TECHNICAL SPECIFICATION FOR SUPERVISION OF E&C OF LIMESTONE GRINDING SYSTEM

CONFIDENTIAL

CUSTOMER : M/s. BIFPCL Bangladesh
PROJECT : Maitree 2X660MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM
TENDER REF : BIFPCL: MAI: FGD: LGS: SUP E&C R00

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

Department	Prepared	Reviewed & Approved
FGD	Jyotish Kumar Patel Jyotish Kumar patel DM-FGD	Kesavan V SDGM-FGD
Revision – 00 Dated 19/02/2022		COMMENTS : -----

CONTENTS

1.0 PROJECT INFORMATION:

a.	Owner	BIFPCL (BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED), Bangladesh
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization

Bangladesh-India Friendship Power Company (Pvt.) Ltd. (BIFPCL) is a 50: 50 Joint Venture Company of Bangladesh Power Development Board, Bangladesh (BPDB) and NTPC Limited, India (NTPC), incorporated under the laws of Bangladesh. BPDB is a statutory body constituted under the Bangladesh Water and Power Development Board Order 1972, and is vested with a significant portion of the generation and distribution of electricity in Bangladesh. NTPC Limited is a Maharatna company incorporated under the Indian Companies Act, and as India's largest power company, has a diversified portfolio covering the entire value chain of the power generation business. Pursuant to the implementation agreement dated April 20, 2013, as entered into between the Government of the People's Republic of Bangladesh, and BIFPCL, and the power purchase agreement also dated April 20, 2013, as entered into between BIFPCL and BPDB, BIFPCL has entrusted BHEL the development of the Coal fired 2x660 MW Maitree Super Thermal Power Project on Turnkey Basis at Rampal, Dist.-Bagerhat, Bangladesh, on the bank of river Possur, Bangladesh, for the purposes of supply and sale of electric power to BPDB. Wet Limestone FGD System is also envisaged by customer in this project to control SO_2 Emissions from the power plant. For the purposes of setting up the Wet Limestone FGD System for 2x660 MW Coal fired Power project at Rampal, BHEL is inviting bids from suitably qualified Bidders for Limestone Grinding system, pursuant to and in accordance with these bidding documents.

A) SITE CONDITIONS

1.	**Ambient Temperature and Relative Humidity**		
a.	**Average Site Condition ASC**		
	Ambient Temperature	:	27.3 deg C
	Ambient Humidity	:	87%
	Ambient Pressure	:	1007.6 mbar
b.	**Summer Site condition SSC**		
	Ambient Temperature	:	36.9 deg C
	Ambient Humidity	:	60%
	Ambient Pressure	:	1007.9 mbar
c.	**Winter Site condition WSC**		
	Ambient Temperature	:	12.2 deg C
	Ambient Humidity	:	100 %
	Ambient Pressure	:	1017.2 mbar
d.	**Reference Site condition RSC**		
	Ambient Temperature	:	31 deg C
	Ambient Humidity	:	88%
	Ambient Pressure	:	1007 mbar

2.	**Design ambient conditions for Electrical Systems**		
a.	Maximum Design temperature (outdoor)	:	45 deg C
b.	Maximum daily average ambient shade temperature	:	38 deg C
c.	Maximum monthly average temperature (in the shade)	:	34.6 deg C
d.	Maximum annual average temperature (in the shade)	:	27.3 deg C
e.	Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms	:	40 deg C
f.	Maximum design temperature of the electrical equipment installed indoors in non-air conditioned rooms	:	45 deg C
g.	Minimum design temperature	:	0 deg C
3.	**Plant Elevation**	:	+5.0 m above sea level
4.	**Wind Load**	:	As per Bangladesh National Building code-2012, Part-6, Chapter 2.4
a.	Basic Wind speed, three-second gust at 10m above ground in exposure C, having a return period of 50 years	:	73 m/s, Exposure category-"C"
5.	**Seismic Load**	:	Seismic Zone 1 as determined by Bangladesh National Building code (BNBC-2012)

Note:

1) Reference site conditions shall apply for the Guarantee Values as well as for the Guarantee test/Performance test

2) Equipment and Material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

B) PROJECT LOCATION AND APPROACH

a.	State/Division	**Khulna**
b.	District	Bagerhat district
c.	Place	Moithara Village, Rampal Upazila
d.	Location	Latitude- 22 deg 37" 0" to 22 deg 34" 30"N Longitude- 89 deg 32'0"E to 89 deg 34'5"E

C) APPROACH TO SITE:

The nearest town Khulna is at a distance of 23 km from project site. The site is connected by road from Mangla- Khulna Highway. Nearest Domestic airport is Jessor, Bangladesh at a distance of about 107 KM and international airport is Dhaka at a distance of 263 KM, Bangladesh. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given above is for general guidance and shall not be contractually binding on the Owner. Bidders shall obtain clarifications/ information, if any, before submitting their offers, regarding scope of work, facilities available at sites, etc. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above. All relevant site data/ information as may be necessary shall have to be obtained/ collected by the Bidder.

2.0 QUALIFICATION REQUIREMENT (PROVENNESS CRITERIA)

Bidder should have successfully erected and commissioned at least one Limestone Grinding system at the time of Techno- Commercial bid Opening. Proof of such experience duly certified by End customer have to be submitted along with the bid.

3.0 SCOPE OF SUPPLY

Scope for the bidders shall include Supervision of Erection & Commissioning of Limestone Grinding System.

Supervision of Erection & Commissioning: Includes supervision of erection & Commissioning.

Sl. No	Scope	Quantity
1.	Supervision of Erection & commissioning of Limestone Grinding System at site for **30 working days** for two numbers of Lime stone Grinding system	1 sets

4.0 SUPERVISION OF ERECTION & COMMISSIONING

SL	SUPERVISION FOR ERECTION & COMMISSIONING
1.	Bidder to provide supervision support for Erection & commissioning for already Available Limestone Grinding system. Erection & commission will be done as per Manual of supplied items.
2.	Bidder shall depute personnel who have vast experience in supervision of Erection & commissioning of Limestone Grinding System.
3.	Any Problem / issues notice during erection & Commissioning, vendor has to provide resolution with help of Bidder expertise.
4.	Any short supply / missed item noticed by bidder during Erection & commissioning activities, Bidder has to identify item and provide technical detail of the item.
5.	Bidder has provide full Supervision support for expediting the Erection & commissioning activities.
6.	Bidder shall include 30 working days of supervisions support for erection & Commissioning at maitree Site for two number of Limestone stone Grinding system.
7.	Bidder's personnel, Sub vendor & Expertise for the supervision for E&C at site as well as Providing of resolution of Problem / issues notice during erection & Commissioning at site shall be borne by the Bidder and shall be inclusive in supervision portion.
8.	TA/DA, boarding and lodging, site visit charges including visa fees shall be borne by the bidder and shall be inclusive in supply portion.

5.0 ANNEXURE

		Bidders Acceptance/ Comments
ANNEXURE-I : Technical specification of Supplied Limestone Grinding system	Refer Enclosed Technical specification of Supplied Limestone Grinding system	
ANNEXURE-II : LAYOUT DRAWING OF BALL MILL BUILDING	Refer Enclosed LAYOUT DRAWING OF BALL MILL BUILDING	
ANNEXURE-III : P&ID Limestone Grinding system	Refer Enclosed P&ID Limestone Grinding system	
ANNEXURE-IV : Process Flow Diagram of Limestone Grinding system	Refer Enclosed Process Flow Diagram of Limestone Grinding system	
ANNEXURE-V : Erection, Operation & Maintenance Manual	Refer Enclosed Erection, Operation & Maintenance Manual	

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

NAME ----------

DESIGNATION ----------

TECHNICAL SPECIFICATION

FOR

LIMESTONE GRINDING SYSTEM

CONFIDENTIAL

CUSTOMER	**: M/s. BIFPCL Bangladesh**
PROJECT	**: Maitree 2X660MW**
APPLICATION	**: FLUE GAS DESULPHURIZATION SYSTEM**
TENDER REF	**: BIFPCL: MAI: FGD: LGS: R00**

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

TECHNICAL SPECIFICATION FOR LIMESTONE GRINDING SYSTEM

Department	Prepared	Checked	Approved
FGD	Kabilash K.M Senior Engineer-FGD	O. Sashi Kumar DM-FGD	R.Lakshmanan AGM-FGD
Revision – 00 Dated 07/05/2018		COMMENTS : -----	

CONTENTS

	TECHNICAL SPECIFICATION OF LIMESTONE GRINDING SYSTEM - MAITREE 2X660MW
	BIFPCL:MAI:FGD:LGS:R00

1.0 PROJECT INFORMATION:

a.	Owner	BIFPCL (BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED), Bangladesh
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization

Bangladesh-India Friendship Power Company (Pvt.) Ltd. (BIFPCL) is a 50: 50 Joint Venture Company of Bangladesh Power Development Board, Bangladesh (BPDB) and NTPC Limited, India (NTPC), incorporated under the laws of Bangladesh. BPDB is a statutory body constituted under the Bangladesh Water and Power Development Board Order 1972, and is vested with a significant portion of the generation and distribution of electricity in Bangladesh. NTPC Limited is a Maharatna company incorporated under the Indian Companies Act, and as India's largest power company, has a diversified portfolio covering the entire value chain of the power generation business. Pursuant to the implementation agreement dated April 20, 2013, as entered into between the Government of the People's Republic of Bangladesh, and BIFPCL, and the power purchase agreement also dated April 20, 2013, as entered into between BIFPCL and BPDB, BIFPCL has entrusted BHEL the development of the Coal fired 2x660 MW Maitree Super Thermal Power Project on Turnkey Basis at Rampal, Dist.-Bagerhat, Bangladesh, on the bank of river Possur, Bangladesh, for the purposes of supply and sale of electric power to BPDB. Wet Limestone FGD System is also envisaged by customer in this project to control SO_2 Emissions from the power plant. For the purposes of setting up the Wet Limestone FGD System for 2x660 MW Coal fired Power project at Rampal, BHEL is inviting bids from suitably qualified Bidders for Limestone Grinding system, pursuant to and in accordance with these bidding documents.

A) SITE CONDITIONS

1.	**Ambient Temperature and Relative Humidity**		
a.	**Average Site Condition ASC**		
	Ambient Temperature	:	27.3 deg C
	Ambient Humidity	:	87%
	Ambient Pressure	:	1007.6 mbar
b.	**Summer Site condition SSC**		
	Ambient Temperature	:	36.9 deg C
	Ambient Humidity	:	60%
	Ambient Pressure	:	1007.9 mbar
c.	**Winter Site condition WSC**		
	Ambient Temperature	:	12.2 deg C
	Ambient Humidity	:	100 %
	Ambient Pressure	:	1017.2 mbar
d.	**Reference Site condition RSC**		
	Ambient Temperature	:	31 deg C
	Ambient Humidity	:	88%
	Ambient Pressure	:	1007 mbar
2.	**Design ambient conditions for Electrical Systems**		

a.	Maximum Design temperature (outdoor)	:	45 deg C
b.	Maximum daily average ambient shade temperature	:	38 deg C
c.	Maximum monthly average temperature (in the shade)	:	34.6 deg C
d.	Maximum annual average temperature (in the shade)	:	27.3 deg C
e.	Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms	:	40 deg C
f.	Maximum design temperature of the electrical equipment installed indoors in non-air conditioned rooms	:	45 deg C
g.	Minimum design temperature	:	0 deg C
3.	**Plant Elevation**	:	+5.0 m above sea level
4.	**Wind Load**	:	As per Bangladesh National Building code-2012, Part-6, Chapter 2.4
a.	Basic Wind speed, three-second gust at 10m above ground in exposure C, having a return period of 50 years	:	73 m/s, Exposure category-"C"
5.	**Seismic Load**	:	Seismic Zone 1 as determined by Bangladesh National Building code (BNBC-2012)

Note:

1) Reference site conditions shall apply for the Guarantee Values as well as for the Guarantee test/Performance test

2) Equipment and Material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

B) PROJECT LOCATION AND APPROACH

a.	State/Division	**Khulna**
b.	District	Bagerhat district
c.	Place	Moithara Village, Rampal Upazila
d.	Location	Latitude- 22 deg 37" 0" to 22 deg 34" 30"N Longitude- 89 deg 32'0"E to 89 deg 34'5"E

C) APPROACH TO SITE:

The nearest town Khulna is at a distance of 23 km from project site. The site is connected by road from Mangla- Khulna Highway. Nearest Domestic airport is Jessor, Bangladesh at a distance of about 107 KM and international airport is Dhaka at a distance of 263 KM, Bangladesh. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given above is for general guidance and shall not be contractually binding on the Owner. Bidders shall obtain clarifications/ information, if any, before submitting their offers, regarding scope of work, facilities available at sites, etc. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above. All relevant site data/ information as may be necessary shall have to be obtained/ collected by the Bidder.

