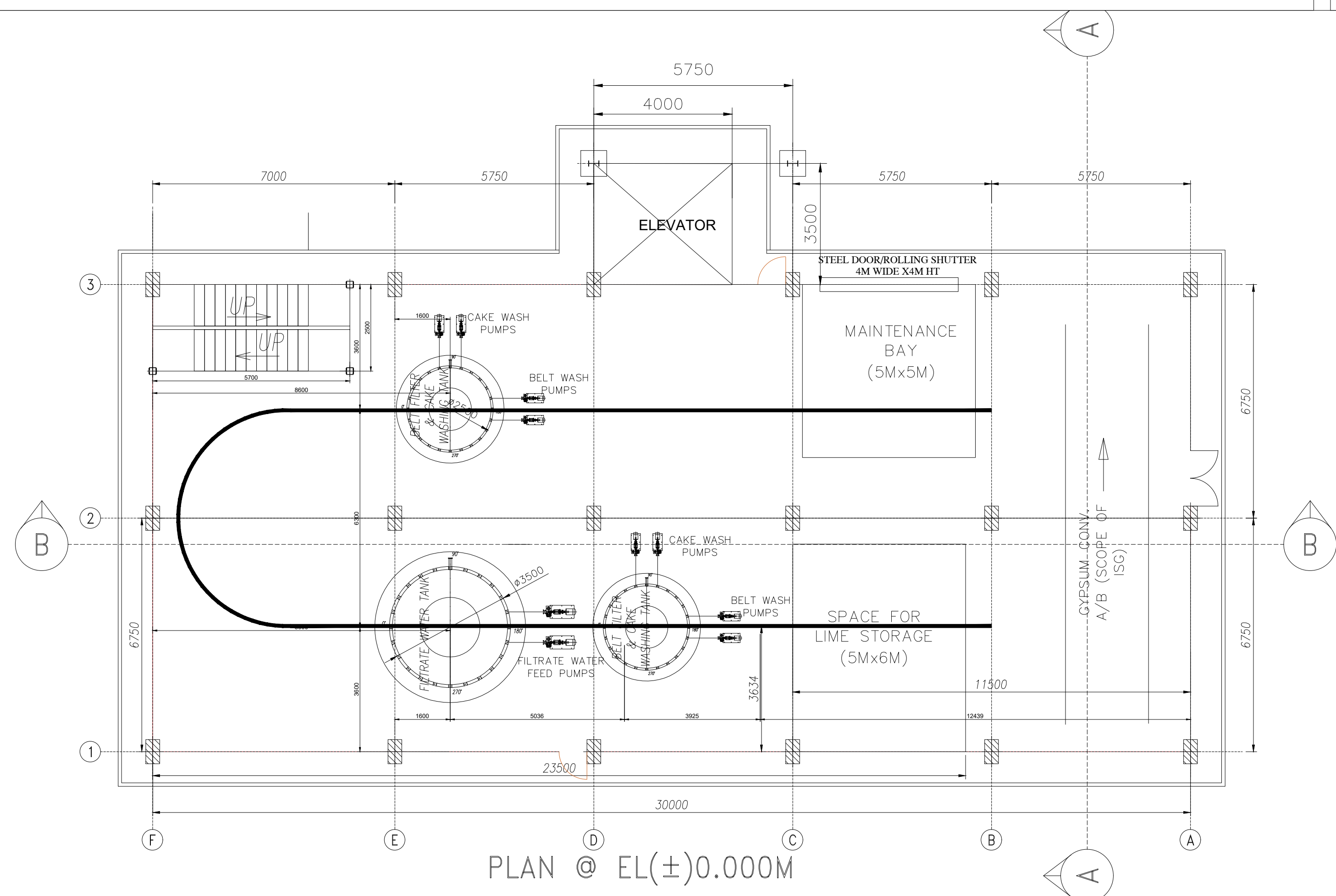
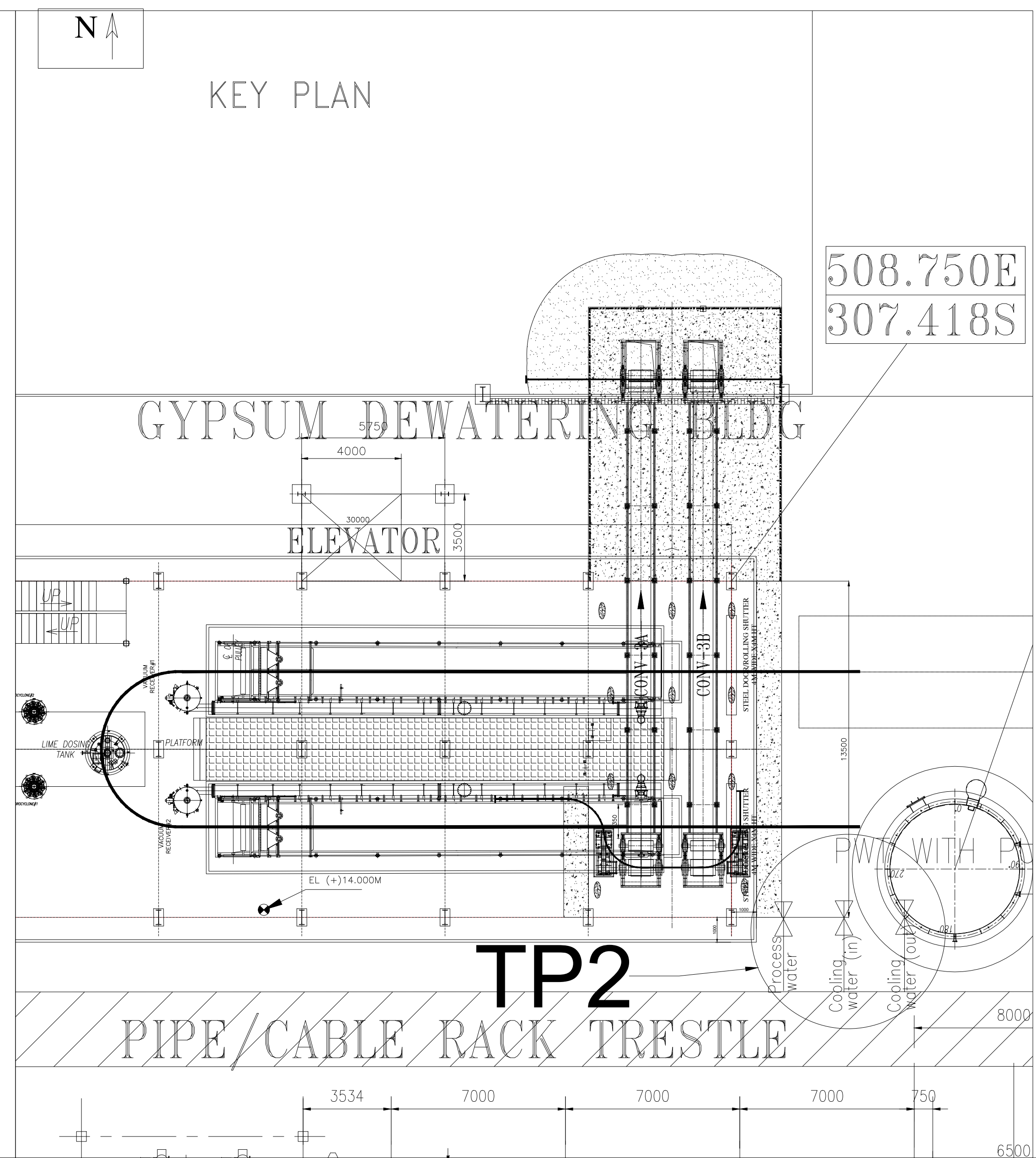
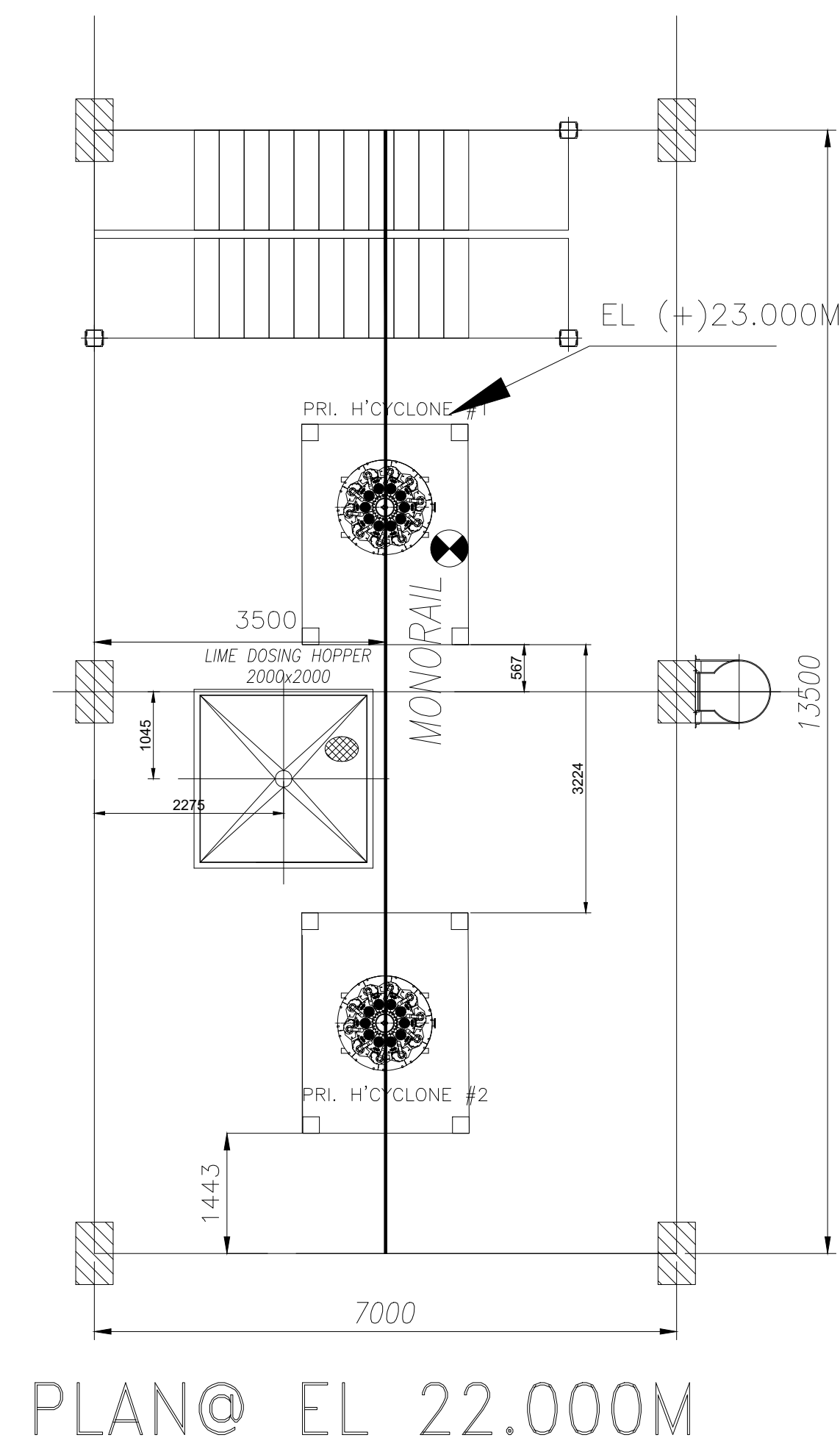
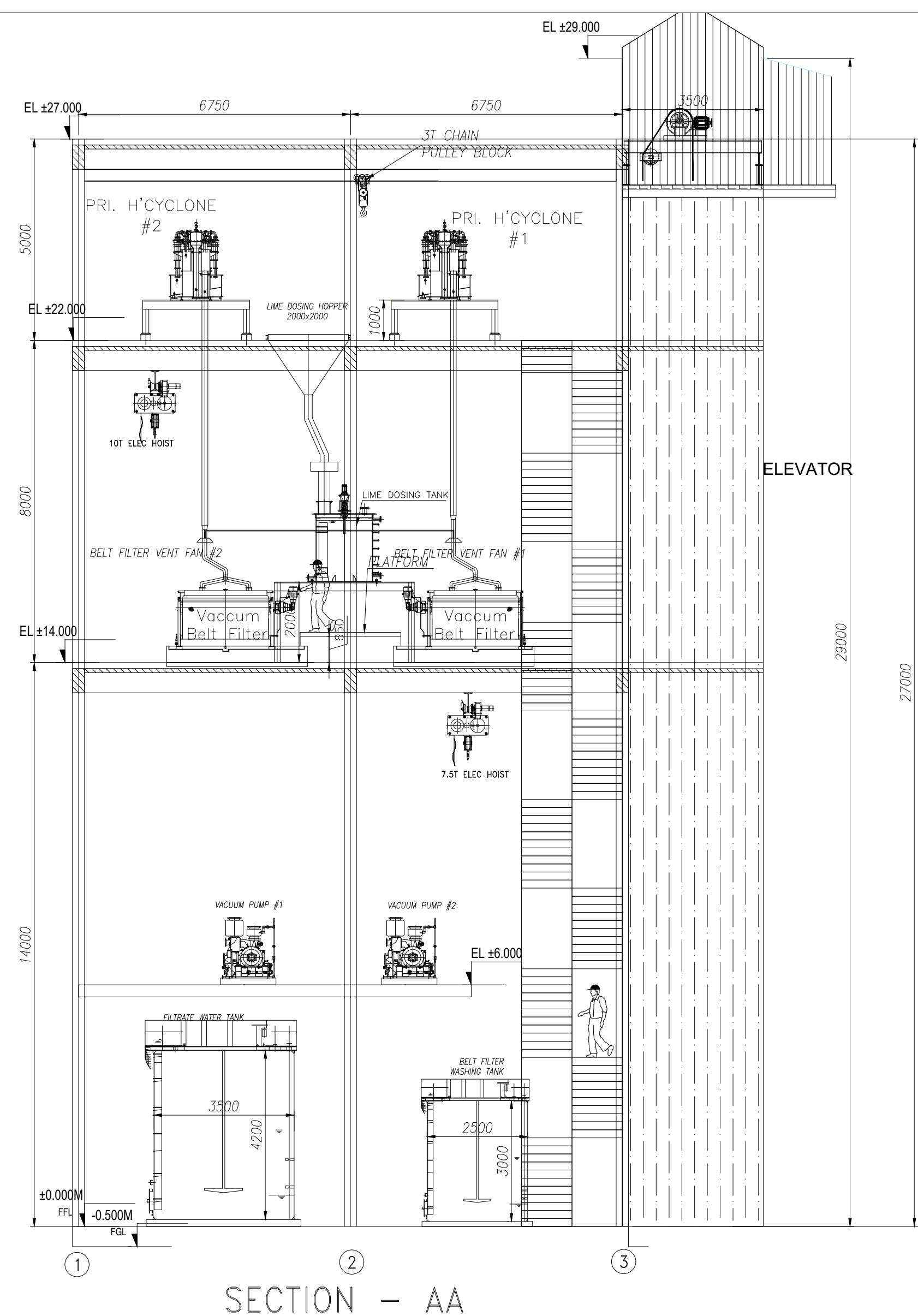
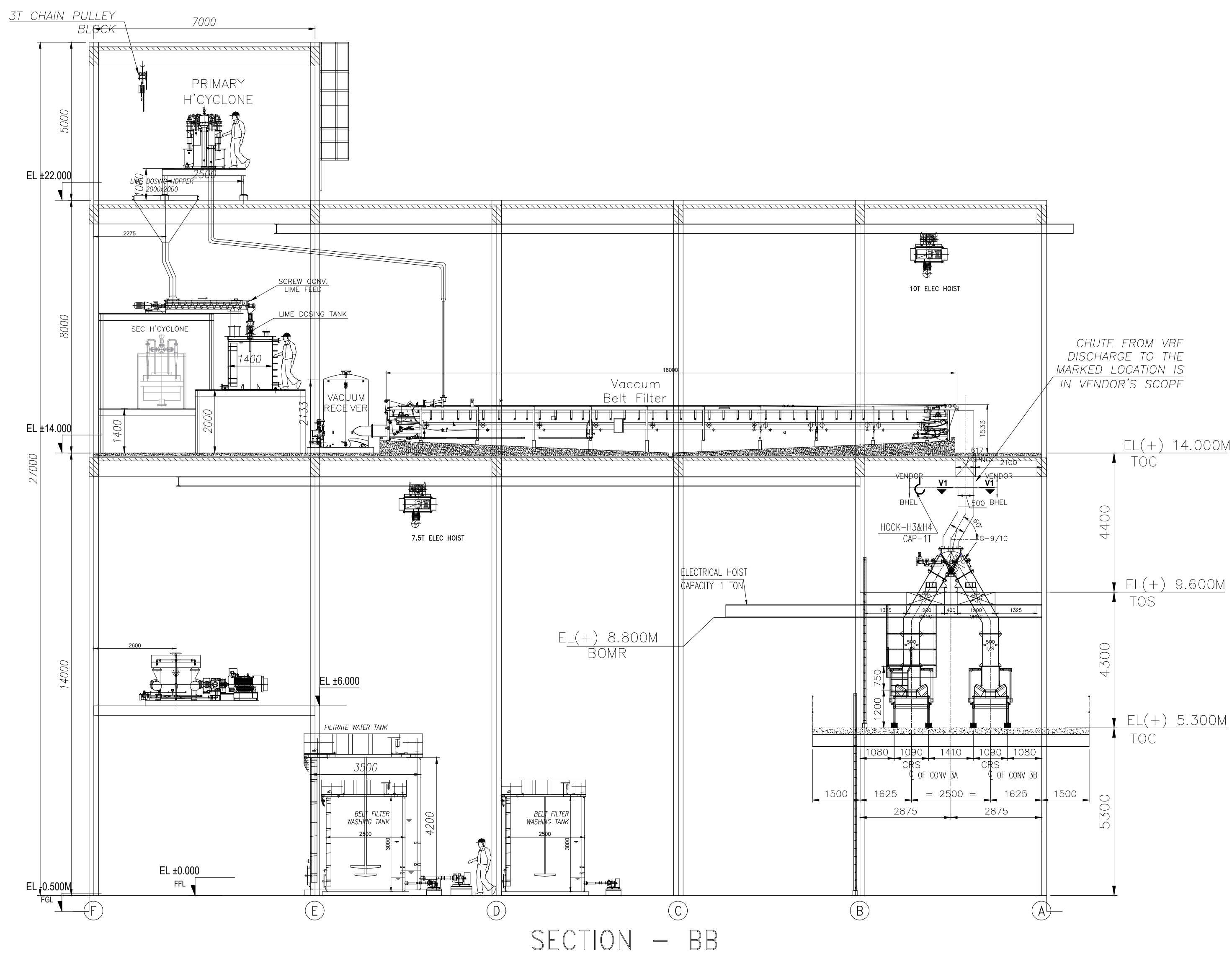
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FILE NO