2.0 APPLICABLE CODES & REGULATIONS

The design of Limestone Grinding System shall conform to the latest edition of International codes accepted by the Buyer according to good engineering practice.

List of codes/standards recommended: (The list is not exhaustive)

S.No	Description	Material	Design & others
1	Piping	AISI, ASTM,ASME,DIN,EN,BS or Equivalent	AFNOR, ANSI, API, ASME, ASTM, AWWA, BS, DIN, EN, EJMA, Manufacturer's standard
2	Machinery	AISI, ASTM,ASME,DIN,EN,BS or Equivalent	AFNOR, AFBMA, AGMA, ANSI,API, ASTM, AWS,BS, DIN, IEC, HI, HEI, ISO, NEC, NEMA, EN, TEMA, VDI, Manufacturer's standard
3	Instrumentation	AISI, ASTM,ASME,DIN,EN,BS or Equivalent	AFNOR, ANSI, API, ASME, BS, DIN, EN, IEC, IEEE, ISA, ISO, NC, Manufacturer's standard
4	Electrical	AISI,ASTM,ASME,DIN,EN,BS or Equivalent	BS, VDE, IEC, EN, ANSI,IEEE, NEMA
5	Civil	AISI, ASTM,ASME,DIN,EN,BS or Equivalent	AFNOR, ASCE, ASNT, BS, DIN, EN, ANSI, ACI,AISC,AWS, SSPC, Manufacturer's Standard
6	Structural Steel	SA/IS2062	BS/EN 1993 (Eurocode-3) or Equivalent international codes.

The design, materials, construction, manufacture, inspection, testing and performance of Limestone Grinding System shall also comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. It is the supplier's responsibility to fully comply with the latest version of changes in regulations, codes and standards.

If there is a conflict between this specification and a referenced document or between the codes and standards the most stringent shall apply.

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, delivery at site, supervision of erection & commissioning and performance testing of Limestone Grinding System along with accessories which is to furnished in the Flue Gas Desulphurization plant of Maitree 2x660MW project in Bangladesh. The following points may be noted.

a. There are two (2) units of each 660 MW and each unit is envisaged with one (1) FGD system. Combined limestone Grinding system (1 working + 1 standby) for both the units will be provided which are located inside the Wet Ball Mill Building.

b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.

c. 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-III & VI** shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, they are denied to participate in this tender.

d. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**Annexure-IV**)".

e. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.

f. No deviation or exception shall be permitted without the written approval of the purchaser.

g. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

h. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.

i. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

4.0 PROVENNESS CRITERIA:

The Bidders are required to meet the Qualification Requirement (QR) for Wet Limestone Grinding Mills, Slurry Pumps and Agitators as per criteria stipulated below.

"Bidder to have previous experience of manufacturing, supplying, erecting and commissioning the Wet Limestone Grinding Mills, Slurry Pumps and Agitators for Wet Limestone based FGD system for at least two (2) no's 500 MW or higher sized pulverized coal fired power generating units such that respective equipment(s) should have been in successful operation for a period not less than two (2) years prior to Dec 2nd 2015".

5.0 TECHNICAL INFORMATION

GENERAL DESCRIPTION OF LIMESTONE GRINDING SYSTEM

The purpose of this system is to grind lump limestone of Size 120 mm (Max) to powder and for preparation of limestone slurry. Limestone dosing bin is provided at the bottom of Limestone day silo for surge requirement. The Belt weigh Feeder is to be installed at the bottom of the Limestone dosing bin and Limestone feed rate is weighed by the belt weigh Feeder. Belt conveyor and Metal separator with detector, is provided at the downstream of Weigh feeder to transfer the lump limestone to Crusher. The hammer mill crusher is provided at the bottom of the belt conveyor to feed the limestone of size < 1 inch (100%) to Wet ball mill system. The Wet Ball Mill system consists of Wet Ball Mill, Wet Ball Mill Lubrication system, Wet Mill receiver Tank with an agitator, Limestone suspension Pump, Mill Hydro cyclone and 2-way distributor. The Wet Ball Mill is the wet horizontal type. The Process water is supplied to Wet Ball Mill and Wet Mill receiver Tank. Slurry from the Wet Ball Mill flows by gravity to the Wet Mill Receiver Tank and then is pumped up to the Mill Hydro cyclone to be classified. The Mill Hydro cyclone underflow containing the oversized material is re-circulated to the Wet Ball Mill inlet directly, while the overflow is discharged to the Limestone Slurry storage Tank via the 2-way distributor as a product of Wet Ball Mill system.

Limestone Grinding System composed of

S.No	Service	Description	Parameters	Quantity
1.	Limestone Intermediate Silo Rod Gate A/B			2 No's
2.	Limestone Intermediate Silo Shut off Gate A/B	Type	Flap Type	2 No's
		Capacity	14 TPH	
3.	Dosing Bin A/B along with rod gates	Type	Cylindrical + Conical	2 No's
		Capacity	3.6 m^3	
		Size	1.7m Dia X 2.5m H (Bidder to confirm)	
4.	Belt Weigh Feeder A/B	Type	Feeder	2 No's
		Capacity	14 TPH	
		Accuracy	Shall not exceed 0.5% for 10 to 100% of feeder capacity	
5.	Belt Feeder A/B	Type	Belt conveyor	2 No's
		Capacity	14 TPH	
		Accuracy	Operation will be interconnect with belt weigh feeder.	
6.	Metal Detector A/B	Type	Coil type	2 No's
		Capacity	14 TPH	
7.	Metal Separator & container A/B	Type	Suspended magnet on a belt conveyor	2 No's
		Capacity	14 TPH	

8.	Crusher A/B	Type	Hammer Mill Crusher	2 No's
		Capacity	14 TPH	
		Bond index	13 Kwh/t	
		Feed rock size	120mm under	
		Output size	25 mm under (100%)	
9.	Wet Ball Mill A/B	Type	Ball mill	2 No's
		Capacity	14 TPH	
		Bond index	13 kWh/t	
		Feed rock size	25 mm under (100% at mill inlet)	
		Slurry Output	30% wt Solid concentration	
		Limestone Fineness in slurry output	325 mesh 90% pass through	
10.	H.P Trunnion Lube Oil Pump A/B	Type	As per Bidder's standard	2 No's
11.	L.P Trunnion Lube Oil Pump A/B	Type	As per Bidder's standard	2 No's
12.	Oil Reservoir & Heater A/B	Type	As per Bidder's standard	2 No's
13.	Wet Mill Receiver Tank A/B	Type	Vertical Cylindrical	2 No's
14.	Mill Hydro cyclone A/B	Type	Vertical Hydro cyclone	2 No's
15.	Distribution Box A/B	Type	As per Bidder's standard	2 No's
16.	Wet Mill Receiver Tank Agitator A/B	Type	Blade Turbine	2 No's
17.	Limestone Suspension Pump A/B	Type	Centrifugal	2 No's

The above table is a summary of the requirements of the contract. Please refer to attached technical requirement for detailed information.

18. **POWER SUPPLY**

Bidder shall design and supply the equipment suitable for mentioned power supply condition.

1) Power Source Condition

AC	Medium Voltage SWGR		Low Voltage SWGR	
	Nominal	Range	Nominal	Range
Voltage (Steady State)	11/3.3 kV	+/- 6%	240/415 V	+/- 10%
Frequency	50 Hz	-5 to +3%	50 Hz	-5 to +3 %
Phase	3 ϕ		1ϕ for 240V, 3ϕ for 415V	
DC	Medium Voltage SWGR			
	Nominal	Range		
Voltage (Steady State)	220 V	-15 to +10%		

2) Power Distribution

		Voltage		Phase	Emergency Power Source	Note
Motor	AC	11	kV	3P		≥1500 kW
		3.3	kV	3P		≥160 kW- <1500 kW
		415	V	3P		≥0.2 kW- <160 kW
		240 / 415	V	3P		0.2 kW and under
Power outlets for welding	AC	240	V	3P		
Power outlets for portable tools	AC	240	V	3P		
Safety power outlets	AC	240	V	3P		
Lighting Distribution	AC	240	V	3P		
Normal Lighting Apparatus	-	240	V			
Emergency Lighting Apparatus	-	240	V			
Control Voltage for						
MV switch gear	DC	220	V	1P		
Motor Control Center	AC	240	V	1P		
Supply to instrumentation services						
Normal	DC/AC	220/220	V	1P	AC is supplied from UPS.	
Emergency Unit	DC/AC	220/220	V	1P	AC is supplied from UPS.	

3) Enclosure for Electrical Equipment

S.No	Description	IP Category
1	Motors- Indoor	IP 54
2	Motors-Outdoor	IP 55
3	LV Switch gear	IP 54
4	Local Start Stop Push Button	IP 55
5	Field instruments	IP 65
6	Junction Box	IP 55
7	Local Control Panel	IP 54
8	Cable Connecting Box	IP 55
9	Indoor A/C or ventilated equipment	IP 41
10	Cable Box- indoor	IP 54
11	Cable box-Outdoor	IP 65

4) Design Ambient conditions for Electricals

S.No	Description	IP Category
1	Maximum Outdoor Design Temperature	45 Deg C
2	Maximum Design temperature for equipments installed in A/C Rooms	40 Deg C
3	Maximum Design temperature for equipments installed in Non A/C Rooms	45 Deg C

19. **INSTRUMENTATION**

S.No	Description	Instrumentation requirement
1	Pumps	Suction and Discharge Pressure Gauges Gland Sealing Pressure Gauges (if applicable)
2	Strainers and Filters	Differential Pressure Gauges and Differential Pressure Switches (as applicable)
3	Heat Exchangers	Temperature gauges and pressure gauges upstream and downstream, both tube side and shell side.

	4	Lubrication and Cooling systems	Pressure gauges indicating system pressure at appropriate locations to enable correct system functioning to be confirmed. Water flow switches and indicators Oil flow switches and indicators on the outlet temperature gauges
	5	Tanks and Vessels	Level transmitters Temperature gauges
	6	Bearings	Oil level indication Bearing temperature transmitter
	Each instrument whose signals are displayed at the DCS shall have local display to the extent possible.		
	All instrumentation and related accessories, material for installation shall be provided. The connections to process piping or equipment shall be provided with root valve.		
	Bidder shall provide the cable accessory and provision for power and I&C Cable connection (such as cable gland, Terminal lug, Opening hole for terminal box, etc.,)		
	For interlock and alarm signal, double redundancy shall be supplied.		
	Density meters (Coriolis type) shall be provided at Limestone suspension pump outlet for measurement and controls. Double redundancy shall be applied for Density meters		
	Radar type level transmitters shall be provided at Wet mill receiver tank for tank controls. Double redundancy shall be applied for the same.		
	Measurement serving for closed loop controls shall be provided with at least two separate sensors, detectors, transmitters.		
	The installation shall include upstream and downstream isolating valves and for control valves, a bypass valve for each control valve on all services. Bypass valve shall have a similar characteristic as the control valve and shall be accessible for maintenance. Local Pressure gauges shall be provided upstream and downstream of each control valve.		
	Bearing Temperature Transmitter for initiating alarm during when “Bearing temperature high” shall be supplied by Bidder along with local display also.		
	Bearing Cooling water Flow switch for initiating alarm during when “Cooling water flow Low” shall be supplied by Bidder for each mill. In addition, sight glass also shall also be provided to view the cooling water flow for each mill		

5.1 LIMESTONE ANALYSIS: (At Limestone Intermediate Silo Outlet)

S.No	Description	Unit	Parameters
1.	**$CaCO_3$**	Wt%	**>90**
2.	**$MgCO_3$**	Wt%	**<3**
3.	**Fe_2O_3**	Wt%	**<0.3**
4.	**Al_2O_3**	Wt%	**<0.3**
5.	**SiO_2**	Wt%	**<2**
6.	**Mn_2O_3**	Wt%	**<0.3**
7.	**P_2O_5**	Wt%	**<0.05**
8.	**Cl_2**	Wt%	**<0.02**
9.	**Na_2O**	Wt%	**<0.05**
10.	**K_2O**	Wt%	**<0.02**
11.	**Sulphur**	Wt%	**<0.03**
12.	**Moisture**	Wt%	**<0.5**
13.	**Bond index**	KWh/t	**13.0**
14.	**Lump size**	**mm**	**10 to 120**

5.2 PROCESS WATER ANALYSIS

The following water to be used for Limestone Slurry Preparation and will be terminated in Limestone Grinding building.

S.No	Constituents	Unit	Water quality
1.	Total Dissolved Solids	ppm	~650
2.	Calcium	ppm	45
3.	Magnesium as Mg	ppm	5
4.	Sodium as Na	ppm	170
5.	Potassium as K	ppm	11
6.	Iron as Fe	ppm	~0.1
7.	Fluoride as F	ppm	0.02
8.	Bicarbonate	ppm	130
9.	Chlorides as Cl	ppm	270
10.	Sulphate as SO_4	ppm	8
11.	Nitrate as NO_3	ppm	0.1
12.	Silica	ppm	0.2
13.	pH		6.4 to 7.4
14.	Turbidity	NTU	<0.05

5.4 COOLING WATER ANALYSIS

The following Demineralized Cooling water (DMCW) will be used for cooling (if applicable) and will be terminated in Limestone Grinding building

S.No	Constituents	Unit	Water quality
1.	pH		9 to 9.5
2.	Temperature	Deg C	38
3.	TDS	Ppm	Minimal
4.	Pressure	MPaG	<0.6
5.	Maximum Allowable Temperature increase	Deg C	5 to 10 Deg C
6.	Maximum Allowable Pressure Drop.	Kg/cm^2	≤ 1.0 Kg/cm^2

5.5 INSTRUMENT AIR ANALYSIS

The following Instrument Air will be used for the system operation and will be terminated in Limestone Grinding building.

		Available Value			Design Value		
		Minimum	Normal	Maximum	Minimum	Normal	Maximum
Temperature	Deg.C	-	-	-	-	36.9	-
Pressure	MPaG	-	-	-	0.55	-	0.8

5.6 OPERATION PHILOSOPHY

1) The Limestone grinding system, consisting of limestone handling equipment, wet ball mill associated with circulation pumps, mill hydro cyclone and tank 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

2) Rotating machines in limestone slurry/water service such as pumps, crushers, feeders and agitators shall be started and stopped manually by means of local push button station.

3) Limestone slurry is prepared by batch operation of limestone grinding system to keep certain limestone slurry storage tank level, i.e., when the limestone slurry storage tank level reaches control high, limestone grinding system is stopped. When the limestone slurry storage tank level is control low, limestone-grinding system is started.

4) Limestone Feed rate is to be kept constant by belt weigh feeder. The limestone which is conveyed from the Dosing Bin by using the belt weigh feeder and the process water are supplied into a limestone ball mill system. The flow rate of process water to wet limestone grinding mill is controlled by Limestone feeding amount at belt weigh feeder. The flow rate of process water to wet mill receiver tank is controlled by density signal from mill hydro cyclone feed slurry. The slurry in wet mill receiver tank is fed up to the mill hydro cyclone and separated into small particle slurry and large particle slurry. The underflow slurry (large particle size limestone) is returned to wet ball mill inlet. The overflow slurry of mill hydro cyclone (small particle size limestone) is sent to the limestone slurry storage tank. The wet mill receiver tank level is controlled by the position of the limestone slurry distribution box. If the wet mill receiver tank level is control low, the overflow slurry of mill hydro cyclone is returned to the wet mill receiver tank by recirculation position of the limestone slurry distribution box. And if wet mill receiver tank level is control high, the overflow slurry of mill hydro cyclone is send to the limestone slurry storage tank discharge position of the limestone slurry distribution box.

6.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Supply, Supervision of Erection & Commissioning & Performance testing of Limestone Grinding System.

Design: Includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions commissioning procedures, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from BIFPCL/BIFPCL's consultant.

Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting, packing & transportation to site, customer clearance/port clearance and any other statutory clearances, receipt and unloading at site.

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.

Performance testing: Testing shall be conducted to prove the rated ball mill capacity & Limestone fineness at site.

Supplier's scope shall cover two (02) numbers of complete Limestone Grinding unit including sub-systems, start-up spares and special tools (typically) as given below. The scope of supply for Limestone Grinding system for both the units shall include but not limited to the following:

Sl. No	Scope	Quantity
1.	Limestone Intermediate Silo Rod gates and Shut off Gates	2 sets
2.	Dosing Bin along with rod gates	2 sets

Sl. No	Scope	Quantity
3.	Belt Weigh Feeder complete with	2 sets
	i. Drivers (VFD with LCP)	
	ii. All connection chute with proper liner	
	iii. All connection bolts/nuts/washers for installation	
	iv. Plugging sensor and any safety device	
	v. Full closed type with opening door	
4.	Belt Feeder	2 sets
	i. All connection chute with proper liner	
	ii. All connection bolts/nuts/washers for installation	
	iii. Required instruments and any safety device	
	iv. Full closed type with opening door	
5.	Metal Detector	2 sets
6.	Metal Separator & container	2 sets
7.	Crusher-Hammer mill type	2 sets
8.	Wet Ball Mill complete with	2 sets
	i. Horizontal Ball Mill and Speed reducer	
	ii. Auxiliary motor for inching operation with speed reducer	
	iii. Lubrication system with all piping and piping supports (Piping Supports and piping design is supplier's scope of supply)	
	iv. Mill Shell, Feed Head, Discharge Head	
	v. Local Panel with emergency push button for control	
	vi. Water cooling for lubrication system and gearbox	
	vii. Dumpster or Drum (Ball and limestone rejects)	
	viii. Ball Charging Hopper	
	ix. All interconnecting extended drain pipe and chutes	
	x. Support Beam (Inlet chute, Ball charge chute (Piping), etc.)	
	xi. Provision for Vibration Monitoring system	
	xii. Initial Ball charge	
	xiii. Anchor Bolts and Nuts	
	xiv. Base frames wherever applicable (including HT Motor base frame)	
	xv. Ball charging device (Tripping Device)	1 Set
9.	H.P Trunnion Lube oil Pumps	2 sets
10.	L.P Trunnion Lube oil Pumps	2 sets
11.	Oil Reservoir & Heater	2 sets
12.	Wet Mill Receiver Tank	2 sets
13.	Mill Hydro cyclone complete sets with	2 sets
	i. Hydro cyclone 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	
14.	Distribution Box	2 sets
15.	Wet Mill Receiver Tank Agitators	2 sets
16.	Limestone Suspension Pumps	2 sets
	i. Casing	

Sl. No	Scope	Quantity
	ii. Rotor and Shaft assembly	
	iii. Coupling arrangement	
	iv. Common base frame and shock absorber	
	v. Single Mechanical seal with automatic flushing with a connection for additional manual flushing.	
	vi. Flushing and drain system	
	vii. Coupling guards	
	viii. Expansion joints at Inlet and Discharge of Limestone suspension pumps	
	ix. Companion flanges with gaskets and fasteners	
	x. Casing drain terminated at battery limit with flange	
	xi. Bearing cooling	
17.	Instruments like Pressure gauge, Flow transmitters, Flow control valves, Bearing Temperature Transmitter, Cooling water flow switch ,Temperature gauges, Density meters as applicable etc.	
18.	Electric common including but not limited to	
	i. Local control panel	
	ii. LV Motors	
	iii. Junction Box	
	iv. instrument	
	v. Push buttons	
19.	Miscellaneous (As and wherever required)	
	i. Coupling arrangement and Coupling guards	
	ii. Expansion joints at Inlet and Discharge	
	iii. Bearing cooling	
	iv. Lubrication system, Lubrication oil or grease for initial charge	
	v. Foundation bolts for supplied items	
	vi. Lifting Eye bolt or lugs	
20.	Test and Inspection at shop including but not limited to;	
	i. Mechanical Running and Performance test	
	ii. Visual and Dimensional Inspection	
21.	Painting and Rust Prevention during shipment and construction	
22.	Export packing and Inland Transportation	
23.	Supervision of Erection & commissioning at site	
24.	Performance Test and Inspection at site	
25.	Special tools & tackles as applicable	
26.	Start-up & Commissioning spares as applicable	
27.	Installation, operation and maintenance manuals	
28.	Bidder to quote for the Initial Spare parts (Mandatory Spares) with breakup price.	
29.	Bidder to quote for the Recommended Spare Parts (for 24 months operation) with break up price.	
30.	Any other items required for completeness of the equipment except the items covered in the exclusions.	