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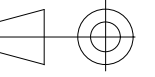
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LIST OF EQUIPMENTS						
EQPT NO	NOS	DISCRIPTIONS	APPX SIZE	APPX WEIGHT OF EACH EQPT UNDER OPERATION	LOCATION	REMARKS
1	02	VACUUM BELT FILTER	20M X 4M X 3M HT	40 MT	ON FIRST FLOOR EL(+114.000)	THE EQUIPMENT COLUMNS WILL BE SUPPORTED ON THE FLOOR
2	02	SECONDARY HYDRO CYCLONE	3.5M X 1.5M X 2.0M HT	10 MT (INCLUDING SUPPORTING PLATFORMS)	ON FIRST FLOOR EL(+114.000)	THE EQUIPMENT HAS 4 COLUMNS WHICH WILL BE SUPPORTED ON THE FLOOR
3	02	LIME DOSING TANK	4M X 4M X 4M HT	25MT (COMBINED WEIGHT INCLUDING SUPPORTS)	ON FIRST FLOOR EL(+114.000)	THE SCREW CONVEYER AND LIME DOSING TANK WILL BE SUPPORTED ON PLATFORM WHICH WILL BE SUPPORTED ON FLOOR
4	02	LIME FEED SCREW CONVEYER	4M X 4M X 4M HT	10 MT	ON FIRST FLOOR EL(+114.000)	
5	01	LIME DOSING SILOHOPPER	2.2M DIA X 2.8M HT	10 MT	FLOOR OPENING ON SECOND FLOOR EL(+122.00)	SUPPORTED ON PERIPHERY OF THE FLOOR OPENING
6	02	PRIMARY HYDROCYCLONE	3M DIA X 4M HT	15MT (INCLUDING SUPPORTING PLATFORMS)	ON SECOND FLOOR EL(+122.00)	PRIMARY HYDRO CYCLONE WILL BE SUPPORTED ON PLATFORM WHICH WILL BE SUPPORTED ON FLOOR
7	02	VACUUM PUMP	6M X 2.5M	20MT	GROUND FLOOR @ EL(+0.000)	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
8	02	VACUUM RECEIVER	1.3M DIA	10MT	FIRST FLOOR @ EL(+114.000)	FLOOR MOUNTED TANK
9	02	BELT FILTER(CLOTH) WASH TANK	2.5M DIA X 3.0M HT	AS PER LOADING DRG	GROUND FLOOR @ EL(+0.000)	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
10	02	BUCKET ELEVATOR FOR LIME FEED	0.7M X 1.5M	10T	FROM GROUND FLOOR TO FIRST FLOOR	OPENING IN FLOOR LEVEL DTD EL(+10.000 AND EL(+18.750)
11	01	FILTRATE WATER TANK	3.5M DIA X 4.2M HT	AS PER LOADING DRG	GROUND FLOOR @ EL(+0.000)	TANK SHIFTED TO OUTSIDE OF THE BUILDING
12	02	FILTRATE WATER PUMP	2M X 1.5M HT	AS PER VENDOR DRG	GROUND FLOOR @ EL(+0.000)	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
13	02	CAKE WASH PUMP	1.5M X 1M HT	AS PER VENDOR DRG	GROUND FLOOR @ EL(+0.000)	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
14	02	CLOTH WASH PUMP	1.5 M X 1M HT	AS PER VENDOR DRG	GROUND FLOOR @ EL(+0.000)	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN

LIST OF EQUIPMENTS				
EQPT NO	NOS	DESCRIPTIONS	LOCATION	REMARKS
1	02	VACUUM BELT FILTER	ON FIRST FLOOR EL(+14.000	THE EQUIPMENT COLUMNS WILL BE SUPPORTED ON THE FLOOR
2	02	SECONDARY HYDRO CYCLONE	ON FIRST FLOOR EL(+14.000	THE EQUIPMENT HAS 4 COLUMNS WHICH WILL BE SUPPORTED ON THE FLOOR
3	01	LIME DOSING TANK	ON FIRST FLOOR EL(+14.000	THE SCREW CONVEYER AND LIME DOSING TANK WILL BE SUPPORTED ON PLATFORM WHICH WILL BE SUPPORTED ON FLOOR
4	01	LIME FEED SCREW CONVEYER	ON FIRST FLOOR EL(+14.000	
5	01	LIME DOSING SILO/HOPPER	FLOOR OPENING ON SECOND FLOOR EL(+122.000"	SUPPORTED ON PERIPHERY OF THE FLOOR OPENING
6	02	PRIMARY HYDROCyclONE	ON SECOND FLOOR EL(+222.000"	PRIMARY HYDRO CYCLONE WILL BE SUPPORTED ON PLATFORM WHICH WILL BE SUPPORTED ON FLOOR
7	02	VACUUM PUMP	GROUND FLOOR @ EL(+0.000	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
8	02	VACUUM RECEIVER	FIRST FLOOR @ EL(+14.000	FLOOR MOUNTED TANK
9	02	BELT FILTER(CLOTH) WASH TANK	GROUND FLOOR @ EL(+0.000	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
10	02	BUCKET ELEVATOR FOR LIME FEED	FROM GROUND FLOOR TO FIRST FLOOR	OPENING IN FLOOR LEVEL DTD EL(+14.000 AND EL(+122.000
11	01	FILTRATE WATER TANK	GROUND FLOOR @ EL(+0.000	TANK FOUNDATION TO BE PROVIDED
12	02	FILTRATE WATER PUMPS	GROUND FLOOR @ EL(+0.000	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
13	02	BELT FILTER(CLOTH) WASH PUMPS	GROUND FLOOR @ EL(+0.000	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
14	02	CAKE WASH PUMPS	GROUND FLOOR @ EL(+0.000	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN

NOTES:					
1. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATING IN METERS.					
2. ELEVEN (11) ON THE GROUND FLOOR LEVELS OF PUMP HOUSE BUILDING WHICH CORRESPONDS TO RL+170.5M.					
3. RL PROVIDED GRADED LEVEL OF GOMW AREA IS ELI-10.50M AND RL+106.5 M.					
4. THE EQUIPMENT/MACHINERY SIZES SHOWN IN THIS DRAWING IS INDICATIVE ONLY AND WILL BE CONFIRMED AFTER VENDOR DATA. THE MAXIMUM APPROPRIATE SIZE AND LOADING IS PROVIDED IN THIS DRAWING.					
5. PLANT OPERATIONS: PRICE ORIGINALLY SHALL BE CONFIRMED DURING DETAIL ENGINEERING.					
6. SURFACE RIGHTS, MINORS AND VENDOTRALS SHALL BE CONSIDERED BY CHN, DESIGNER FOR OHSWM CENTERING BUILDING.					