6.1	**TECHNICAL REQUIREMENTS**
6.1.1	**GENERAL**
1.	Noise level produced by Wet Ball mill shall not exceed 90 dB(A) and Noise level by any other rotating equipment individually or collectively shall not exceed 85 dB(A) measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. Predicted sound pressure levels for the pump drive assemblies shall be submitted as part of the proposal data.
2.	The Bidder shall guarantee the vibration stipulated by ISO 10816.
3.	The Bidder shall guarantee the consumption of electric power, process water and cooling water.
4.	The limestone slurry preparation system shall be capable of 24 hours operation per day and 7 days operation per week. The grinding system shall also be designed and constructed to allow intermittent operation in daytime basis.
5.	Limestone of 120 mm (Max) size diameter will be delivered from Limestone intermediate silo to Limestone Grinding system. Limestone shall be crushed to 25mm under (100%) and transferred to Wet Ball Mill.
6.	Limestone shall be further pulverized in the wet ball mill and flow as slurry by gravity to a Wet Mill receiver tank and then shall be pumped to mill hydro cyclone by the limestone suspension pumps. The mill hydrocyclone underflow, which rejects oversized materials, shall be recirculated to the wet ball mill inlet while the overflow is discharged by the gravity to two (2) limestone slurry storage tank with 30% solid. The limestone rejected from the ball mill reject chute shall be collected in drum/container and easily removed to outdoors.
7.	The location of wet ball mills is inside the building.
8.	The limestone slurry preparation system shall be equipped to automatically drain and vent all non-free draining slurry piping upon shutoff of flow to the piping leg.
9.	The Bidder shall design and provide facilities to prevent large particles or inert from causing equipment damage, nozzle and pipe plugging in limestone slurry preparation system.
10.	While the grinding system is out of service, the rotating machines such as mills, pumps and the rest shall be switched off as much as possible taking the minimization of start-up/shutdown time into account.
11.	Special attention shall be paid to the grinding system design so that the grinding system in operation and/or in standby status will not have any trouble caused by the slurry characteristics such as abrasion and settling. The Bidder shall clarify the measures to protect the grinding system from such troubles.
12.	The grinding system shall be designed so that it uses only process water for grinding water, pump seals and the rest.
13.	The Vendor shall design so that the Limestone Grinding system and their auxiliary equipments including open space for maintenance can be accommodated by the building as per plan shown in Annexure-XIII-GA Drawing of Limestone Grinding Building
6.1.2	**DESIGN AND CONSTRUCTION REQUIREMENTS OF INDIVIDUAL EQUIPMENT**
A)	**CHUTES**
i.	The minimum valley angle of chutes shall be 60 degrees from horizontal. Transfer chutes shall be adequately sized and sloped to ensure smooth flow of Lime without any accumulation

	anywhere.
ii.	Chutes shall be made of minimum 20 mm thick TISCRAL / 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.
iii.	**Ball Mill Chute:** a. Feed chute shall be corrosion resistant metal lined and designed to prevent overflow. b. Inlet chute shall have necessary provisions for loading balls into the ball mills, such as ball charging hopper. c. A discharge chute shall be provided with necessary provisions to collect and separate balls and tramp metal.
B)	**LIMESTONE CRUSHER**
i.	Hammer mill type crusher shall be provided for sizing the input limestone to a size, which shall be suited for their limestone pulverizer and system. Crusher shall be supplied complete with accessories and subsystems.
ii.	The design, manufacture, inspection and testing of Limestone Crushers shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed.
iii.	Each crusher shall be sized for 14 TPH throughput of a Limestone Ball Mill, and be designed to enable the succeeding equipment of grinding system to maintain the stable and continuous operation.
iv.	**Design requirements**
a.	The crusher shall be of hammer mill type.
b.	The crusher design should be such that the crushing action is accompanied by the minimum of attrition.
c.	Uniform crushing impact shall be assured.
d.	The crusher shall be capable of delivering the normal rated output even when handling damp limestone having maximum moisture content. No clogging or building up of material on the crushing element shall develop.
e.	Temperature sensing devices shall be installed on both bearings of each of the crusher to trip the crusher incase temperature goes beyond allowable limit.
f.	Zero speed limit switch shall be provided for protection against any un-crushable material. It shall sense the speed of rotor and shall trip the rotor when actual speed falls below the design speed.
g.	It is generally said that the natural frequency of the crusher casing shall be designed to avoid harmonizing with rotating speed of the rotor.
h.	Provision for Vibration sensors, Key phase sensors shall be provided in crusher. VMS and Vibration probes if any are excluded from Bidder's scope of supply. For each bearing there shall be provisions for Two (02) No's of Vibration sensors (X and Y Axis) for vibration measurement. Provisions shall be provided in line with API 670 Vth Edition Standard These provisions shall be covered suitably. Details to be provided along with the offer.
i.	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. Vibration dampers shall be provided to meet the specified vibration level.
v.	**Construction requirement**
a.	**ROTOR**
	The rotor shall consist of Forged steel shaft, with integral discs or key fitted discs on shaft. Hammers shall be held by spring dowel bushes & shall be arranged around the circumference of the rotor. The number of hammers and number of rows shall be selected as per requirements. The rotor shall be balanced statically and dynamically.
b.	**GRINDING WALL**
	The grinding walls shall be arranged symmetrically around either side of the rotor and carried by spindles supported in bearings attached to the casing. The wall shall consist of grinding wall supports and wear resistant grinding plates/Impact plates bolted on. For product size control, distance between the grinding plates and hammer shall be adjustable.
c.	**HAMMER**
	The hammer shall be in two parts- head and arm. The hammer head shall be of wear resistant steel material. The hammer arm shall be of forged alloy steel. In the event of wear, only the hammer head shall be replaced. Arms shall be selected so that they have long life and do not require frequent replacement.
d.	**FRAME /HOUSING**
	The housing shall be split type. Housing shall be fabricated from MS steel plates of weld able quality and shall be stiffened suitably. Maximum accessibility shall be provided for routine inspection and replacement of parts. For these purposes, the doors shall be of hinge connection with effective dust sealing arrangement. Hydraulically operated top cover of crushers shall be provided for quick inspection and replacement of hammers. The entire inside surface of crusher coming in contact with limestone shall be provided with abrasion resistant liners.
e.	**DRIVE**
	The hammer crusher will be driven through Electric motor, scoop type hydraulic coupling and gearbox.
vi.	Design and construction features of hammer mill crushers offered by the bidder shall be similar to the crushers, which are already working satisfactorily for same or higher capacity.
C)	**SHUT-OFF GATES**
i.	Limestone intermediate silo outlet chute shall be provided for feeding limestone from silo to the feeder. The size of the opening chute shall be sufficient to ensure proper flow of the limestone. There shall be no reduction of section in the bunker outlet chute from bunker to feeder. The outlet chute shall be provided with suitable poke doors/holes in order to remove jamming/blockage. A motorized bunker shut-off gate shall be provided at the inlet to each feeder. In addition, rod gate shall also be provided the outlet of Limestone intermediate silo outlet and Dosing Bin outlet.
ii.	All parts of the gate in contact with limestone shall be of stainless steel construction.
iii.	The shut-off gates and its actuator shall ensure 100% closing of the gate even with 'bunker full of limestone'.
iv.	Facility shall be provided to open/close the bunker outlet gate, through actuator, from remote as well as local.

v.	In addition, a hand wheel with proper access shall also be provided for manual operation of the gate. The force at the rim of the hand wheel shall not exceed 35 kg with bunker full of coal.
D)	**BELT WEIGH FEEDERS**
i.	The Continuous belt type weighing feeders shall control the limestone flow from the intermediate silo to the Crusher & wet ball mill. Capacity of each weighing feeder shall be 14 ton/h.
ii.	Feeder shall be adjustable to any feed rate over the full range of designed feed rate. Belt scale load cell shall be designed with built-in overload protection and shall be compensated for temperature. Belt feeder weigh accuracy shall not exceed 0.5 percent for 10 to 120 percent of feeder capacity.
iii.	Each feeder shall be provided with a local emergency stop pushbutton, local test push button with lockout provision, remote operation, and a feeder discharge plug switch and alarm.
iv.	The continuous belt type-weighing feeder shall be designed as horizontal belt conveyor with variable speed drives and equipped with a manually adjustable flow-regulating gate. Belt feeder sag shall be maintained at less than 1.5 percent of the idler spacing. Belts shall be continuous and have abrasion resistant covers.
v.	Belt weighing feeder shall be subject to the requirements for the following, but not be limited to: - Belt weighing feeder shall be horizontal, heavy duty and supported by structural steel beams. - In case length of feeder is such that return idlers are not necessary as specified herein and provided the operation of the feeder is thus not adversely affected, return idler in such cases may not be required. - Feeder will have overweight, underweight, and loss of product on the belt. - The limestone mill feeder shall automatically maintain adjustable set point of limestone flow using feeder speed and belt weight as feedback signals. - Head pulley shall be of the crowned design with lagging. - Skirt plates of rubber lined carbon steel shall be provided at the inlet feed box. - Feeder inlet chute shall be carbon steel rubber lined. - Feeder shall be totally enclosed. - Two tracking switches shall be provided on each side of the belt. - Tail pulley shall be spiral wrapped. - The feeder driver enclosures shall be designed to prevent accumulation of limestone dust and moisture, and to utilize access doors and grease pipe extensions.
vi.	The feeder shall be designed to deliver the required rate of flow regardless of the type of limestone being handled.
E)	**METAL DETECTOR**
i.	Metal detectors shall be provided at specified location to detect metallic objects in the limestone stream. Metal detectors shall have high reliability with enough sensitivity to detect 25mm aluminum sphere below the burden of limestone in case of synthetic belting. However, for steel cord belting the sensitivity shall be 35mm. It shall also detect other metals, like brass, copper, stainless steel, manganese steel, bars, scraps etc. The equipment shall have provision for automatic static calibration with adjustable sensitivity.
ii.	Metal detectors shall be completely solid state using latest state of art technology. It shall be suitable for 50°C ambient and RH of 100%. The search sensor shall be protected from rain and direct sunlight by means of a nonmetallic covering other than wood. Control unit shall have adjustable controls for sensitivity, ON/OFF push buttons, resettable operation counter, audio-

	visual alarms local remote selector switch and all other necessary controls for trouble free operation of metal detector. It shall be suitable for mounting on wall, column, structure etc. with IP-65 Degree of protection. It shall be constructed from FRP of thickness not less than 2mm.
iii.	The coils shall be protected against being struck by an oversized material. The coils should have adjustment for magnetite/iron in incoming limestone. It should ignore magnetite/iron and shall distinguish between metal pieces and magnetite/iron. In order to counteract interference from external sources such as motors, lightning and radio-transmitters, and to nullify the effect of climate changes/aging, dual receiver coils are to be used. In order to allow passing of steel cord belt and metal belt fasteners without giving alarm and at the same time detecting tramps, suitable arrangements shall be provided.
iv.	In case a few nonmagnetic idlers or non-magnetic deck plates are required, the Contractor shall provide these. However, these shall be metallic. Wood is not to be used. LED display of COAST COUNT to indicate the number of pieces of tramp iron detected since last reset shall be provided so that the operator is alerted for the pieces of tramps, if any, between tramp marker and coil before restoring conveyor. TOTAL COUNT, which is not resettable, shall also be provided on the same LED display on demand. The location of tramp metal pieces shall be indicated by sand bag marker.
v.	Fiberglass enclosure (with IP 65 degree of protection) shall be provided for all type of coils. Local control panel shall be provided with IP:54 degree of protection.
F)	**MAGNETIC SEPARATOR - SUSPENDED MAGNET (SM)**
i.	Suspended Magnetic Separator shall be provided for picking up tramp magnetic pieces buried under limestone from moving Conveyor.
ii.	Magnet core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminum wire with class 'H' insulation, to limit the absolute temperature of the winding to 140 deg. centigrade. The oil used for cooling the SM shall be silicon based.
iii.	The 'Force Index' i.e. the product of flux density in gauss and rate of change of flux density w.r.t. distance, at the bottom of falling material trajectory shall be 100,000 (gauss x gauss/inch) minimum in hot condition for mounting height of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. However, the strength of the magnet shall not be less than 1000 gauss in hot running condition at distance of 450mm in the conveyors carrying uncrushed limestone & 400 mm in the conveyors carrying crushed limestone. The minimum strength of the magnet shall be 1000 gauss at the specified mounting height at the center of Belt width. Bidder shall select magnet width to suit above. Characteristic curve of magnet with the value of flux density varying between 50 mm to face of conveyor belt shall be provided. The cross section of magnet shall be suitably designed to provide sufficient area for magnetizing the coil effectively covering full cross section of the discharge material. The magnetic separator shall be located such that it picks-up tramp iron from limestone trajectory after it has been discharged from head pulley.
iv.	The tramp magnetic pieces buried under limestone picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided upto ground level.
v.	The magnetic separator units shall be supported by suitable structural member from the top by taking support from the operating floor beams with turnbuckle arrangement to facilitate the necessary adjustments during operation. Further, electric Hoists operated cross travel arrangement shall be provided to move magnetic separator away to facilitate maintenance of the conveyor discharge pulley/Belt. ON/OFF control push buttons with indicating lamps shall be

<table>
<tr><td></td><td>provided at the local station. The materials of chutes and hoppers associated with magnetic separators above the drive floor shall be SS-304 in the magnetic zone. Other chutes shall be of 1 mtr. sq. dimension and shall be made of MS. Chutes shall have poking doors at all floors to clear jammed material.</td></tr>
<tr><td>vi.</td><td>Suitable arrangements shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use. Protection against high oil temperature in magnet shall be provided.</td></tr>
<tr><td>G)</td><td>WET BALL MILL</td></tr>
<tr><td>i.</td><td>There shall be 2X100% ball mills for grinding of limestone. Each mill shall be sized as per the following conditions, all occurring together.
<table>
<tr><td>(1)</td><td>Capacity</td><td>14.0 TPH</td></tr>
<tr><td>(3)</td><td>Input Limestone Size</td><td>1” (max.)- <25 mm</td></tr>
<tr><td>(4)</td><td>Output Fineness</td><td>325 mesh & 90% pass through</td></tr>
<tr><td>(5)</td><td>Mill Wear Part Conditions</td><td>Near Guaranteed Wear Part Life</td></tr>
<tr><td>(6)</td><td>Limestone bond index (kWh/Ton)</td><td>13</td></tr>
</table></td></tr>
<tr><td>ii.</td><td>The limestone ball mill shall produce ground limestone slurry at a rate of 14 ton/hr (dry basis) with particle sized 90% passing through 325 mesh. The wet ball mill shall be of the wet horizontal type and shall be furnished complete with drive system including speed reducer and Inching Drive, gear lubrication system, bearing lubrication system, all accessories and all required instrumentation to furnish a complete functioning ball mill.</td></tr>
<tr><td>iii.</td><td>Ball mills shall be designed to accept the following streams concurrently; dry limestone feed, process water and recycle stream of oversized limestone slurry.</td></tr>
<tr><td>iv.</td><td>Ball mill shall be fabricated of heavy structural quality welded steel plate. All shell welds shall be full penetration welds.</td></tr>
<tr><td>v.</td><td>Each mill shall have an outlet spout that is opposite of the inlet chute.</td></tr>
<tr><td>vi.</td><td>Head, trunnion and shells shall be per the Bidder's standards. The main shaft shall be forged alloy steel and shall be equipped with heavy duty, precision type which are designed to provide reliable and trouble free operation. The design shall ensure that thrust is not transmitted through the gear reducer, shaft and coupling to the motor.</td></tr>
<tr><td>vii.</td><td>The mill shell shall include two (2) inspection doors with a minimum size. The inspection doors shall be sized to admit the largest liner segment or discharge grate. The openings shall be hinged (if possible) and shall be equipped with watertight seals and bolted enclosures.</td></tr>
<tr><td>viii.</td><td>The mills shall be designed and constructed with adequate strength and rigidity to ensure true alignment of the shell and trunnion bearings. Shell shall be bolted to the shell, using an external flange design. Head and shell shall be drilled for liners prior to shipment. The discharge shall be provided with a trommel screen.</td></tr>
<tr><td>ix.</td><td>All internal parts that may require replacement shall be designed to be easily dismantled and replaced without necessity of removing the mill or its drive from the foundations.</td></tr>
<tr><td>x.</td><td>Water-jacketed inserts shall be included for bearing cooling, if necessary. The pedestal and cap shall be of welded steel fabrication with inspection doors in the caps. Sole plates shall be adjustable.</td></tr>
<tr><td>xi.</td><td>Vibration shall be minimized.</td></tr>
</table>

xii.	Temperature sensors (with transmitter, dual type, instrument box) shall be provided on each ball mill bearing to provide indication of bearing temperature.
xiii.	A local emergency stop switch shall be provided for all motors(Bidder's Scope) in mill system
xiv.	The local control station (with emergency stop switch/ local/remote, etc.) shall be provided for each inching drive.
xv.	Ball mill shall be completely shop assembled, aligned and operated in so far as possible. Components shall be match marked after shop assembly to assure proper assembly in the field.
xvi.	Mill Liners - All wetted surface except for ball and trommel grate shall be rubber lined. - All rubber linings shall be done in strict accordance with the rubber Manufacture is inspection and applicable codes and standards. - Mill liners shall be attached by through bolts with leak proof washers.
xvii.	Ball Mill Drives - Each ball mill shall be furnished with speed reducing gear driver and inching drive. Speed reducer shall be provided with a flexible, spacer type, coupling and guard. Mill gear and pinion shall be of Spur design. Ball Mill Motor is in BHEL Scope of supply.
xviii.	Grinding Balls - The Bidder shall furnish a complete ball charge for each mill. - The Bidder shall provide in the data for frequency, procedures and equipment for ball removal, screening of undersized balls, and ball charging. - The Bidder shall provide the ball consumption rate versus limestone hardness in his offer. - Bidder shall also guarantee ball consumption per ton of limestone throughput.
xix.	Wet ball mill wear parts guarantee: All parts of the mill including mill body, HP & LP trunnion, hydro-cyclones, integral pipes, mill circuit pumps and other parts in contact with limestone slurry shall be provided with replaceable rubber wear liners. The wear liners or wear parts shall have a minimum guaranteed wear life of not less than **8000 hrs.** Without reversal of the liners. The guaranteed capacity and fineness of the mill shall not be affected within the guaranteed life of the mil wear parts
xx.	**Coupling:** The HT drive motor for Ball Mill is excluded from the Bidder's scope of supply. However, the bidder shall supply coupling for secondary transmission. 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.
H)	**LUBRICATION SYSTEM FOR WET BALL MILL**
i.	Each ball mill shall be furnished with an individual lubricating package for automatically lubricating each trunnion bearing and for the gear drive.
ii.	The trunnion bearings shall be oil lubricated and the gear drives shall be oil or grease lubricated.
iii.	Low and High pressure lubrication system(Oil lubrication system) - Each lubrication system shall be complete with pumps, valves, piping, filters, oil reservoirs, coolers, controls and all necessary accessories. Standby oil pumps and oil coolers shall be provided. Wherever required duplex oil filters shall be provided. Oil reservoir shall include heater, vent and filling equipment, initial filling of oil shall be

	provided. Oil shall be of the fire resistant type and shall not contain PCB. - Lubrication system shall be designed for smooth startup and shut down of the ball mill. The system shall be designed to permit the ball mill to come to a complete stop, without bearing damage, in the event of the failure of the oil.
iv.	The bidder shall furnish an automatic lubrication system for the gear pinion drive. The system shall include drum, drum pump, distribution piping, valves, drum heaters and controls, initial filling of grease shall be provided.
v.	Oil piping shall be shop fabricated, pickled, oiled, and sealed for shipment. All piping shall be provided with sufficient flanges to simplify installation and maintenance. All piping shall be arranged for a neat compact appearance.
vi.	Filter regulators, if required, shall be furnished.
vii.	All Lube oil piping shall be made of Gr. 304 Stainless Steel
I)	**MILL HYDRO CYCLONES (CLASSIFIER)**
i.	The hydro cyclone classification system shall be provided to classify the limestone slurry to the specified size. Overflow from the hydro cyclone shall be gravity fed by distribution piping to the limestone storage tank. The underflow shall be recycled back to the ball mill for further grinding.
ii.	The Mill hydro cyclone system shall include a hydro cyclone manifold system with cyclones, isolation valves, feed distributor, overflow and underflow collection launders, piping, and structural steel support structure.
iii.	Mill hydro cyclone may be fabricated of carbon steel, polyurethane. Replaceable (rubber, polyurethane, ceramic or other suitable material) liners of not less than 12 mm thickness shall be provided. Feed and overflow shall be flange connections. The cone angle shall not be larger than 20°. Manually adjustable rubber apex nozzle shall be provided for initial operation. Ceramic apex orifice shall be furnished and installed after determination of the ideal orifice size(s). Apex Nozzle shall be ceramic.
iv.	Mill hydro cyclone shall be arranged in a circular configuration and fed from a cylindrical feed chamber, completely lined with rubber, with flange connections to the classifiers. The feed chamber shall contain no internal partitions, baffles, and/or obstructions. The feed chamber diameter and height above of the outlet nozzle shall be a minimum of 1.5 times of the inlet feed pipe diameter. The feed chamber shall be designed to provide uniform and constant inlet pressure to each classifier. A full diameter domed cover attached by flange connections shall be provided for inspection and maintenance. Feed piping connection shall be from below the feed chamber.
v.	The classifier set shall have sufficient redundancy. A minimum 10% spare hydro cyclones shall be provided in each set of classifier.
vi.	A local pressure gauge and transmitter with diaphragm seal and capillary shall be provided for monitoring and operating of the feed chamber pressure.
vii.	Maximum feed velocity shall not exceed 3 m/sec.
viii.	The overflow discharge pipe shall be able to discharge the total feed volume at a flow velocity of less than 2.4 m/sec. Piping connection shall be flanged. All wetted surfaces shall be lined with chloro-butyl rubber.
ix.	The underflow launder discharge pipe shall be able to discharge the feed volume at not more than 2.4 m/sec.

x.	The Mill hydro cyclone shall be independently supported with no interference for vertical removal. Feed connections shall have individual isolating valve.
xi.	The overflow launder shall be located around the feed manifold. All wetted surfaces shall be lined with 12 mm minimum thickness rubber.
xii.	The underflow launder shall be located underneath the classifiers and overflow launder and around the feed distributor.
xiii.	Mill hydro cyclone shall be designed to prevent splashing of slurry from the launders. A curtain or similar device is acceptable.
xiv.	The bidder shall provide the rubber apex nozzles for commissioning in Mill hydro cyclone.
J)	**WET MILL RECEIVER TANK**
i.	The Bidder shall provide two (2 nos.) wet mill receiver tank. One (01) no of wet mill receiver tank for each mill. Each tank shall be sized as per bidder's standard.
ii.	The storage tanks shall be equipped with sufficient number of agitators, to avoid settling of limestone, as per the proven practice of the supplier.
iii.	The slurry preparation tank shall be CS construction with 4mm thick chlorobutyl rubber lining.
K)	**AGITATORS**
i.	Agitators shall be provided for the Wet Mill Receiver tanks where slurry collects and for chemical tanks etc. as specified. One (01) no. of agitator shall be provided at each tank.
ii.	All agitators shall be driven by electrical motor. Protective means, such as torque-limiting switch shall be provided to prevent agitators from being overheated, when seized by sticky slurry, especially during starting up.
iii.	For slurry tanks, agitators shaft and blade shall be constructed of Alloy 926(1.4529) or better.
iv.	During a power failure the solid suspension in the slurry may settle at the bottom of sump or tank. Agitator must be capable of mixing again the settled suspension (solids) after 12 hours breakdown.
v.	The stirring equipment shall be designed, manufactured and assembled in accordance with the latest issues of relevant codes, IEC recommendations, accident prevention regulations and legal regulations. All agitators shall be designed for continuous operation unless otherwise specified. The ability for freewheeling is preferred.
vi.	The agitators shall be equipped with bearing lantern, spindles and stirring paddles.
vii.	To prevent mechanical blocking/load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.
viii.	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
ix.	Static and dynamic (as far as applicable) balancing of all agitator's shall be carried out after assembly.
L)	**PIPING**
	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at all load operation. The slurry pipes shall be lined with min. 4mm thick chlorobutyl rubber lining. The Bidder to provide slurry pipes of size lower than 3" made up of FRP. All the rubber-lined pipes shall be of flanged connection.
	All Lube oil , Instrument Air piping shall be made up of Gr.304 Stainless Steel material

All process water & Cooling water piping shall be made up of Carbon Steel Pressure Piping

S.No	Medium	Schedule	Pipe Material
1)	Process water line	Sch 40	A53-B or equivalent
2)	Process water flushing line	Sch 80	A53-B or equivalent
3)	Instrument Air	Sch 40S	A312-TP304 or equivalent
4)	Cooling water	Sch 80	A53-B or equivalent
5)	Lube Oil-HP	Sch 80S	A312-TP304 or equivalent
6)	Lube Oil-LP	Sch 40S	A312-TP304 or equivalent
7)	Limestone Slurry Line	Sch 20	A53-B or equivalent + Rubber Lining
8)	Slurry Overflow & drain from Mill receiver Tank	Sch 40	A53-B or equivalent + Rubber Lining

Terminal Point for Piping:

1) Cooling water supply pipe: 65 NB
2) Cooling water return pipe: 65 NB
3) Process water pipe: 100NB
4) Instrument Air Pipe :50NB

All these pipes are provided near to Limestone ball mill building. Pipe sizes are tentative and any changes in detail engineering stage shall be borne by the bidder.