NTPC DRG. No.		9962-001-RP-109-PVM-B-086		REV. 03	
PROJECT:		1 X 660MW PANKI THERMAL POWER EXTENSION PROJECT.			
OWNER: 		UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.			
REVIEW CONSULTANT:  NTPC		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)			
CONSULTANT: 		DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA			
EPC CONTRACTOR: 		BHARAT HEAVY ELECTRICALS LTD.			
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA					
TITLE		GENERAL ARRANGEMENTS OF GPYSUM DEWATERING SYSTEM			
		DEPT. SCALE		DRAWING NO.	
		SIGN		00-FW-738-00142	
				SHEET	
		01 OF 01		REV. 03	

LEGEND:	
FGL	- FINISHED GROUND LEVEL
FFL	- FINISHED FLOOR LEVEL
T.O.P.F	- TOP OF PLATFORM
TOC	- TOP OF CONCRETE
OPENG	- OPENING
MR	- MONORAIL
THK	- THICK
TYP	- TYPICAL
GDWB	- GYPSUM DEWATERING BUILDING
VBF	- VACUUM BELT FILTER

Annexure -IX Piping & Valve Material Specification

PROJECT: UPRVUNL PANKI 1X660MW

1. General

This specification covers the basic requirements for the design and materials of process and utility piping for the Gypsum dewatering system of Flue Gas Desulfurization Plant.

2. Material Selection

- 1) Basically, rubber lined pipes are selected to prevent the corrosion and erosion for process service, namely slurry line.
- 2) Class AA60 is applied according to process line conditions.
- 3) For utility services, other classes are applied.
- 4) In principle, piping material will conform to ASTM, but ASTM equivalent material specified by other authorized code may be applied.
- 5) Non-asbestos type shall be used for Packing and Gasket.

3. Design of Piping Component

- 1) In principle, each component of all piping will be selected from ANSI ASME or international standard in the dimensions and other requirements.
- 2) Metric series are applied to the bolt thread.
- 3) Nozzle weld tees or extruded tees are used as branch connection in lined piping, in general.
- 4) Short radius elbow may be used for 550mm or larger size piping.
- 5) Fittings for 50 and smaller galvanized piping shall be of screwed type.

4. Piping Material

1) Symbols of Piping Service Class

Piping service class name is composed of the following symbols.

Example: A A 60

Suffix Number

Second Pipe Material Symbol

First Pipe Material Symbol

Note:

First Pipe Material Symbol	
A: Lining	AA: Rubber Lining
B : G.I	BA: G.I
C: Carbon Steel	CA: Carbon Steel
	CC: Carbon Steel

2) Class No. and Fluid Designation

CLASS NO.	FLUID NAME	SYMBOL	
AA60	Gypsum Slurry	GS	
	Filtrate Slurry	FS	
	Waste Water	WW	
	Duct Drain	DD	
	Belt filter Vent Gas	VBG	
BA01	Instrument Air	AI	
CC01	Process Water	WP	Note 1
	Raw Water	WR	
	Cooling Water Supply	WCS	
	Cooling Water Return	WCR	
	Vacuum Pump Vent	VG	
	Antifoam Agent	AA	

Note I

Class AA60 shall also be applied for process water service line in contact with corrosive and abrasive media.

3) Abbreviations

Abbreviations used throughout this specification are as follows:

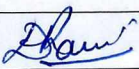
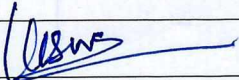
BB	:	Bolted Bonnet
BC	:	Bolted Cover
BE	:	Bevel End
BW	:	Butt Weld
CAL	:	Calculation
CR	:	Chloroprene Rubber
E	:	Electric Resistance Weld
EPDM	:	Ethylene Propylene Diene Methylene Rubber
Eq	:	Equal
FE	:	Flange End
FF	:	Flat Face
G. OP	:	Gear Operation
Gal.	:	Galvanized

HEX.	:	Hexagon
IIR	:	Isobutyl Isoprene Rubber
ISRS	:	Inside Screw Rising Stem
La	:	Larger
L.OP	:	Lever Operation
NB	:	Nominal Bore
NW	:	Nozzle Weld
OS&Y	:	Outside Screw & York
PE	:	Plane End
PP	:	Poly Propylene
PTFE	:	Poly Tetra Fluoro Ethylene
RF	:	Raised Face
R/L	:	Rubber lined or rubber seated
S	:	Seamless
SB	:	Screw Bonnet
SC	:	Screw Cover
SCH	:	Schedule No.
SCR'D	:	Screwed
Sm	:	Smaller
SO	:	Slip On
St.	:	Stellite
SW	:	Socket Weld
W	:	Weld
WN	:	Welding Neck
W/LINING	:	With Lining
V#	:	Valve No.
13 CR	:	13% CHROMIUM

CLASS	Max. Press. (MPaG)	1.0		C. A. mm
AA60 (1/1)	Max. Temp. (degC)	70		
FLUID	GYPSUM SLURRY			
ITEM	Size	Thickness	Specification	
PIPING	DN25 – DN50	Heavy	IS 1239 SML PE (I:R/L)	
	DN65 – DN150	Heavy	IS 1239 E. R. W BE (I:R/L)	
	DN200 – DN300	SCH20	IS 3589 Gr. 410 E. R. W BE (I:R/L)	
	DN350 – DN400	7. 1T	IS 3589 Gr. 410 E. R. W BE (I:R/L)	
	DN450 – DN500	SCH10	IS 3589 Gr. 410 E. R. W BE (I:R/L)	
	DN550 –DN1000	7. 9T	IS 3589 Gr. 410 E. R. W BE (I:R/L)	
	DN1100–DN1200	9. 5T	IS 3589 Gr. 410 E. R. W BE (I:R/L)	
	FITTING	DN25 – DN50	Suit to PIPE	SA234 WPB (I:R/L) ASME-B16. 9
DN65 – DN150		Suit to PIPE	SA234 WPB (I:R/L) ASME-B16. 9	
DN200 – DN300		Suit to PIPE	SA234 WPB (I:R/L) ASME-B16. 9	
DN350 – DN500		Suit to PIPE	SA234 WPB (I:R/L) ASME-B16. 9	
DN550 –DN1000		Suit to PIPE	IS 2062 Gr. B (Plate formed) (I:R/L) ASME-B16. 9	
DN1100–DN1200		Suit to PIPE	IS 2062 Gr. B (Plate formed) (I:R/L) ASME-B16. 9	
FLANGE	DN25 – DN600		S0 IS2062 Gr. B(Plate) FF (I:R/L) ASME-B16. 5 Cl. 150	
	DN650 –DN1800		S0 IS2062 Gr. B(Plate) FF (I:R/L) AWWA-C207 Cl. B	
PINCH VALVE	DN25 – DN150		PN 16 BODY-A126-B TRIM-13CR SLEEVE-CR LINING-IIR FF HAND WHEEL	
GASKET	DN25 – DN600		V-2000 RUBBER RUBBER OR EQ. ASME150 4.0 mm T FLAT RING	
	DN650 –DN1800		V-2000 RUBBER RUBBER OR EQ. AWWA CL. B 4.0 mm T FLAT RING	
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307–GR. B/A563–GR. A FINISHED	
Note: I: R/L – Replaceable Wear Resistant Natural Rubber Lining of minimum 6mm thickness. Additional thickness of 2 mm rubber lining shall be provided in bends.				

CLASS	Max. Press. (MPaG)	1		C. A. mm
BA01 (1/1)	Max. Temp. (degC)	45		
FLUID	INSTRUMENT AIR			
ITEM	Size	Thickness	Specification	
PIPING	DN6- DN150	Heavy	IS1239-I (Galv.) SML Screwed	
FITTING	DN6 - DN150	Suit to PIPE	IS1239-II (Galv.) Screwed	
FLANGE	DN6 - DN150		SO IS2062 Gr.B (Galv.) Screwed	
GATE VALVE	DN6 - DN50		API-602 PN 16 Body:A182-F304 Disc:AISI304 Stem:13%CR SW/NPT Thread for Inst Air BB, OS&Y HAND WHEEL	
	DN65 - DN250		ASME-B16.34 PN 16 Body:A351-CF8 Disc:AISI304 Stem:13%CR RF/BW BB, OS&Y HAND WHEEL	
GASKET	DN6 - DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 4.0 mm T FLAT RING	
	DN200- DN250		V-6500 NON-ASBESTOS OR EQ. ASME150 4.0 mm T FLAT RING	
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR. B/A563-GR. A FINISHED	

CLASS	Max. Press. (MPaG)	0.11for VG	0.85 for Water	C. A. mm
CC01 (1/1)	Max. Temp. (degC)	155 for VG	45 for Water	
FLUID	WATER, VENT GAS			
ITEM	Size	Thickness	Specification	
PIPING	DN6 – DN50	Heavy	IS1239-I SML Screwed	
	DN65 – DN150	Heavy	IS1239 E. R. W BE	
	DN200 – DN300	SCH20	IS3589 Gr. 410 E. R. W BE	
FITTING	DN6 – DN150	Suit to PIPE	BW IS1239-II	
	DN200 – DN300		BW SA234-WPB ASME-B16.9	
FLANGE	DN6 – DN300		SO IS2062 Gr. B(Plate) RF ASME-B16.5 Cl.150	
GATE VALVE	DN6 – DN50		API-602 PN16 Body:A105 Disc& stem:13CR SEAT STELLITE STL SW BB, OS&Y HAND WHEEL	
	DN65 – DN300		ASME-B16.34 PN16 Body:A395/A216WCB Disc& Stem:13CR RF/BW BB, OS&Y HAND WHEEL	
GLOBE VALVE	DN6 – DN50		API-602 PN16 Body:A105 Disc& stem:13CR SEAT STELLITE STL SW BB, OS&Y HAND WHEEL	
	DN65 – DN300		ASME-B16.34 PN16 Body:A395/A216WCB Disc& Stem:13CR RF/BW BB, OS&Y HAND WHEEL	
CHECK VALVE	DN6 – DN50		API-602 PN16 Body:A182 Gr 304 Trim:SS304 SEAT STELLITE STL SW BC, LIFT	
	DN65 – DN300		ASME-B16.34 PN16 A395 13CR RF BC, SWING	
BALL VALVE	DN6 – DN100		ASME-B16.34 PN16 Body:A105 Ball & Stem: AISI304 Seat:PTFE RF BALL LEVER. FULL BORE	
BUTTERFLY VALVE	DN50 – DN150		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER LEVER.	
	DN50 – DN150		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER AIR CYLINDER W/L. SWITCH	
	DN50 – DN150		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER ELECTRIC MOTOR W/L. SWITCH	
	DN200 – DN300		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER WHEEL WITH GEAR	
	DN200 – DN300		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER AIR CYLINDER W/L. SWITCH	
	DN200 – DN300		ASME-B16.34 PN16 Body: A216-WCB Trim:13CR Lining: EPDM Seals: Viton RF WAFER ELECTRIC MOTOR W/L. SWITCH	
GASKET	DN6 – DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 4.0 mm T FLAT RING	
	DN200 – DN300		V-6500 NON-ASBESTOS OR EQ. ASME150 4.0 mm T FLAT RING	
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR. B/A563-GR. A FINISHED	

	Bharat Heavy Electricals Ltd Boiler Auxiliaries Plant Ranipet-632 406			FLUE GAS DESULPHURISATION DEPT TECHNICAL SPECIFICATION	
00	07-04-2020	Fresh Release	 Diwakar Kumar Ravi	 Ashish Kushwaha	 V. Kesavan
REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
Clause No.	Requirement	Butterfly Valve (Wafer Type)			Vendor's Acceptance /Comments
1	Eligibility	Vendors having manufacturing facility in India are only eligible to quote for the offer.			
2	Scope of Supply	1) Manually Operated Butterfly valve with manual lever / gear box as applicable			
		2) Electrically Actuated Butterfly Valve with electric actuator as per Enquiry Specification			
		3) Pneumatically Actuated Butterfly Valve with Pneumatic actuator with equalizing valve + flow control valve +Air Lock Relay+ filter regulator with auto drain, metallic bowl +Check valve +JB +2 coil 5/2 solenoid valve+2nos DPDT limit switch +tubing & fitting + wiring + exhaust silencer + 1/4 "NPT (F) Ball Valve			
3	Application and Actuator selection	a)The valves are used in the slurry pipe of Wet Limestone based Flue Gas Desulphurization plant.			
		b)The property of flowing fluid are given below Specific gravity – 1.215; Viscosity – 0.03Pa.S; Concentration – 30 wt%; Max solid particle size - 150 mesh (140 micron); Normal solid particle size,d50 - 325 mesh (43 micron); Hardness - 5-7(Mho scale)			
		c)Hence Actuator to be selected 2.5 times the valve torque requirement			
4	Design Standards	1)Valve Design shall be as per EN593/API 609/ BS5155/ASME B16.34 Class 150			
		2) Valves testing as per EN12266 Rate A (No visible weeping or formation of drops or bubbles).			
		3) Valve flanges shall conform to ANSI B 16.5 CL 150 (EPDM lining to be extended to face of the flange).			
		4) Valve shall accommodate any actuator (manual gear box, pneumatic Or electric). Vendor to design the valve with actuator mounting flange dimension as per ISO 5211/ ISO5210 .			
5	Design	1) The valves as well as all accessories shall be designed for easy disassembly and maintenance.			
		2) For all types of valves, the design with shaft eccentric to the disc is preferred. Centric is also acceptable.			
		3) The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be provided in the hub of valve body.			