M) VALVES

S.No	Medium	Valve	Rating	Body	Trim	Lining	Connection
1)	Process water	BFV	CL.150	A216 WCB	13CR	EPDM	WAFER
2)	Process water	Gate	CL.150	A395	13CR		RF
3)	Cooling water	Gate & Globe	CL.150	A105	13CR	SEAT STL	SW
4)	Process water Control valve	Globe	Accessories: Positioner , Actuator: Motor Seat Leak: ANSI/FCI Class IV				
5)	Limestone Slurry	BFV	CL.150	A126B	A351C F8M	EPDM	WAFER

All the control valves shall be motor actuated. Limestone suspension pump Suction valve, and discharge valve shall be Butterfly valve - Electrical Motor operated with both high and low Limit switches, whereas Limestone suspension pump Suction drain valve, and discharge line flushing valve shall be Butterfly valve- Electrical Motor operated with only low Limit switch.

Cooling water supply line shall be provided with a gate valve (manually operated) and a globe valve (manually operated) in cooling water return line. Cooling water drain line shall be provided with a gate valve (Manual operated) and shall be directed to trench. All other valves actuation shall be decided as per bidder's practice.

Each control valve shall be provided with an upstream motor operated butterfly valve with only low limit switch and downstream manual operated butterfly valve for isolation purpose. Each control valve shall be provided with bypass control valve with the similar characteristics of main control valve. Isolation valves which is applicable for main control valve is also applicable for bypass control valves.

N) LIMESTONE SUSPENSION PUMP

1x100% centrifugal type limestone suspension pump shall be provided for each Wet Ball Mill. Each limestone suspension pump shall be sized under the following conditions all occurring

<table>
<tr><td></td><td>together.
<table>
<tr><td>(1)</td><td>Flow</td><td>As per system requirement.</td></tr>
<tr><td>(2)</td><td>Head</td><td>As per system requirement.</td></tr>
<tr><td>(3)</td><td>Margins</td><td>Flow 10% (minimum)</td></tr>
</table></td></tr>
<tr><td>1.</td><td>All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The bidder can also offer a Hi-chrome alloy lined pump, Carbon steel /C.I lined with highly alloyed stainless steel, a Silicon Carbide impeller and SiC lining for casing if the bidder has supplied a similar pump for a previous installation for similar service. The material used by the contractor shall be proven in previous installations.</td></tr>
<tr><td>2.</td><td>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.</td></tr>
<tr><td>3.</td><td>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.</td></tr>
<tr><td>4.</td><td>Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.</td></tr>
<tr><td>5.</td><td>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.</td></tr>
<tr><td>6.</td><td>All pumps shall be fitted with suction and discharge pressure gauges. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS316 or equivalent.</td></tr>
<tr><td>7.</td><td>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.</td></tr>
<tr><td>8.</td><td>Design pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.</td></tr>
<tr><td>9.</td><td>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).</td></tr>
<tr><td>10.</td><td>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.</td></tr>
<tr><td>11.</td><td>External flushing is required to remove the accumulated particles and all related information should be mentioned in data sheet.</td></tr>
<tr><td>12.</td><td>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.</td></tr>
<tr><td>13.</td><td>In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.</td></tr>
</table>

14.	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –up on overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
15.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
16.	The sealing areas shall be designed in such a way so that solids do not precipitate in them or affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
17.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
18.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
19.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.
20.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
21.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling shall be of flexible type made of cast steel. The bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the pump and the motor by bidder. The coupling between shafts shall be so designed that they become tight during pump operation.
22.	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.
23.	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, “Taper wedge” and the necessary fastener for Pump and Motor with Base plate. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem.
O)	**ACCESSORIES:**
1.	**Expansion Joints:**
i.	Expansion Joints shall be provided at suction and discharge of each pump and also for other equipments wherever applicable.
2.	**Pressure Gauges:**
i.	Pressure Gauges shall be furnished for at suction & discharge of each pump. Pressure gauges of class 1.6 or better must be used wherever applicable in the mill system. Pressure instrument for measurement of steady pressure at varying pressure shall operate in a band centered on

	60% of its maximum range. Pressure gauges shall have a dial size of 160 mm. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS316 or equivalent.
3.	**Flow Measurement & Control:**
i.	One (01) number of Flow meter to be mounted for each mill at the process water line to Wet ball mill inlet. One (01) number of Flow meter to be mounted for each mill at the process water line to Wet mill receiver tank inlet.
ii.	Process water flow to Wet ball mill inlet shall be controlled by the signal from Belt weigh feeder. Process water flow to Wet mill receiver tank inlet shall be controlled by the signal from density meter at Limestone suspension pump outlet.
iii.	Flow meter shall be Vortex flow meter type. All wetted parts shall be 316 SS or equivalent. Output signal shall be Contact (SW Form: SPDT)
iv.	Bearing Cooling water flow switch and sight glass shall be provided to monitor the flow of cooling water to bearing for each mill. The alarm shall be generated whenever the cooling water flow falls below preset value. Bearing cooling water Flow switch shall take the signal to PLC / DCS system.
4.	**System control:**
i.	Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the equipments can be controlled from the control console in the FGD Control room.
iii.	**Alarm Signal:** a) Bearing temperature high b) Bearing Cooling water flow Low c) Wet Mill Receiver tank level low d) Density level signal **Interlock signal:** a) Wet Mill Receiver 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 Cooling water Flow switch for initiating alarm during when “Cooling water flow Low” shall be supplied by Bidder for each mill. In addition, sight glass also shall also be provided to view the cooling water flow for each mill. Bearing cooling water Flow switch shall take the signal to PLC / DCS system.

	Radar type level transmitter shall be supplied by the bidder for level controls in the wet mill receiver tank. When level reaches low, both agitator and pump shall be stopped. All wetted parts of radar type transmitters shall be 316 SS or equivalent. Coriolis Type Density meter shall be supplied by the bidder for measurement of density signal.
5.	**Provision for Vibration Monitoring:**
i.	Provision for Vibration sensors, Key phase sensors shall be provided in equipment. For each bearing there shall be provisions for Two (02) No's of Vibration sensors (X and Y Axis) for vibration measurement. Provisions shall be provided in line with API 670 Vth Edition Standard These provisions shall be covered suitably. Details to be provided along with the offer.
P)	**ELECTRICALS**
1.	For detailed specification on Electricals, kindly refer to Annexure-X-Electrical Specification.

7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit system shall be used in the drawings and in any displays on the equipments. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm^{2}G. For instance, the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English.
3.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.
4.	The equipment and the system as a whole shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
5.	All connecting pipes / chutes, pipe supports, trestles, valves, motor (other drives) etc. along with necessary valves from chute to mill and from hydro-cyclone to common slurry storage tanks and wherever required within the system shall be in the scope of the supplier.
6.	The overall vibration level shall be as per ISO 10816. (If not stated otherwise specifically for any equipment).
7.	Suitable drain connections shall be provided.
8.	The complete system and individual equipment shall be suitable for continuous stable operation.
9.	Suppliers shall suitable specify their delivery schedule along with the offer and Standard code specified shall be strictly adhered.
10.	Supplier shall provide the loading of item and other factors which shall be required for effective civil construction.
11.	Tanks, pumps, agitators, hydro-cyclone etc. are to be designed by bidder based on their experience considering the required milling capacity of each Ball Mill System

S.No	Description
12.	**CHUTES:** Minimum clear cross section of chute: 600 mm x 500 mm (inside both ways). Minimum clear cross section of Discharge debris chute: 500mm X 500mm (inside both ways)
13.	Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for 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.
14.	Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load-operating hours whichever is longer.
15.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable International standards.
16.	Unless otherwise specified, flanges shall be in accordance with ANSI B16.5 Class 150.
17.	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.
18.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
19.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
20.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
21.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
22.	Provide double nuts for anchor bolts.
23.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
24.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
25.	The bidder shall have full responsibility for vibration control of the equipment train at the site and the unit's satisfactory performance, even if the foundation and drivers are provided by the

S.No	Description
	BHEL.
26.	Bidder to quote for the Initial Spare parts (Mandatory Spares) for system and individual equipment.
27.	Bidder shall provide the mating flanges with the necessary gaskets.
28.	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.
29.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
30.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
31.	Quality Plan to be submitted along with the offer.
32.	During entire period of the project, the bidders shall strictly follow and adhere to the guidelines for effective Health & Safety Management. Supply of safety gears/PPE for bidder's/bidder's sub vendor personnel deputed at site for Supervision of E&C, PG tests etc. shall be in bidder's scope. Also refer to **Annexure-IX- Health & Safety Management Manual** for complying with requirements whichever is applicable.
33.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
34.	Material of construction for all equipment/components shall subject to BHEL/BIFPCL/BIFPCL's consultant approval during detail engineering. Accordingly, bidder shall consider MOC for all equipment/components as per best engineering practice, global standards and global references.
35.	Bidder to provide sub vendor list and Bidder shall strictly adhere to BHEL/BIFPCL approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by BIFPCL/BHEL before placing order and bidder shall submit relevant documents as per **Attachment-VI-Sub-Supplier Questionnaire.**
36.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BIFPCL for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of BIFPCL/ BHEL, the same may be replaced with another BIFPCL/BHEL approved sub-vendor only, without any price implications to BHEL.
37.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the BIFPCL/ BIFPCL's consultant and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP.

S.No	Description
	- Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the customer/customer's consultant along with BHEL.
38.	Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
39.	During detail engineering, bidder to strictly adhere to BHEL/BIFPCL/BIFPCL's consultant drawing formats, document numbering, quality plan & FQP formats.
40.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).
41.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/BIFPCL/BIFPCL's consultant during detail engineering.
42.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
43.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/BIFPCL/BIFPCL's consultant should be addressed timely by the bidder.
44.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
45.	Bidder shall submit the signed and stamped copy of all the pages, which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"
8.0	**PACKING AND FORWARDING**

S.No	Description
1.	Packing shall be as per relevant clause of product packing specification – **Annexure-VII**-PE:TS: 888:100:A001 (Sea worthy packing)-**8.4-Packing of Goods in Wooden crates/cases/Boxes-8.4.2- Cases with Lining-Packing Category IV**
2.	Cardboard containers shall be enclosed in a solid wooden container.
3.	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.
4.	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.
5.	Crates and packing material used for shipping will become the property of owner (BIFPCL).
6.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship that 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.
7.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
8.	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
9.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. **BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (Pvt) LIMITED** **2X660 MW MAITREE SUPER THERMAL POWER PROJECT** **BANGLADESH**

S.No	Description
	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.
10.	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.
11.	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.
12.	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 cases in which a complete unit of equipment is packed.
13.	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).
14.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
15.	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.
16.	**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.
17.	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.
18.	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

S.No	Description
	"very severe" during final finishing/shipping.
19.	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 10 days of LOI.
20.	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).
21.	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.
9.0	**SUPERVISION OF ERECTION, TESTING AND COMMISSIONING**
1.	The erection of Limestone Grinding system will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per Ball Mill for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.
2.	There will be one visit per boiler and totally, there will be 2 visits for 2 ball mill. The bidder will be informed well in advance for the visit. Bidder shall include 15 working days per visit in the offer with minimum 2 visits.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.
PERFORMANCE TESTING AT SITE	
1.	Bidder to conduct performance test at site to prove the rated ball mill capacity and Limestone fineness
2.	Number of visits shall be Two (2). Bidder to complete the test for both the units. TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.
10.0	**EXCLUSION**
1.	The following work associated with the Limestone Grinding System will be done by others: a. Supply of main drive HT motor for ball mill b. Civil foundations c. Walkways, platforms and ladders d. Element handling hoists

S.No	Description
11.0	**INSPECTION AND TESTING**
1.	**Hydro cyclones** visual, dimensional etc.
2.	**Agitators :** Impellers shall be tested for dimensional and balancing check. Gear Boxes shall be tested for run test as per standard practice
3.	**Pumps :**
a.	Hydrostatic test for pumps is to be conducted at 150 % of design pressure for duration of 30 minutes, taking into consideration of the fact that actual operating temperature is 60 deg Celsius (maximum).
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.
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.
f.	Mechanical running and the performance test shall be conducted for One(01) Number of Limestone suspension Pump at the Bidder’s works before dispatch or where the test facilities are available.
g.	The Bidder shall conduct performance test for the remaining pump and submit the reports.
4.	**General Inspection requirements to be considered are as below:**
1.	S.No / Item / Inspection & Test item / Remarks 1) / Pumps / Material certificate check / Shaft & impeller only Dimensional inspection /

S.No	Description			
			Non destructive testing	As per specification
			Hydrostatic test	
			Balancing Test	Static & dynamic
			Performance test	Incl. Noise & Vibration
	2)	Agitator	Material certificate check	
			Dimensional inspection	
			Balancing Test	Static & dynamic
			Function test	No load test of reduction gear to be performed.
	3)	Crushers/Conveyors/feeders	Material certificate check	
			Dimensional inspection	
			Function test	Short time no load test to be performed
			Performance test	Applicable for Belt weigh feeders & Crushers only.
	4)	Tank	Material certificate check	
			Dimensional inspection	
			Water Filling test	
	5)	Wet Ball Mill	Material certificate check	
			Dimensional inspection	
	6)	Rubber lining Pipe	Dimensional inspection	
			Visual Inspection	
			Spark Test	
	7)	Butterfly Valve	Material certificate check	
			Non destructive testing	
			Hydrostatic test	
			Operation test	Motorized valve only
	8)	Control Panel	Insulation Resistance Test	As per IEC
			Dielectric Strength Test	As per IEC
			Function Test	
			Dimensional Inspection	
	9)	Control valve & valves	Material certificate check	

S.No	Description			
			Hydrostatic test	
			Seat leak test	
			Function test	
			Dimensional Inspection	
	10)	RTD	Material certificate check	
			Performance test	
			Hydrostatic test	
	11)	Pressure transmitter, Level Transmitter	Material certificate check	
			Calibration Test	
			Pressure & Air Leak Test	
	12)	Flow meter	Material certificate check	
			Calibration Test	
			Dimensional Inspection	
			Hydrostatic test	
2.	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.			
3.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BHEL / BIFPCL prior to manufacture. Inspection of above mentioned tests by BHEL/ BIFPCL representative at bidder's works is envisaged			
4.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/BIFPCL.			
5.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/BIFPCL within one (1) week of the successful completion of balancing.			
6.	Vibration levels shall be measured during shop running/performance tests.			
7.	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.			
8.	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.			
9.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding			

S.No	Description
	to specific weight and traction resistance.
10.	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.
11.	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.
12.	Equipment shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
13.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
14.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
15.	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.
16.	Mechanical running test shall be carried out for Wet ball mill. Bidder to arrange Motor of same or higher rating for the shop test and inspection.
17.	Bidder to also refer **Annexure-VIII** –Clause no. B.0.7 w.r.t "Inspection & Testing" for "Testing during Manufacturing" (clause B.0.7.2), and "Testing at Site" (clause B.0.7.3) (which includes Erection Tests, Commissioning Tests, PG Testing, Reliability Run Test etc.)
12.0	**PAINTING**
1.	For painting requirement, bidder to refer Annexure-XI-Painting Specification
2.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope.
3.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BIFPCL/ BIFPCL's Consultant.
13.0	**SPARES,TOOLS & TACKLES**
13.1	**START UP & COMMISSIONING SPARES**
	Start-up & Commissioning Spares shall be part of the main supply of the Limestone Grinding System. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares used till the Commercial Operation Date (COD)/ Issuance of Provisional Acceptance Certificate (PAC) shall come under

S.No	Description
	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 equipments are energized. These start-up & commissioning spare part list shall not be included in "Initial Spare Parts List". Temporary strainers shall be supplied for Limestone suspension pumps as commissioning spare mandatorily.
13.2	**FINAL SPARE PARTS LIST (RECOMMENDED SPARES)**
	Bidders shall also furnish the **Final Spares Part List** (i.e. recommended spares list) along with the offer. Bidder shall provide a "Final Spare Parts List" which shall comprise of all items of the Initial Spare Parts List as well as other spares required for long term routine/planned and breakdown maintenance. Bidder shall indicate all details for each item of aforesaid Final Spare Parts List, such as Bidder's/ Original equipment manufacturers (OEM's) name and location, drawings, normal delivery period, quantity, life time/ service life, Bidder's/OEM's serial numbers and price labeling according to the plant numbering code etc. The format and content of the final spare parts list shall be agreed in the basic/detailed engineering phase and shall be subject to BIFPCL's approval. Then the final spare parts list shall be submitted by the bidder to the BHEL for approval not later than eighteen (18) months prior to the Scheduled Commercial Operation Date (COD)/ Issuance of Provisional Acceptance Certificate (PAC) of 1st Unit. The bidder shall name OEM/ three (3) vendors with complete address for each of the spare parts. Bidder shall quote for the "Final Spares Part List", however it shall not be considered for L1 evaluation, but these spares items shall remain available for order anytime during the first three (3) years commencing from COD of each unit, at the initial unit prices quoted in the offer as adjusted pursuant to the indexation mechanism approved by BIFPCL/BIFPCL's consultant. However, the BHEL/BIFPCL shall have the freedom to decide at its sole discretion to purchase spare parts either from OEM (according to quoted unit price as stated above) or directly from sub-vendors or from any other source.
13.3	**INITIAL SPARE PARTS (MANDATORY SPARES):**
	Bidder to quote for below mentioned mandatory spares with break up price.

S.No	Equipment	Quantity
1.0	**Mill Hydro-cyclone**	
	1. Hydro-cyclone Isolation Valve	10% of each type
	2. Flexible Hose	2 sets
2.0	**Weigh Feeders**	
	1. Belt	1 no.
	2. Weighing Instrument Sensor	1 no.
3.0	**Wet Ball Mills**	
	1. Liners inside WBM	1 set
	2. HP Pump (Lube Oil)	1 no.
	3. LP Pump (Lube Oil)	1 no.
	4. Oil Filters	2 no's.
	5. Pump & Motor Coupling	1 no. of each type
4.0	**Belt Feeder**	
	1. Idlers	10% of each type

S.No	Description		
		2. Coupling	1 no. each
		3. Belt	1 no. each
	5.0	**Pumps**	
		1. Impeller assembly	1 no. of each type
		2. Casing liners-If applicable	1 no. of each type
		3. Seals	1 no. of each type
		4. Coupling	1 no. of each type
		5. Oil Cups-If applicable	1 no. of each type
		6. Shafts & Sleeve	1 no. of each type
	6.0	**Agitators**	
		1. Impeller assembly	1 no. of each type
		2. Bearing Assembly	1 no. of each type
		3. Coupling /Belt and Pulley (as applicable)	1 no. of each type
		4. Gearbox Assembly (if applicable)	1 no. of each type
	7.0	**415V Motors**	
		1. Bearing(DE) of each type	1 no. of each type
		2. Bearing(NDE) of each type	1 no. of each type
		3. Cooling fan of motors of each type	1 no. of each type
		4. Terminal Block	1 no. of each type
	8.0	**Field Instruments**	
		1. Flow transmitter	1 no. of each type
		2. Radar Level Transmitter	1 no. of each type
		3. Pressure Gauge	1 no. of each type
		4. RTD	1 no. of each type
	Bidder shall quote for the “Initial Spares Part List”, and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written “S” mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years’ storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan.		
13.4	**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.		

S.No	Description
14.0	**PERFORMANCE GUARANTEE**
	All performance tests for Limestone Grinding system and its equipments shall be carried out in presence of the purchaser and 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 Limestone Grinding system, equipments and its accessories 2) Capacity of Wet Ball Mill 14.0 TPH and Solid Content of Grinding System Product 30 (thirty) percent w/w (constant) to be guaranteed. 3) Limestone fineness at product output-325 mesh 90% pass through shall be guaranteed. 4) Bidder to demonstrate the life of wet ball Mill wear parts for a minimum wear life of not less than 8000 hrs. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation. 5) Bidder to guarantee ball consumption per ton of limestone throughput. Bidder shall furnish the minimum ball diameter below which the balls shall be replaced. 6) The Bidder shall ensure a design of the equipment to achieve an average target availability of 90%. 7) Scheduled Maintenance (Minor Overhauls): Recommended intervals between maintenance outages shall be >25000 hours operation. 8) Scheduled Maintenance (Major Overhauls): Recommended intervals between maintenance outages shall be >75000 hours operation. 9) Noise level-≤90 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 10) 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. 11) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BIFPCL’s approval. 12) 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.
15.0	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:**
1.	**POWER GUARANTEE** Bidder to specify the guaranteed power consumption of complete limestone grinding system as well as individual equipment in their offer. The following equipments shall be considered for Guaranteed Power consumption calculation (GPC). a. Limestone Crusher – 1 No. b. Belt feeder- 1 No.

S.No	Description
	c. Belt Weigh feeder -1 No d. Wet Ball Mill-1 No e. Limestone suspension Pump – 1 No. f. Wet Mill Receiver Tank Agitator – 1 No.
2.	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:** The best of the parameter for auxiliary power consumption quoted by any qualified bidder shall be taken as the base or ceiling value. Adjustment factor for excess power consumption in USD = (GPC-CV) X PL GPC- Guaranteed Power Consumption quoted by bidder in KW CV- Ceiling Value for Guaranteed Power Consumption in KW PL- Power Loading @ 4060 USD/KW Exchange rate as applicable on price bid opening date will be considered.
16.0	**LIQUIDATED DAMAGES FOR POWER CONSUMPTION**
	If actual Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in USD = (GPC-APC) X P X 2 sets of Equipments Where • GPC- Guaranteed Power Consumption quoted by bidder in KW • APC- Actual Power Consumption in KW • P- Penalty @ 4060 USD per KW
17.0	**WARRANTY**
1.	The warranty period shall begin on the date of taking over by BIFPCL or date of issuance of the provisional acceptance certificate for the unit (whichever occurs first) and shall end after twenty-four (24) months. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.
2.	In case of failure of the equipment to meet the guarantee, BIFPCL/BHEL reserves the right to reject the equipment. However, BIFPCL/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
18.0	**FIRST FILL OF CONSUMABLES:**

S.No	Description
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 COD including top up requirements at the time of issuance of PAC/declaration of COD. 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 BIFPCL/BHEL's approval herein shall be furnished eighteen (18) months prior scheduled COD of the 1st unit. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BIFPCL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
19.0	**TRAINING**
19.1	Successful bidder shall provide comprehensive training for BIFPCL/BIPCL's Consultant Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Limestone Grinding System- Operation & Maintenance, Troubleshooting etc.
20.0	**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 BIFPCL 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.
21.0	**DOCUMENTATION**
A	**DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER**
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. As a minimum requirement, the following information shall be furnished to fully describe the scope of work and services offered. Duly filled-in Technical Data sheets (Annexure I) and guarantee schedule furnished under Annexure-II. 1. PID diagram 2. Performance curve 3. Terminal point details. 4. General Arrangement drawings indicating dimensional data with civil loads and pocket details.