		4) At site Valves will be mounted in the open space, fasteners shall be atmospheric corrosion material						
		5) The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components. Bearing should not be exposed to slurry medium.						
		6) All valves should have adjustable mechanical stop limiting devices to prevent over travel of valve disc in open/close position-vendor to confirm						
		7) In case of Pneumatic and Electric Actuated Valves, Clutching/Declutching arrangement to be provided for Manual override and same to be shown in the GA drawing. - Vendor to confirm						
		8) Lifting lugs shall be provided for all valves above NB150 size (6 inches)						
		9) For Manual operation, locking arrangement to be shown clearly in the drawing. Vendor to confirm						
		10) Disc Pin sizing and selection calculation to be submitted.						
		11) Valve Torque (VT) Calculation to be provided considering the following Bearing Torque, Centre of gravity Torque, Dynamic Torque, Hydrostatic Torque, Shaft off-set or eccentricity Torque, Packing and Hub Torque, Seating Torque, Unseating Torque, Total Opening and Closing Torque to be provided						
		12) Considering the slurry property (refer clause and factor of safety (FST) torque shall be be 2 times as that of VT (ie $FST=2 \times VT$)						
		13) The Actuator Torque (AT) finally selected shall deliver minimum 1.5 times as that of FST (ie $AT=1.5 \times FST$ or $AT=2.5 \times VT$)						
6	Provision for Manual Override	1) For Manually operated Valve: (i) handle will be sufficient for valve dia. upto 150mm, (ii) worm and worm wheel type gear box unit is required for 200mm and above						
		2) For Electrically operated valve: All valve shall be provided with worm & worm wheel (which would be default feature of electric actuator)						
		3) For Pneumatic valve: Upto 150mm hand lever & 200 and above, Worm and worm wheel. While operating hand lever, clutching arrangement should allow to rotate valve disc only and piston should be in same position.						
7	Valve & Actuator Mounting Position	1) Most of the valve are mounted in the Horizontal Direction in horizontal pipe. For horizontal mounting, Support Bearing to be provided in both Drive and Stub shaft (apart from thrust Bearing). 2) Actuator also mounted in the valve stem by 360 degree rotation – vendor to specify						
8	Locking Device	Provision for mechanical locking is required both in the open/close Position of the valve with fine adjustment.						
9	Design temperature	The valve is to be designed to withstand maximum 100°C						
10	Hydro test and Leakage rate	1) Valve working pressure 16 Bar						
		2) Body Test pressure 24 Bar and duration as per EN12266						
		3) Seat Leakage Test pressure: 18 Bar & duration as per EN12266 Rate A						
11	Material Of Construction	Fluid	Body	disc	Stem	Body Lining*	Valve shaft Seals	
		Gypsum Slurry	IS210 FG220	A182-F44 or CK3MCuN (or) CD3MWN -7A	Super Duplex2507	EPDM	Viton	
		Lime Slurry	IS210 FG220	A182-F60 or A995-CD3MN(4A)	Duplex2205	EPDM	Viton	

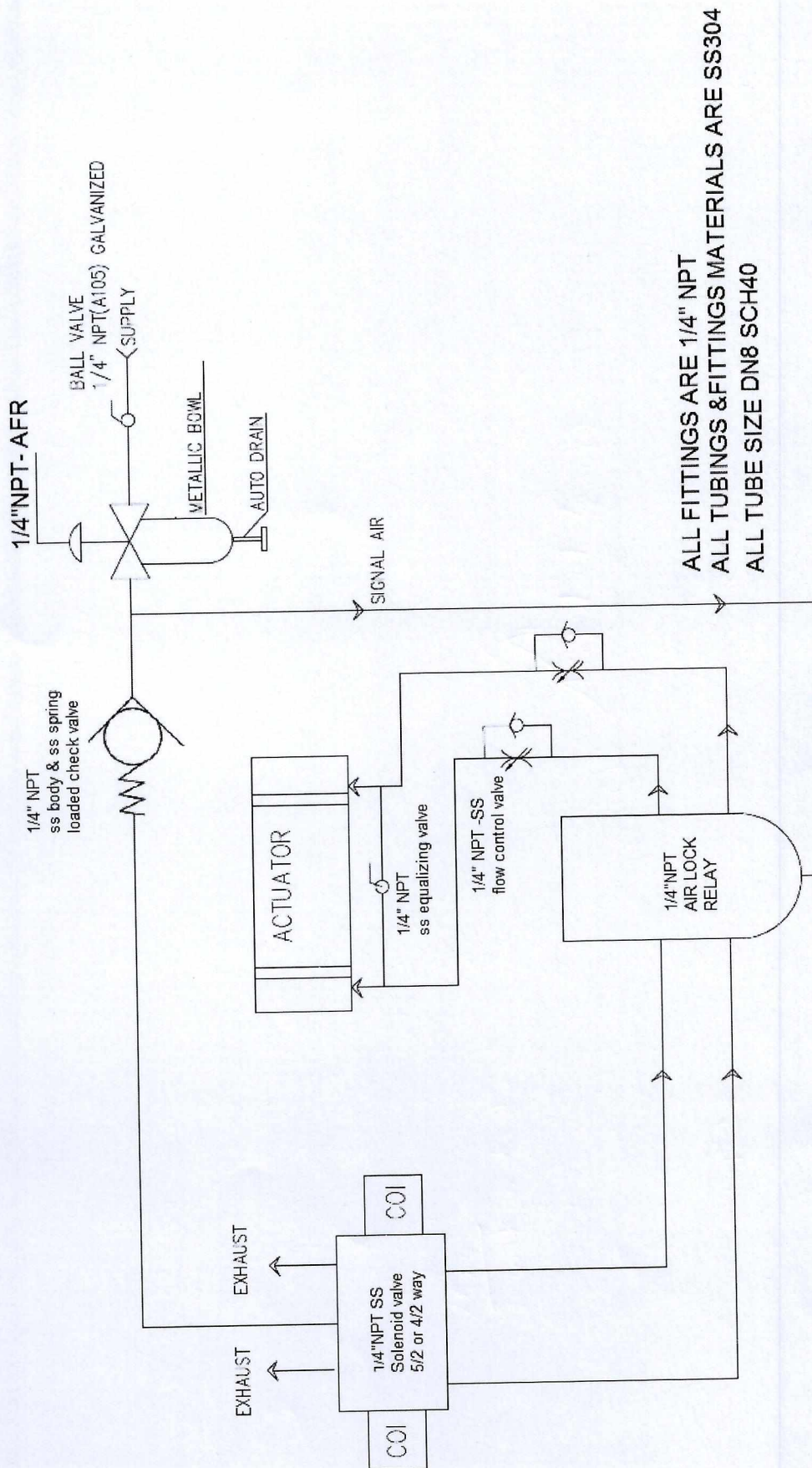
		Water/ Air	A216 WCB	13CR	13CR	EPDM	Viton	
		* EPDM lining for Valve upto NB150 shall be integrally moulded with body. For valve NB200 and above integral moulded lining is preferable , however vendor can offer replaceable cartridge type seat seal also						
		All connecting pin, fasteners in the flow path are similar to disc material.						
12	Depth of the valve	Face to Face dimension (depth of the valve) including body lining will be furnished by the vendor for each valve size. It should be as per API609 table 2						
13	Pneumatic Actuator specification	1a)Quarter turn, Pneumatic Double acting cylinder actuator to be designed considering the following						
		1b) One step higher sized cylinder to be selected considering internal resistance of piston sliding friction and rack & pinion/scotch yoke. It is assumed as 0.5kg/sqcm – vendor to indicate the internal resistance pressure						
		1c) The cylinder to be designed considering the instrument air pressure of 4 kg/sqcm						
		1d) The actuator selection shall be as per this specification clause 5 of SIno 11,12 & 13. – vendor to furnish the actuator torque selection calculation for each valve size along with offer						
		1e)The Actuator model along with catalogue to be furnished with exploded view highlighted with recommended seal kit and repair kit.						
		1f) Piton diameter and pinion or Yoke radius to be furnished along with offer – vendor to furnish for each valve size						
		(2) Two independent external travel stops permit easy and precise adjustment of +/- 5 deg in both directions.- vendor to confirm						
		3) Make :Rotex/Electro matic/Virgo/flowserve/Bray/Any renowned make subject to approval of BHEL/NTPC- Make to be specified during technical offer itself.						
		4) Drive mechanism Rack & Pinion/ Scotch yoke- vendor to specify						
		5) Air Tubing : DN8 SC40 –stainless steel (SS304) OD - 13.72mm, Wall Thickness – 2.235mm . Vendor to follow this tube size and confirm						
		6) Material of all Pneumatic Fitting shall be of SS 304/316 only.						
		7) All valves should have Local Position Indicator- vendor to confirm						
		8)All valves should have Manual Override and hand lever operated <=150 valve, and 200 and above should have declutchable gear operator provision- Vendor to confirm						
		9) Power Failure Position : Stay Put- vendor to confirm						
		10) Air Failure Position : Stay Put – vendor to confirm						
		11) Actuator Travel Time : Less than 10 seconds						
		12)Actuator Protection Class: IP-65 (Min.)						
		13)Mechanical seals of Pneumatic Actuator cylinder should be of "VITON" (Piston packing, Piston seal, Rod Packing, wipers & cushioning etc.)- vendor to confirm and same to be ensured in the drawing approval stage.						
		14)Wear Strip of Pneumatic Actuator piston should be of EPDM- vendor to confirm.						
		15) ¼" NPT SS Flow control Valve : 2nos. (renowned make only)- vendor to specify the make and model						
		16)¼"NPT SS equalizing Valve vendor to specify the make and model no						
		17)¼" NPT- Air Lock relay (Double acting)-vendor to specify the make & model						

		18) 1/4" NPT (F) Ball Valve in pneumatic circuit before AFR	
		19) 1/4" NPT – SS body & SS spring loaded check valve (valve opening 0.1kg/cm ² – vendor to confirm)	
		20) 1/4" NPT Solenoid Valve: 5/2, Double Coil-Solenoid valve 24V DC.	
		21) Solenoidal Valves Body: SS 304/316 material.	
		22) Solenoidal valve should be of renowned make – Avcon, Rotex, Asco. Any other make shall be subjected to BHEL/NTPC approval for which sample valve to be supplied to BHEL. If sample is not meeting the requirements of BHEL, then vendor to choose any one of the above make.	
		23) Cable from Solenoid to junction box: 3C X 1.5sqmm unarmoured HR PVC with FRLS property & with Al Mylar taped insulation required.	
		24) Limit switch cable: OD of the cable 4PX0.5sqmm shall be 10.5 ± 2mm unarmoured HR PVC with FRLS property & with Al Mylar taped insulation required.	
		25) 1/4" NPT Air Filter Regulator: Auto Drain AFR with Suitably sized Metallic bowl with sintered bronze filter element to be provided – vendor to specify make/model no	
		26) Filter regulator to be adjusted to any position as per the site requirement so that drain should be in downward direction.	
		27) Actuator axis shall be perpendicular to flow pipe axis.	
		28) Valve Open / Close position Locking arrangement required – so that valve will be in same position whenever actuator is taken for maintenance	
		29) All threading shall be "NPT".	
		30) All ferrules shall be of SS 304 material only.	
		31) Lot of piping are coming side by side there is limited space, hence All Pneumatic accessories to be compactly arranged along with PN actuator. General arrangement drawing in 3D along with valve & pneumatic fittings with all accessories to be provided during the technical offer.	
14	Electrical Actuator	Electrical Actuator with Integral starter as per enclosed specification.	
15	Limit Switch	1) 2nos of DPDT (2 NO + 2NC) limit switch are to be provided, 1 for open and 1 for close position	
		2) Protection class : Weather Proof IP65	
		3) Rating: 24VDC / 230V AC, minimum 5A for 24V DC	
16	Junction Box	1) FRP junction box (JB) Wall thickness 4mm (min) – vendor to confirm	
		2) JB with 2x12 terminals (600V grade) with proper lugs and ferrule – vendor to confirm	
		3) Double compression metallic cable glands- 4NOS OF 4 PAIR X 0.5 and 3 nos. of 3 core X 1.5sqmm (totally 7 nos)	
		4) In the JB, all glands are mounted such that water should not enter (cable bottom entry & glands face downward)	
		5) Cable: All Wirings from limit switches, solenoid valve to JB with proper cable gland shall be pre-assembled at vendor works.	
		6) Working voltage: 24V DC, 110 or 240V AC	

		7) Protection Class: Finally wired JB has to meet IP 55.	
17	Documents to be submitted during technical offer	1) Point wise acceptance and deviations (if any) of this specification.	
		2) Vendor to submit duly filled, sealed & signed all pages & datasheets enclosed in this specification	
		3) Previously supplied BFV reference list for the offered models with PO copies	
		4) Valve Torque (VT) Calculation to be provided considering the following: Bearing Torque, Centre of gravity Torque, Dynamic Torque, Hydrostatic Torque, Shaft off-set or eccentricity Torque, Packing and Hub Torque, Seating Torque, Unseating Torque, Total Opening and Closing Torque to be provided otherwise offer will not be considered.	
		5) Actuator torque calculation & selection basis to be provided.	
		6) GA drawing showing all accessories with BOM & cross sectional view along with actuator, manual override & valve locking arrangement. otherwise offer will not be considered. And also General arrangement drawing in 3D along with valve & pneumatic fittings with all accessories to be provided.	
		7) Electric Actuator Data sheets with wiring diagram as per tender specification format	
		8) Valve Regulation Characteristic Curve & CV calculations.	
		9) Pneumatic circuit diagram comprising of all pneumatic accessories and electrical wiring diagram consisting of Limit switch+ solenoid+ JB for Pneumatically operated Valve	
		10) POD Test Certificate for all offered sizes of valve to be submitted, in the absence of which actual P.O.D. test shall be conducted by the bidder in the presence of Employer's representative.	
		11) compliance to BHEL SQP by vendor's seal and signature	
		12) List of Commissioning spares required & its make and model number. Its cost to be included in the main offer	
		13) Latest Valve catalogue	
18	Documents to be approved before manufacturing	a) GA drawing showing all accessories with BOM & cross sectional view along with actuator, manual override & valve locking arrangement –for BHEL/NTPC Approval	
		b) Valve Actuator Data sheet with wiring diagram - for electrically actuated valves - for BHEL/NTPC approval	
		c) Junction box drawing with TB and double compression cable gland - for BHEL/NTPC approval	
		d) Pneumatic circuit diagram & Electric wiring diagram – for Pneumatically operated valves - for BHEL/NTPC approval	
19	Name plate	Name plate has to contain the following details. 1) Tag Numbers____ 2) MOC: Disc____ and stem_____ 3) BFV size____ and Rating_____ 4) Torque requirement_____ 5) BHEL material code (Indent No / P.O.Ref.) 6) Manufactures details :vendor Name____Batch no____Val.SINo 7) Approximate weight including actuator (as applicable) in kgs	

20	Inspection	Inspection shall be as per the approved BHEL's standard quality plan and will be carried out by Customer/BHEL/BHEL's authorized agency at vendor works. a)NTPC projects:-cat-III b)Panki:- Electric and PN are cat I & manual valve is cat-III	
21	Painting	a)NTPC Projects : i)Surface preparation– Power tool cleaning to St3 (SSPC-SP3). ii)Primer- Red oxide Zinc phosphate primer to IS 12744 (two coat 30+30 micron). iii)Finish paint- Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats 30+30 micron). Total DFT=120 micron.	
		b)Patratu (exception) i)Surface preparation– Power tool cleaning to St3 (SSPC-SP3). ii)Primer- two coat of Red Oxide Zinc Phosphate Primer to IS: 12744 DFT-25μ/coat iii)Intermediate:One coat of Synthetic Enamel undercoat to IS:2932-30μ iv)Finish paint- Two coats of Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 DFT- 35μ/ coat Total DFT=150 micron.	
		c)Panki Projects: i)Surface preparation– blast cleaning to SA 2 1/2 ii)Primer- Two coats of Epoxy Zinc phosphate primer as per IS 13238. DFT-35μ/coat iii)Finish paint- Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35μ/coat Shade: Light grey Shade no. 631 of IS:5 Total DFT=140 micron.	
		d)Any change in the Painting scheme will be informed to vendor during Addendum release stage/Drawing approval stage. Vendor to confirm	
		e)Note: Painting not required for SS parts, GI parts (GI bolts if used shall be 40 micron and above , Any other parts made up of GI, zinc coating thickness shall be more than 85 micron)	
22	Packing	Valve assembly shall be wrapped in polythene bag and packed in a strong rigid wooden box. Rain water should not enter into the packing of actuators during storage in the outer yard of power plant.	
23	Outside the box	PO number, vendor name, item size, material code, model number, Quantity inside the box to be mentioned.	
24	General Instruction	1) All Necessary material test certificates to be produced at the time of inspection for Valve body, Disc, stem, seals, Viton seals, Limit switch, Air Filter regulator, Air cylinder or Electric Motor, Solenoid valve etc .	
		2) Only latest revision shall be referred for all the Standards specified.	
		3) After the receipt of offer, All vendors will be assessed by BHEL team and further processing of offer is based on the team's reports and recommendation. This is mandatory for all vendors	

PNEUMATIC CIRCUIT DIAGRAM



ALL FITTINGS ARE 1/4\" NPT
ALL TUBINGS & FITTINGS MATERIALS ARE SS304
ALL TUBE SIZE DN8 SCH40

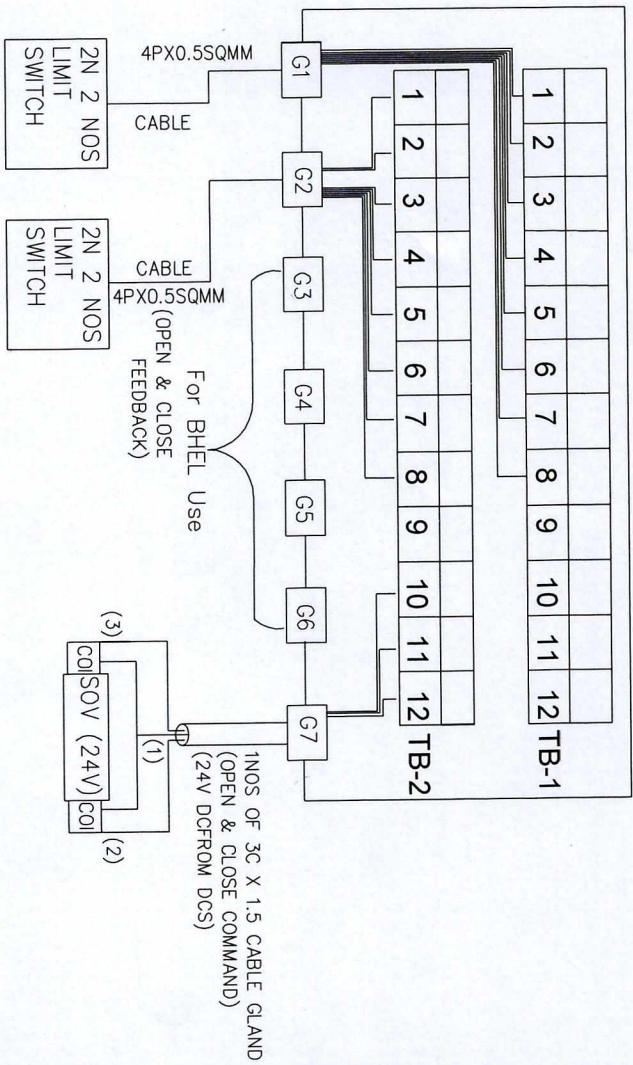
Ashish Kushnaka
(BHEL)

Dilwakar Kumbhar
(BHEL)

Vijay
(BHEL)

TYPICAL WIRING DIAGRAM

JUNCTION BOX IP 55



NOTE:

1) FOR SCREENED CABLES:

- CONDUCTOR : ANNEALED BARE COPPER
- INNER SHEATH : PVC
- SCREENING : ALUMINIUM MYLAR TAPE
- OUTER SHEATH : EXTRUDED FRLS PVC SHEATH FOR CABLE 4P X 0.5SQMM ;
- OD OF THE CABLE : $10 \pm 2MM$
AND. (G1, G2, G3 & G4) DOUBLE COMPRESSION BRASS CABLE GLAND-BRACO MODEL NO. CBW01SS OR EQUIVALENT OF OTHER MAKE
- FOR CABLE 3C X 1.5SQMM :
(i) OD OF THE CABLE : $13 \pm 2MM$
(ii) 3NO. (G5, G6 & G7) DOUBLE COMPRESSION BRASS CABLE GLAND - BRACO MODEL NO. CBW01S OR EQUIVALENT OF OTHER MAKE
- WIRING FROM LIMIT SWITCH TO JUNCTION BOX AND SOLENOID VALVE TO JUNCTION BOX ARE IN VENDOR SCOPE.
- ALL WIRING ARE USED WITH ATC LUGS (24NOS.) WITH FERRULES.

SOLENOID WIRING LINE NO.

- COMMON LINE
- OPEN COMMAND LINE
- CLOSE COMMAND LINE

Divakar Kar-Ram
(BHEL)

Asish Kushwaha
(BHEL)

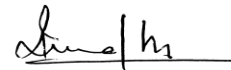
V. Kesavan
(BHEL)

Annexure-X - Sample Quality Plan

		MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN										
				ITEM: VACCUM BELT FILTER SYSTEM: FGD						QP NO		FGS:725		
										REV. NO:		00		
										DATE:		12.02.2019		
								PAGE NO:		Page 1 of 6				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D *	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
1.0 RAW MATERIAL (*Material shall be as per Drawing)														
1.1	Vacuum Pump	Material TC (Physical & chemical) for impeller. Casing, Shaft	Major	Review of TC	100%		Approved drawing/data sheet	TC	√	P	V	V		
		NDT of impeller & Shaft	Major	UT	100%		ASTM A 388/ASME sec.V	TC	√	P	V	V	UT of shaft ≥ φ40mm	
		Capacity power, pressure efficiency noise, Vibration	Major	Measurement	100%		Approved drawing /data sheet	TC	√	P	W	V		
1.2	Speed reducer	Visual, dimension, Run test including of leakage, temp. rise, Noise level and vibration.	Major	Visual & Measurement	100%		Approved data sheet / Drawing	TC	√	P	V	V		
1.3	AC Drive	Type, Make, Rating, Routine test.	Major	Visual & measurement	100%		Approved Drawing/Data sheet	TC	√	P	V	V		

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.
M: MANUFACTURER / SUB SUPPLIER, **C:** MAIN CONTRACTOR.
N: CUSTOMER/CONSULTANT **P:** PERFORM **W:** WITNESS **V:** REVIEW OF RECORDS
MA: MAJOR AND **MI:** MINOR

PREPARED BY



Rakesh Kumar Madhu, (SEr/QA)

REVIEWD & APPROVED BY

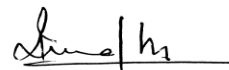


K C Gandhi Parimalam, (DGM/QA)

 Ranipet		MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN										
				ITEM: VACCUM BELT FILTER SYSTEM: FGD						QP NO		FGS:725		
										REV. NO:		00		
										DATE:		12.02.2019		
								PAGE NO:		Page 2 of 6				
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D *	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
1.4	Belt	Visual & review of test certificate (tensile, Elongation, Thickness)	Major	Review of documents	100%		Approved data sheet/Drawing		TC	√	P	V	V	
1.5	Filter Cloth	Visual & Review of physical properties (Tensile, Elongation, Thickness, air permeability test. Etc.)	Major	Review of documents	100%		Approved data sheet/Drawing		TC	√	P	V	V	
1.6	Belt Wash Pump	Chem & mech Properties of Impeller, Casting, Shaft	Major	Review of documents	100%		Approved data sheet/Drawing		TC	√	P	V	V	UT of shaft ≥ φ40mm
		Balancing of Rotating Parts	Major	Static & Dynamic Balancing	100%		ISO 1940 Gr.6.3		TC	√	P	V	V	
		Hydro test of casing	Major	Static pressure testing	100%		Approved Data Sheet/Drawing		TC	√	P	V	V	Hydrostatic testing of casings for

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MA: MAJOR AND **MI:** MINOR

PREPARED BY



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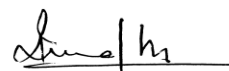


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					M	C/N				D *	M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D *	** 10.			11.	
														30min at 1.5 times of shut-off head or 2 times pump rated head which ever higher
		Run test (Capacity, Head, efficiency, brake horse power, Noise and vibration)	Major	Measurement	100%	Approved Data Sheet/Drawing	TC	√	P	W	V			
1.7	Hydro cyclone	Visual & Dimension	Major	Visual & Measurement	100%	Approved Data Sheet/Drawing	TC	√	P	W	V			
1.7 (a)	Rubber Composition	Material content	Major	Measurement	1/Batch	Manufacturer standard	COC	√	P	V	V			
1.7 (b)	Rubber lining	Spark test at accessible area	Major	Inspection check	100%	Technical Spec/Relevant standard	IR	√	P	W	V			Spark test 10-12.5KV min

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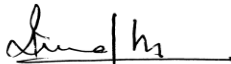


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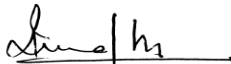


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					M	C/N				M	C	N		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
1.8	LT Motor	Make, Rating, Type, Routine test, Paint	Major	Measurement	100%		Approved Data sheet		TC	√	P	V	V	For Motor up to 30KW COC Above 30KW up to 50KW motor routine test shall be witnessed my BHEL. 50KW & Above separate QP to be submitted. Applicable for all MQP will be submitted.
1.9	Instruments	COC/Functional Check	Major	Measurement	100%		Approved Data Sheet/Drawing		TC	√	P	V	V	
2.0 FINAL INSPECTION														
2.1	Vacuum belt filter assembly	Visual, Dimensional	Major	Dimensional	100%		Approved Drawing			√	P	W	W	
2.2		Run test (for 30 minutes)	Major	Visual, Measurement	100%		Approved Drawing			√	P	W	W	
2.3	All components required paints.	Visual, DFT	Major		100%		Approved Painting Scheme			√	P	W	V	
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 Ranipet	MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		STANDARD QUALITY PLAN											
			ITEM: VACCUM BELT FILTER SYSTEM: FGD					QP NO		FGS:725				
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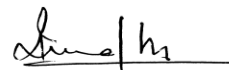
1	VACCUM TANK (RAW MATERIAL INSPECTION)												
1.1	Plates for shell and dished ends & structural	Chemical & Physical	Major	Chemical & Physical	1/ Heat	Approved Data Sheet/ Drawing	TC	√	P	V	V		
2.0	IN PROCESS CONTROLS												
2.1	Welding (As applicable)	WPS,PQR,WPQ	CR	Verification	100%	ASME Sec. IX/Relevant Standard	Repor rts	√	P	V	V		
2.2	Stress Relieving	Physical	Major	Review	100%	Relevant Standard / Manufacturer standard	HT chart	√	P	V	V	AS applicable	
2.3	All Weld	Weld Quality	Major	DPT	10%	Relevant Standard / ASME Sec- VIII Div:1	IR	√	P	V	V		
2.4	Weld quality of circumferential & longitudinal seams	CR	UT	As Per Code	ASME Sec- V/ Appd.Drg	Relevant Standard / ASME Sec- VIII Div:1	IR	√	P	V	V	Only butted Welds	
3.0	FINAL INSPECTION												
3.1	Complete Vessel	Dimensional	Major	Dimension	100%	Approved drawing	IR	√	P	V	V		
3.2		Nozzle Orientation	CR	Dimension	100%	Approved drawing	IR	√	P	V	V		
3.3		Hydro Test	CR	Hydro Test	100%	2X working PR or 1.5x design PR Whichever is higher for 30 minutes duration	NO Leakage	IR	√	P	V	V	

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					M	C/N				M	C	N		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
3.4		Pneumatic Test of RF pads (as applicable) for soundness/leakages	CR		100%		ASME SEC-VIII/appd. Drg/appd. Datasheet	No leakage	IR	√	P	V	V	
3.5 (a)	Rubber Lining of tank	Rubber lining	Major	Spark test	100%			Technical spec/Data sheet	IR	√	P	W	V	Spark test 10-12.5KV min
3.5 (b)	Rubber Lining of tank	Rubber lining	Major	Hardness testing	100%			Technical Spec/Data sheet	IR	√	P	W	V	Shore hardness value shall be within 60
3.6	Painting & Marking	Finish / DFT	Major	Visual	100%		Appd. Drg /Data Sheet		IR	√	P	V	V	
3.7	Quality Dossier	Document	Major	Review of document	100%		Compilation of all documents		Quali ty Dossi er	√	P	V	V	

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PREPARED BY



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REVIEWD & APPROVED BY



K C Gandhi Parimalam,(DGM/QA)

LT MOTOR DATA SHEET

(Bidder to submit along with technical offer)

DE-1	LT MOTORS	1 Cake Wash Pump	2 Belt Filter Wash Pump	2 Vacuum Pump (if LT)	4 VBF Drive Motor
A.	GENERAL				
1.	Quantity (as per enquiry)				
2.	Motor Manufacturer & Country of origin.				
3.	Motor type				
B.	DESIGN AND PERFORMANCE DATA				
1.	Frame size				
2.	Type of duty	S1	S1	S1	S1
3.	Type of enclosure / Method of cooling/ Degree of protection				
4.	Applicable standard to which motor generally conforms				
5.	Efficiency class as per IS 12615 (vendor to fill up efficiency here)				
6.a	Whether motor is flame proof	NO	NO	NO	NO
6.b	If yes, the gas group to which it conforms as per IS:2148	N.A	N.A	N.A	N.A
7	Type of mounting				
8	Direction of rotation as viewed from DE END				
9	Standard continuous rating at 40 deg.C. Ambient temp. as per Indian Standard (KW)				
10	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)				
11	Maximum continuous load demand of driven equipment in KW				
12	Rated Voltage (volts)	415	415	415	415

13	Permissible variation of :				
13.a	Voltage (Volts)				
13.b	Frequency (Hz) (+3% to -5%)- vendor to specify				
13.c	Combined voltage and frequency 10% - vendor to specify				
14	Rated speed in RPM (at rated voltage and frequency)				
15	At rated Voltage and frequency:				
15.a	Full load current				
15.b	No load current				
16	Power Factor at				
16.a	100%/75%/50% load				
16.b	NO load				
16.c	Starting.				
17	Efficiency at rated voltage and frequency,				
17.a	100% load				
17.b	75% load				
17.c	50% load				
18	Starting current (amps) at				
18.a	100 % voltage				
18.b	85% voltage				
18.c	80% voltage				
19	Minimum permissible starting Voltage (Volts) 85% of rated voltage upto 110KW , 80% above 110kw				
20	Starting time with minimum permissible voltage/80%/ 100%/ 110%				

20.a	Without driven equipment coupled				
20.b	With driven equipment coupled				
21	Safe stall time with 100% ,110% & 80% of rated voltage				
21.a	From hot condition				
21.b	From cold condition				
22	Torques :				
22.a	Starting torque at min. permissible voltage(kg-mtr.)/ rated voltage				
22.b	Pull up torque at rated voltage				
22.c	Pull out torque				
22.d	Min accelerating torque (kg.m) available at lowest permissible starting voltage should be 10% of rated torque				
22.e	Rated torque (kg.m)				
23	Stator winding resistance per phase (ohms at 20 Deg.C.)				
24	GD2 value of motors				
25	No of permissible successive starts when motor is in hot condition				
26	Locked Rotor KVA Input				
27	Locked Rotor KVA/KW				
28	Vibration limit :Velocity (mm/s)				
29	Noise level limit (dBA)				
C.	CONSTRUCTIONAL FEATURES				
1.	Stator winding insulation				
1.a	Class & Type				
1.b	Winding Insulation Process				
1.c	Tropicalised (Yes/No)				

1.d	Temperature rise over specified maximum ambient temperature of 50 deg C				
1.e	Method of temperature measurement				
1.f	Stator winding connection				
2	Main Terminal Box				
2.a	Type				
2.b	Location(viewed from NDE side)				
2.c	Entry of cables(bottom/side)				
2.d	Recommended cable size(To be matched with cable size envisaged by owner)				
2.e	Fault level (MVA),Fault level duration(sec)				
2.f	Cable glands & lugs details (shall be suitable for power cable recommended by motor vendor (vendor scope)				
3	Type of DE/NDE Bearing				
4	Motor Paint shade				
5	Weight of				
5.a	Motor stator (KG)				
5.b	Motor Rotor (KG)				
5.c	Total weight (KG)				
D.	List of accessories.				
1.	Space Heaters (Nos./Power in watts/supply voltage)				
2.	Terminal Box for Space Heater (Yes/No)				
3.	Speed switch (Yes/No) No of contacts and contact ratings of speed switch				

4.	Insulation of bearing (Yes/No)				
5.	Noise reducer(Yes/No)				
6.	Grounding pads				
6.a	No and size on motor body				
6.b	Nos on terminal Box				
7.	Any other fitments				
E.	List of curves. (All curves to be attached along with offer)				
1.	Torque speed characteristic of the motor (enclosed yes / No)				
2.	Thermal withstand characteristic ((enclosed yes / No)				
3.	Starting. current Vs. Time ((enclosed yes / No)				
4.	Starting. current Vs speed (enclosed yes / No)				
5.	P.F. and Effi. Vs Load (enclosed yes / No)				

BIDDER'S SIGN & SEAL -----

NAME -----

DESIGNATION -----

ANNEXURE -XII MOTORS, CABLES, JUNCTION BOX, INSTRUMENTS & ELECTRICAL ACTUATOR SPECIFICATION

PANKI-FGD				
ELECTRICAL PARAMETERS				
Sl.No	Type of electrical item	Technical requirement		
1	AC Motor	Energy Efficiency Type	Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be Efficiency class-IE2,conforming to IS 12615, or IEC:60034-30.	
		Type of enclosure	Outdoor Motors IP 55	
		CLASS OF INSULATION	Class-F	
		DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS	Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
			UP to 3 KW	As per manufacturer's practice
			Above 3 KW - upto 7 KW	85
			Above 7 KW - upto 13 KW	115
			Above 13 KW - upto 24 KW	167
			Above 24 KW - upto 37 KW	196
			Above 37 KW - upto 55 KW	249
			Above 55 KW - upto 90 KW	277
			Above 90 KW - upto 125 KW	331
			Above 125 KW-upto 200 KW	203
		Canopy	Shall be provided for all outdoor motors	
		Space heaters	Above 30KW	
		LT Motor sources	KEC /CGL/SIEMENS/ABB/BBL	
		HT Motor	BHEL/ABB/SIEMENS	
2	LT POWER CABLES	Type of Power cable	Stranded aluminium conductor, extruded XLPE insulation, extruded HRPVC,FR-LSH inner sheath, aluminium round wire armour for single core cables and galvanized steel strip /wire armour for three (3) core cables, and extruded HRPVC, FR-LSH overall sheath	
3	LT CONTROL CABLES	Type of Control cable	Stranded copper conductors, HRPVC Insulation, extruded HRPVC FRLS Inner sheath, round wire/strip armour, and extruded HRPVC, FRLS overall sheath.	
4	Instrumentatiuon cab	Type-F-	Copper Conductor, Individual & Over all sheilding	
		Type-G	Copper Conductor, Over all sheilding	
5	Power Junction Box	Type	FRP for Outdoor/ Stainless steel JB (For Indoor)	
		Protection	IP-66	
6	Control Junction Box	Type	FRP for Outdoor/ Stainless steel JB (For Indoor)	
		Protection	IP-66	

7	Actuator	Type	Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.
8	Instruments	Temp Transmitters,	Shall be connected to DDCMIS through field bus such as
			Profibus, Foundation Field bus etc directly from the transmitter. Wherever instruments with profibus facility is not possible/not required, vendor shall come out with proper technical reasons for getting UPRVUNL approval.
			2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal

CHAPTER 17 : AC & DC MOTORS**1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 Dust Particles

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 Special Fumes

1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.3 LOCATION OF MOTOR - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.

Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE

1.5.1 AC Motors:

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 VOLTAGE (NOMINAL)

1.6.1 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 MV MOTORS

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 FREQUENCY (NOMINAL) - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,



whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

- 1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.
- 1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.

Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

1.12 **SUPPLY VARIATIONS**

Motors shall be capable of running continuously at full load under following variations in power supply:

- 1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 **ABNORMAL CONDITIONS CAPABILITY**

Motor shall have following capabilities as specified design ambient temperature:

- 1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 **STARTING CAPABILITY**

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

- 1.14.2 Cold Motor Starting Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.3 Hot Motor Starting Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.
- 1.14.4 Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.
- 1.14.5 Break-away Starting Current Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:
- 1.14.5.1 Motors above 1500 KW upto 4000kW 600% without any positive tolerance except for ID Fan Motor.
- 1.14.5.2 Motors above 4000 KW 450%. Not subject to any positive tolerance.
- 1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.
- 1.14.5.3 **Starting voltage requirement**
- a) All Motors (except Mill Motors)
- 80% of rated voltage for Motors upto 4000 kW
 - 75% of rated voltage for Motors above 4000 kW
- b) For Mill Motors:
- 85% of rated voltage for Motors above 1000 kW
 - 90% of rated voltage for Motors below 1000 kW
- Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.
- 1.14.5.4 **Starting Time**
- 1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
- 1.14.5.4.2 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
- 1.14.5.4.3 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

1.14.5.5 Torque Requirements:-

1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% of motor full load torque.

1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 SAFE STALL TIME

1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :

1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.

1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.

1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 CLASS OF INSULATION

1.16.1 LV Motors Class F.

1.16.2 MV & HV Motors Class F

1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.

1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.

1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS**..... Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 BUS TRANSFER WITHSTAND CAPABILITY

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 TYPE OF ENCLOSURE

- 1.19.01 Outdoor Motors IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:
- a) Fuel Oil area : Group IIB
 - b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034).

1.20 METHOD OF COOLING

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 TYPE OF MOUNTING As required for the driven equipment.**1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits

prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW 203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22 WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.
AC motors
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class(B) or better
AC & 220V
DC motors

1.23 DIRECTION OF ROTATION

1.23.1 As needed by driven equipment.

1.23.2 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3 If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24 BEARINGS



- 1.24.1 General Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 GeneralMotors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight conforming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm² two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.

1.34.5 **For Main Terminals**

LT Motors

1. Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

1.44 **TYPE TEST**

1.44.01 **HT MOTORS**

- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
- b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
- c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
- d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.

e) **LIST OF TYPE TESTS TO BE CONDUCTED**



The following type tests shall be conducted on each type and rating of HT motor

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of HT motor

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02

LT Motors

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

1 x 660 MW – Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.45 INFORMATION WITH PROPOSAL

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISSIONING CHECK LIST (HT MOTORS)

A PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90° apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
 - a) Check the variation of resistance
 - b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISSIONING CHECK LIST (LT MOTORS)**A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

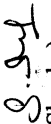
Contractor will furnish the data in respect of DC motors.

DATASHEET

Auxiliary power supply		
1.1	HV supply	
	11kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors rated above 1500 kW
	Fault level	50 kA for 1 second
1.2	MV supply	
	3.3kV, 3 Φ , 3W, 50 Hz non effectively earthed	Motors above 200kW upto and including 1500kW
	Fault level	40 kA for 1 second
1.3	LV supply	
	415V, 3 Φ , 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1 Φ , 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	
	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		

SL. NO.	ITEM	NTPC APPROVED VENDORS	PLACE	QP CATEGORY	NTPC Type Test Requirements & Quality Plan/Check Lists Requirement	Remarks
04	LT MOTORS	a) KEC c) CGL b) SIEMENS c) ABB a) BBL b) NGEF c) Marathon d) Jyoti e) LHP (For other PMD vendors except above NTPC approved vendors, pl refer Sln. 4 under important notes in page no:11)	Bangalore/ Hubli (Up to 90KW) Ahmednagar Mumbai Faridabad up to 55KW/ Bangalore above 55KW Mumbai Hubli (up to 15KW) Kolkata Vadodara Solapur	Please refer remark column for Categorization Please refer remark column for Categorization	BAP/QR/ G501 & G502 /LTM:012 Rev NO: 00 dt 17 05 2018 ** Acceptance of Motor rating between 30KW to 50 KW is based on NTPC Review of Routine Test Inspection report as per IS 325 Witnessed by BHEL/BHEL AIA ie Main contractor along with COC of the manufacturer and the contractor confirming as follows: "It is hereby confirmed that the above mentioned motor was /motors were manufactured taking care of NTPC specific requirements regarding ambient temperature, voltage and frequency variation, hot starts , pull out torque, starting KVA/KW, temperature rise, distance between centre of stud and gland plate, space heater and in accordance with approved drawing /data sheets" ##Acceptance of Motor less than 30KW is based on COC of the manufacturer and the contractor conforming as follows: "It is here by confirmed that the above mentioned motor/motor was / were manufactured taking care of NTPC specific requirements regarding ambient temperature, voltage and frequency variation, hot starts , pull out torque, starting KVA/KW, temperature rise ,distance between centre of stud and gland plate and tested in accordance with approved drawing /data sheet".	<u>Cat I</u> <u>Above 50 KW and up to 200KW</u> NTPC insp as per appd RQP/MQP <u>Cat-II</u> <u>**From 30KW to 50KW</u> BHEL Inspection <u>#Cat-III</u> <u>Up to 30KW</u>

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2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS**2.01.01 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF. PRESSURE AND DP BASED FLOW, LEVEL MEASUREMENTS**

Sl. No.	Features	Essential/Minimum Requirements
1	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible
2	Accuracy	$\pm 0.1\%$ of calibrated span (minimum) (upto turn down ratio of 10:1).
3	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4	Turn down ratio	10:1 for vacuum/very low pressure applications. 5:1 for very high pressure application. 30:1 for other applications.
5	Stability	$\pm 0.1\%$ of calibrated span for six months for Ranges up to and including 70Kg/cm ² . $\pm 0.25\%$ of calibrated span for six months for Ranges more than 70Kg/cm ² .
6	Zero and span drift	+/- 0.015% per deg.C at max span.

		+/- 0.011% per deg.C at min. span.
7	Load impedance	500 ohm (min.)
8	Housing	Weather proof as per IP-65 with durable corrosion resistant coating.
9	Over Pressure	150% of max. Operating pressure.
10	Connection (Electrical)	Plug and socket type
11	Process connection	1/2 inch NPT (F)
12	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility
13	Material	Die cast Aluminum with epoxy coating/SS316 for body. SS316 for Diaphragm.
14	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. - LCD/TFT digital integral Indicators with scale of Engg. Units. -2 valve SS316 manifold for absolute & Gauge pressure transmitters, 3-valve SS316 manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve SS316 manifold for DP/Level/Flow applicable. Transmitters should not be mounted directly on the manifold; Manifold shall be non integral type only. - Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. -For hazardous area, explosions proof enclosure as described in NEC article 500.
15	Diagnostics	Self Indicating feature
16	Power supply	24V DC $\pm$ 10%.
17	Adjustment/calibration From hand held calibrator/centralized OWS based system n/maintenance (as applicable).	From hand held calibrator/centralized OWS based system

Notes

For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.

LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2.02.00 Specification for Pressure Gauge, D.P Gauge, Temperature Gauge and Level Gauge

s. no.	Features	Essential minimum requirements		
		Pr. Gauge/DP Gauge/Draught gauges	Temperature gauge	Level Gauge
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm/ Bellow for Low pr. Of SS 316	Mercury in Steel/Bimetallic type for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body Material	Die Cast Aluminum with stoved enamel black finish /SS316	Die Cast Aluminum with stoved enamel black finish /SS316	Forged carbon steel/SS 304
3	Dial Size	150 mm with toughened shatter proof glass	150 mm with toughened shatter proof glass	Tubular covering entire range
4	End Connection	½ inch NPT (M)	¾" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	+/- 1% span	+/- 1% span	+/- 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range Selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale

8	Over range test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C		
9	Housing	Weather and dust proof as per IP-65	Weather and dust proof as per IP-65	CS/304 SS leak proof.
10	Zero/span Adjustment	Provided	Provided	-
11	Identification	Engraved with service legend or laminated phenolic name plate		
12	Accessories	Blow out Disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS316 Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS/ alloy process requirement.
13	Material of Bourdon/ movement	SS 316	SS 316	

Notes – *Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with inert liquid suitable for the application.

2.03.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

Guided wave radar type level transmitters shall be provided for level measurements of the vessel under vacuum or low pressure applications as specified in Part-A.	
Type	Guided wave Radar
Principle	TDR (Time domain reflectrometry)
Probe Type & Material	Coaxial, SS316/316L. If required, probe shall be suitable for overfill prevention.
Connection type and material	Flanged and SS316/316L.
Signal o/p	4-20mA with HART signal suitable for overfill prevention.
Display	Integral
Power supply	24 VDC



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Accuracy	5mm
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 50082-2
Housing material	Die cast Aluminum/SS316.
Vent & Drain Plug material	SS 316
Local Display	LCD digital type, configured in engg. Units.
Accessories	Integral cable between sensor and transmitter unit with connectors on both side, gasket and cable gland, digital panel meter, name plate and metal tag. All material of accessories will be SS 316.
Mounting	External cage mounting
The transmitters shall be provided with IP-65 protection class with durable corrosion resistant coating. The transmitters shall be able to provide digital signals super imposed on 4-20 mA signal as per HART protocol.	

2.04.00 Ultrasonic Type level Transmitter

Sl.No.	Features	Essential / Minimum requirement
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Also refer note-3.
2.	Output signal	4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol)
3.	Sensor Accuracy	+/- 0.5% of calibrated span.
4.	Sensor Repeatability	3mm or better
5.	Power supply	24 V DC +/-10%
6.	Temperature compensation	To be provided within transducer
7.	Configuration	
8.	Housing	Weather proof as per IP-65 with durable corrosion resistant coating.
9.	Adjustment/Calibration/maintenance	From hand held calibrators/ centralized OWS HART based system (as applicable)
10.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc.

11.	Sensor Material	Corrosion resistant material to suit individual application requirement.
12.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry
13.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
14.	Display	LCD display with integral keypad to be provided.
15.	Diagnostics	Loss of echo alarm etc.
16.	Load Impedance	500 ohms minimum.
17.	Electrical Connection	Plug and socket.
18.	Accessories	- All weather canopy for protection from direct sunlight and direct rain. - All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316. For hazardous area, explosion proof enclosure as described in NEC article 500.
Note:- 1) Bidder can also provide Radar type transmitter in place of ultrasonic transmitters subject to approval by Owner during detailed Engineering. 2) The frequency used for Ultrasonic /sonic measurements shall be suitable for envisaged applications and this shall be supported by the standard product catalogue of the instrument manufacture. 3) Four wire type transmitters can also be provided subject to Owner's approval during detailed engineering stage. However, in such cases isolated 4-20mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 24V DC for main plant and CW system applications. Power supply can be 240V AC (UPS) / 24V DC for other application.		

	4) Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided by owner during detailed engineering. Separate Sensor unit & electronics unit with LCD display to be provided for the applications, which will be decided during detailed engineering by owner.
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2.05.00 HART Hand Held calibrator

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

HART hand held calibrator shall be provided with following minimum accessories per set:-

- i. Soft carrying case with adjustable shoulder straps & lead compartments.
- ii. HART lead set.
- iii. Rechargeable batteries.
- iv. Battery charger.
- v. Power adaptor.
- vi. Universal plug kit for power adaptor.
- vii. Load resistor.
- viii. Interfacing cables of each type as per requirements.
- ix. Protective boot.
- x. Standard banana jack.
- xi. Operation manual & software CD.

The quantity of HART hand held calibrator to be provided by Bidder is listed in Appendix- I to Vol.V, Table IV, Part A of Technical Specifications.

2.06.00 Temperature Elements and accessories**2.06.01 Thermocouples**

S.No.	Features	Essential/Minimum Requirements
1.	Type of Thermocouple	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type S/R) depending on operating temperature Range (ungrounded type).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Die cast Aluminum. Head of TE to be provided with sufficient space and arrangement to head

		mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of Thermocouple	Swaged type magnesium oxide insulation
5.	Calibration and accuracy	As per IEC-751/ANSI-C-96.1(special class) for T/C
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8.	Standard	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.
	Sheath O D	8 mm.
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

Notes

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills

itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.
3. The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

2.06.02 Resistance Temperature Detector (RTD)

S.No.	Features	Essential/ Minimum Requirements
1.	Type of RTD	Four /Three wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of RTD	Metal sheathed, ceramic packed
5.	Calibration and accuracy	As per DIN-43760/IEC 60751 Class-A for RTD
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well
8.	Standard	DIN-43760/IEC 60751 for RTD and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.

	Sheath O D	8 mm.
	Gauge	18 SWG
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

NOTES:

- 1) The specifications for RTDs of winding/ bearings of motor/ pump can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be PT100.

2.06.03 Metal Temperature Thermocouples

S.No.	Features	Essential / Minimum Requirements
1.	Measuring Medium	Metal Temperature
2.	Material of Thermocouple	Chromel Alumel Type K
3.	Type of Thermocouple	Duplex with separate hot junctions, ungrounded Insulation Mineral Insulation Magnesium Oxide.
4.	Thermocouple wire gauge	16 AWG
5.	Protective sheath	SS 321
6.	Protective sheath dia	8 mm O.D
7.	Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01, 1975
8.	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310



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		or as per OEM design
9.	Cold end sealing	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin
10.	Minimum bending radius	30 mm
11.	Length of T/C	30 Mtr. (minimum)

Notes:

- 1) The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.
- 2) For boiler metal temperature applications considering the location of installation and response time, manufacturers standard and proven specification for metal temperature measurement can also be a accepted subject to OWNER approval. The manufactures shall submit adequate supporting documents for establishing their standard and proven practice.

2.06.04 Thermo well (for all process temp. elements) - (As per ASME PTC 19.3, latest edition)

- a. Shall be one piece solid bored type of 316 SS/F11/F22/F91 of step-less tapered design for water and steam Services depending upon process parameters.
- b. For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.
- c. For Air & Flue gas 316 SS protecting tube with welded cap. (However bidder shall provide better material for Flue gas service if required based on the specified boiler design parameters).
- d. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
- e. Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 (latest edition).

"All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

2.06.04 Void

2.06.05 TEST THERMOWELLS (TW)



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Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection		
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with SS chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

2.07.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the bidder as well as Owner. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. **Single Input Head mounted Temperature Transmitter**

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

b. **Single Input DIN-rail mounted Temperature Transmitter**

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail.

Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. **Dual-input Temperature Transmitter with Indicator:**



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These shall be suitable for mounting on pipes/ support. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

The exact applications for which this type of transmitter is to be provided shall be finalized by owner during detailed engineering.

d. Common requirements for each of the above type of temperature transmitters.

Output	:	2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.
Input	:	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal)
Isolation	:	Min. 500 V AC
EMC compatibility	:	as per EN 61326
Operating ambient temperature	:	0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator)
Power supply	:	Compatible with input module of Control System
Accessories	:	Mounting arrangements including Clamps etc.
Composite Accuracy	:	(a) For head mounted and DIN-rail mounted type Refer note-2 RTD = <0.4% of 0-250 deg C span T/C-K type = <0.4% of 0-600 deg C span T/C-R type = <0.4% of 0-1000 deg C span

(b)	For dual-input type:
RTD	= <0.25% of 0-250 deg C span
T/C-K type	= <0.2% of 0-600 deg C span

e. Field bus compatible temperature transmitters

Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas.



As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Notes (Common for a to e above):-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

2.08.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be $\pm 0.1\%$ of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and SS316 valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Owner's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

2.09.00 FLUE GAS ANALYSER

The following flue Gas analyzers are envisaged:-

- i) Flue Gas analyzers for control and monitoring – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.
- ii) Flue Gas Dust Emission analyzer for each ESP (at each Path) – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.



Each analyser shall be independent and shall not share power supply, processor etc. with other analyser except compressor for purging air.
The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.

2.09.01 Common Requirements for all Analysers:-

S.No.	Features	Essential / Minimum Requirements
1	Output signals	
	Analog	4-20 mA DC galvanically isolated. If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to OWS/PC based station.
	Binary	2 NO + 2 NC for high alarm
2	Zero & span Adjustment	To be provided with range selection facility.
3	Ambient temp.	50°C
4	Indication	Digital Alphanumeric Display. Display of reading in engineering units shall be provided.
5	Enclosure Type/Material	Weather & Dust proof (IP 65) Die cast Aluminium/SS.
6	Type of Electronics	Microprocessor based with self diagnostic.
7	Digital Signal transmission	HART/RS 485 Port Modbus Protocol/Ethernet TCP/IP protocol.
8	Calibration	Auto & Manual (from Remote)
9	Power Supply	To be arranged by Bidder subject to Owner's approval.
10.	Others	I) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DDCMIS (in central control room) & OWS/PC station are to be provided by Bidder.
		ii) All the calibration gases required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.
11	Location of probe	High temp O2 –SH zone Low temp O2:- ECO outlet, AH outlet and ID inlet. Dust emission analyser – In each ESP gas stream/path
12	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards
13	Type of Technology	Dust emission analyser – Opacity In situ (Path)type/ Tribo Electric Induction method In situ type

CHAPTER 18 : ACTUATORS**1.00.00 ELECTRICAL ACTUATORS WITH INTEGRAL STARTERS****1.01.00 SCOPE**

This Specification covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

1.02.00 CODES STANDARDS

All the equipment specified herein shall comply with the requirements of the latest issue of the relevant National & International standards.

The design and materials used for the components shall also comply with the relevant National & International standards.

As a minimum requirement, the following standards shall be complied with :

Electric motor operated actuators: IS 9334

Degrees of protection provided by enclosures at low: IS 2147

voltage switch gear and control gear

Flame Proof enclosure at electrical apparatus: IS 2148

Specification for three phase induction motors: IS 325

AC contactor for voltages not exceeding 1000 V: IS 2959

Degree of protection provided by enclosures for : IS 4691

Rotating electrical machinery

Specification for rotating electrical machines: IS 4722

For other code refer Section D28.

1.03.00 SERVICE CONDITIONS

The actuator shall be integral type and suitable for operation in a hot, humid and tropical atmosphere, highly polluted at places with coal dust & fly ash and shall be suitable for an ambient temperature ranging from (-) 20 deg C to (+) 70 deg C.

Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.00.00 RATING

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%.

(b) Sizing:-

For Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For isolating service:- three successive open-close operations or 15 mins, whichever is higher. For regulating service 150 starts per hour or required cycles, whichever is higher.

2.01.00 PERFORMANCES

2.01.01 The actuator shall meet the following performance requirements:

2.01.02 Open and close the valve completely and make leak-tight valve closure, without jamming.

2.01.03 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

The entire mechanism shall withstand any shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

2.02.00 SPECIFIC REQUIREMENT**2.02.01 CONSTRUCTION**

a) The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator and transmitter, . in built thermostat for overload protection, space heater and internal wiring. Actuator shall be integral type. Integral starters shall have facility to hook-up with plant DCS for positioning of limit and torque switches.

b) The actuator enclosure shall be totally enclosed, dust tight, weather proof (NEMA-6/IP-68) suitable for outdoor use without necessity of any canopy.

c) All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

d) The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

e) A lockable local/remote selector switch shall also be provided for selecting mode of operation.

f) Gear Train :

Metal (Fibre gears are not acceptable) self-locking to prevent drift under torque switch (where ever applicable) spring pressure when motor is de-energised.

g) Manual Wheel:

Shall disengage automatically during motor operation.

2.02.02 **MOTOR**

The squirrel cage induction motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each. The motors shall otherwise generally conform with technical specification for motors mentioned elsewhere in this specification.

The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 70 degree 'C' over ambient temp. of 70 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-68.

The actuators shall be designed to be self locking upon loss of power. Motor shall be designed to close in 30 secs from full open position and shall have adequate capacity to open and close under full unbalanced design pressure.

The actuators shall be flange mounted to valve bonnets or with gearing and disengaging hand wheel for dampers.

2.02.03 **LIMIT SWITCHES**

Each motor actuator shall have Six (6) rotary drum position limit switches with two for open each with 2 NO + 2NC contacts and two for close each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. Each rotary drum limit switch shall have two (2) limit switches for intermediate open position each with 2 NO + 2 NC contacts. The limit switches shall have capacity of 5A at 240V AC or 0.5A at 220V DC.

Each motor actuator shall also have two (2) torque limit switches with four (4) normally opened and four (4) normally closed contacts each.

The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.

The motor operators/actuators shall conform to AWWA specification and shall be capable of meeting 150 percent of unseating torque at specified voltage.

The motor actuators shall have 2 nos. potentiometric type transmitters of 100 ohm rating.

Torque switches shall function to stop the motor on closing. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be non-self resetting type only (i.e.) once a particular direction torque switch operates, it will get resetted only when the equipment is operated in other direction.

All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block.

2.02.04. **POSITION INDICATOR/TRANSMITTER**

- a) Motor actuators shall be provided with clearly visible local position indicators mounted on the operator assembly itself. Suitable transducers shall be provided for remote indication of the position.
- b) To be provided for 0 to 100% travel.
- c) As required. Suitable for stabilized 4-20 mA signal, 2 wire inductive type, 24 volts DC operated.

2.02.05. **HAND WHEEL**

Hand wheel shall enable manual operation in case of power failure but it shall get automatically disengaged when once the motor starts functioning. The effort required to operate manually shall not exceed 18 Kg.

2.02.06 **SPACE HEATER**

Provision of space heater, if necessary, shall also be made with servomotor limit switch compartments. The space heaters shall be suitable for operation at 240V AC and its rating shall be indicated by the tenderer. Space heater circuit shall be complete with thermostat.

2.02.07 **TERMINAL BOX**

- a) The terminals, terminal boards, terminal boxes, winding coils and associated equipments shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by associated fuses. The terminal boxes shall be totally enclosed.
- b) 650V grade for power cables.

2.02.08 **WIRING**

All wiring connections for various limit and torque switches, space heaters, position transmitters shall be brought out on separate terminal boards mounted on the valve, having liberal space for wiring and making connections to Purchaser's external circuits. Plug in type terminals shall be used suitable for analog/digital application. There shall be atleast 5 terminal spare to terminate spare cores of cable. Size of each control terminal shall be such that two (2) nos. lugged 2.5 sq.mm cable can be terminated on

each side. Power terminals shall be suitable for termination of 6 sq.mm lugged wire or as required depending on the motor capacity.

Motor terminal box and actuator terminal box shall be provided with cable glands to suit cable type and size.

Adequate earthing terminals preferably not less than 8 SWG GI wire shall be provided for suitable earthing system. Two earthing terminals shall be provided per motor, one No. on either side of the motor. The actuator shall include a diagnostic module, which will store and enable down load historical down load operation and torque data to permit analysis of actuator and valve in service performance. Data down load shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecommunication data transfer. Diagnostic and configuration software shall be made for user PC system.

2.02.09 INTERFACES:

Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

- (a) For Binary Drive (both ON-OFF and INCHING type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

Interface with the control system shall be through hardware signal only. Inter posing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

- (b) For Modulating Drive:- the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided
- (c) Open/close command termination logic shall be suitably built inside actuator.

2.02.10 DRAWING AND DATA AND MANUALS

Data sheet for each of the actuator shall be furnished alongwith internal wiring diagram, suggested control schematic and limit switch contact development and manufacturer's catalogues.

2.02.11 NAME PLATE

Name plate shall be provided on the actuators with at least following data
(a) Tag no. (b) Torque Rating (c) Full travel time.

2.02.12 PAINTING

The actuator shall be painted with epoxy based paint (the colour shall be indicated by the supplier). Paint shade shall be RAL 7032.

2.02.13 PACKING

The actuators shall be properly packed for transport by rail/ road/sea as applicable.

2.02.14 OVERLOAD PROTECTION

The actuator motor shall be provided with integral starter along with thermistor for overload protection.

2.02.15 TESTS

The actuator and all components thereof shall be subject to routine factory tests as per relevant IS Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

Following routine test shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Operational test. Test certificates duly signed by inspecting agency shall be furnished.

The actuator shall be type tested as per IEC/National Standard, by international/national recognised test house. The test certificates issued by this house shall be furnished.

2.02.16 TEST WITNESS

Tests shall be performed in the presence of Owner/Purchaser's representative so desired by the Owner/ Purchaser. The contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.