S.No	Description
	5. Rotor GD^2 (kg-m2) for Ball Mill Drive 6. Torque Vs Speed curve for Ball Mill Drive 7. Calculation of Motor rating, Bearing capacity and selection of coupling 8. Bill of material along with material and code 9. Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment. 10. Erection, Operation & Maintenance manual with lubrication schedule 11. Procedure for shop / site performance tests 12. Time schedule for delivery. 13. Quality Assurance Plan. 14. Make of all bought out items. 15. Deviation & clarification list 16. Utility Consumption list. 17. Steel Ball Consumption. 18. Spares List 19. Hoist / Crane requirement. 20. Reference list of similar projects executed. 21. Sub Supplier questionnaire format (Annexure-VI) 22. List of proposed makes and vendors 23. Training program and schedule for BHEL/BIFPCL's personnel 24. Equipment maintenance schedules 25. Technical Description for Ball Mill system 26. Piping & Valve list. 27. Instrument List 28. General Arrangement for Limestone ball mill building with all equipments. The above 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 with requirements specified here under. However as minimum the following shall be submitted. 1. Drawing Schedule 2. Plot Plan & Layout 3. Process Flow Diagram

S.No	Description
	4. Equipment List 5. Utility Consumption 6. Chemical List 7. Duly filled technical datasheet. 8. P &I Diagram 9. Operation & Maintenance Manual 10. Performance Test Procedure & Report 11. Outline Drawing of Equipment 12. Fabrication Drawing of Equipment 13. Warranted Performance curve of Machinery 14. Platform Drawing 15. Line Index 16. Piping Material Specification 17. Piping Arrangement Drawing 18. Piping Support Arrangement Drawing 19. Isometric Drawing 20. Data sheet of Piping Parts 21. Valve Drawing 22. Instrument Schedule List 23. Instrument Function Loop Diagram 24. Interlock and Operation Description 25. Interlock/ Sequence Logic Diagram 26. Instrument Power Supply Diagram 27. Instrument Set Point List 28. Instrument Data Sheet 29. Control Valve Data Sheet, including On-Off Valve 30. Nozzle Elevation Plan for Level Instrument 31. Specification and Drawing of Instrument 32. Instruction Manual for Instrument 33. Local Control Panel Specification 34. Local Control Panel Drawing 35. Cable Duct/Tray Routing Plan 36. Fabrication Drawing for Cabinet Duct/Tray 37. Plot Plan of Field Instrument 38. Layout of Instrument Wiring 39. Layout of Instrument Air Supply Piping and Signal tubing 40. Hook-up Drawing for Instrument 41. Instrument Connection List 42. Instrument Cable Schedule 43. Parts Drawing for Instrument Installation Materials 44. Calculation Sheet for Control Valve 45. Calculation Sheet for Flow Instrument 46. Motor List 47. Motor Data Sheet 48. Outline drawing of Motor 49. Loading Data 50. Planning Drawing of Building

S.No	Description
	51. Planning Drawing of Foundation 52. Consumable Parts List 53. Lubricant List 54. Special Tool List 55. Spare Parts List for Erection 56. Spare Parts List for Commissioning 57. Spare Parts List for 2 years of Warranty Period Operation 58. Construction Work Specification 59. Construction Manual List 60. Painting Specification 61. Transportation and Storage Specification 62. Shop Inspection Specification 63. Shop Inspection Report 64. Site Inspection Specification 65. Site Inspection Report 66. Supply Item List for Package Verification at Site 67. Packing List 68. Sub-Vendor List 69. Manufacturing Schedule 70. Progress Report Drawings that are reviewed by the BIFPCL / BIFPCL's Consultant 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. BIFPCL / BIPCL's Consultant 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 BIFPCL 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. In addition, One (1) copy of operation and maintenance manuals shall be translated into "Bangla" and provided as paper copies and in electronic format. 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 BIFPCL's 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.

22.0 ANNEXURES

ANNEXURE-I-TECHNICAL DATA SHEET

Sl. No	Description			Data
1.0	**GENERAL**			
	a. Client		:	BHEL-Ranipet
	b. Project		:	MAITREE (2x 660MW)
	c. Ultimate Customer		:	BIFPCL
	d. Location		:	Khulna, Bangladesh
	e. Service		:	Continuous
	f. Installation		:	Inside the Building
	g. Qty –common for both units		:	2 sets (1W+1S)
2.0	**MANUFACTURER DETAILS**			
	a. Model		:	Bidder to provide
	b. Type		:	Horizontal
3.0	**OPERATING CONDITION**			
	Medium to be handled		:	Limestone
3.1	**PERFORMANCE DATA- WET BALL MILL**			
	a. Capacity	TPH	:	Bidder to Provide
	b. WBM Dimensions WmXLm	M	:	Bidder to Provide
	c. efficiency	%	:	Bidder to Provide
	d. BKW Normal / Maximum	KW	:	Bidder to Provide
	e. Motor rating	KW	:	Bidder to Provide
	f. Motor Speed	Rpm	:	Bidder to Provide
	g. Speed Maximum/ Normal/Minimum	rpm	:	Bidder to Provide
	h. Noise level	dB(A)	:	Bidder to Provide
	i. Performance curve		:	Bidder to Provide
3.2	**CONSTRUCTION DATA –WET BALL MILL**			
	a. Manufacturer		:	
	b. Model No.		:	Bidder to Provide
	c. Journal bearing: Type / Size:		:	Bidder to Provide
	d. Thrust bearing: Type / Size:		:	Bidder to Provide
	e. Bearing cooling required		:	Yes / No - Bidder to confirm
	f. Cooling water required		:	Bidder to confirm the quantity
	g. Type of drive		:	Bidder to Provide
	h. Shaft seal		:	Bidder to Provide
	i. Size / Code		:	Bidder to Provide
	j. Type of coupling		:	Bidder to Provide
	k. Service factor		:	Bidder to Provide
	l. GD^2 at drive shaft end		:	Bidder to Provide
	m. Rotation viewed from coupling end		:	Clock wise / Counter clock wise
	n. Coupling type		:	Yes / No - Bidder to confirm
	o. Coupling make		:	Bidder to Provide
	p. Base plate common to WBM, bearing housing, coupling & Motor		:	Yes / No - Bidder to confirm
	q. Total weight	kg	:	Bidder to Provide
	r. Maximum Erection weight	kg	:	Bidder to Provide

3.3	**MATERIALS –WET BALL MILL**		
a.	Shell	:	Bidder to Provide
b.	Liner	:	Bidder to Provide
c.	Discharge drum	:	Bidder to Provide
d.	Feed Head	:	Bidder to Provide
e.	Discharge head	:	Bidder to Provide
f.	Gear guard cover	:	Bidder to Provide
g.	Air clutch	:	Bidder to Provide
h.	Pinion drive	:	Bidder to Provide
i.	Shaft Seal	:	Bidder to Provide
j.	Base frame	:	Bidder to Provide
4.0	**Technical Data**		
4.1	**Bunker/Silo shut off gates**		
a.	Manufacturer	:	Bidder to Provide
b.	Type	:	Bidder to Provide
c.	Material of the gates	:	Bidder to Provide
d.	Motor rating (KW)	:	Bidder to Provide
4.2	**Down spout**	:	
a.	Manufacturer	:	Bidder to Provide
b.	inside diameter (mm)	:	Bidder to Provide
c.	Thickness (mm)	:	Bidder to Provide
d.	Height (mm)	:	Bidder to Provide
e.	Material	:	Bidder to Provide
f.	Off set between feeder outlet and centre line of Limestone bunker, if any	:	Bidder to Provide
4.3	**Belt Conveyor**		
a.	Design Capacity	:	14.0 TPH
b.	Maximum Slope	:	Bidder to Provide
c.	Maximum Belt sag between idlers	:	Bidder to Provide
4.3.1	**Belting**		
a.	Type	:	Synthetic Fabric of Nylon/Nylon
b.	Cover Grade	:	i. Flame Test : Conforming to ISO:340
c.		:	ii. Drum Friction and Electrical Surface Resistance Test: Conforming to Canadian standard association CAN/CSA M-422-M*& Grade-C.
d.	Cover Thickness (without –ve tolerances)	:	Synthetic belting | Steel Cord
e.	No. of plies	:	Minimum 3
f.	Drive Arrangement	:	Bidder to Provide
g.	Factor of Safety	:	10 (Minimum) for N-N belt.
		:	7 (minimum) for Steel Cord Belt.
4.3.2	**Bearing**		
a.	Carrying	:	Ball Bearings of deep groove type or seize resistance type of min. 30 mm size, lubricated for life.

b.	Return	:	Ball Bearings of deep groove type or seize resistance type of min. 20 mm size, lubricated for life.
4.3.3	**Material**		
a.	Roller	:	ERW Steel tube min. wall thickness 4.0 mm
b.	Spindle	:	EN-8 or equivalent
4.3.4	**Pulleys**		
i)	General (for all types of Pulleys)	:	
a.	Pulley Shaft Diameter	:	Margin of minimum 20% shall be considered on maximum tension at design capacity for arriving at shaft dia.
ii)	**Drive Pulleys**		
a.	Lagging	:	Hot lagged with vulcanized natural rubber
b.	Lagging thickness	:	12 mm thick grooved in diamond pattern with grooves 6 mm wide X 6 mm deep.
c.	Minimum angle of wrap	:	210 degrees
d.	Maximum out of roundness	:	0.5% of nominal diameter
iii)	**Other Pulleys**		
a.	Lagging	:	Hot lagged with vulcanized natural rubber
b.	Lagging thickness	:	12 mm thick plan
iv)	**Rubber for lagging**		
a.	Type	:	Natural rubber blended with styrene Butadiene rubber.
b.	Hardness	:	55 to 65 durometer (Shore A)
c.	Elongation	:	Over 300%
d.	Strength	:	160-245 kg/cm2
e.	Abrasion Loss	:	250 mm3 (max.) as per DIN 53516
f.	Specific Gravity	:	Max. 1.5
g.	Adhesion Strength	:	10 kg/cm (minimum)
v)	**Bearings for Pulleys**		
a.	Type	:	Heavy duty roller type
b.	Casing	:	Horizontal split type
c.	Sealing	:	Dust tight with double labyrinth seals
d.	Lubrication	:	Greasing arrangement with conical head shape nipples
e.	Pulley Material	:	Mild steel conforming IS:226/IS:2062
f.	Shaft Material	:	Forged Steel shaft EN-8 or equivalent material.
4.4	**Chutes and Hoppers**		
a.	Minimum Valley Angle	:	60 degrees
b.	Material :	:	
	i) Chute work	:	
	ii) Sliding zones & adjacent sides	:	20 mm thick. TISCRAL / equivalent

	iii) No striking/ Non sliding zones	:	10 mm thick MS
	iv) Chute with valley angle 80 degree and above	:	All four sides of 20 mm thick. TISCRAL/equivalent material
	v) In the zone of magnetic field	:	SS-304 10 mm thick.
	vi) In the zone of flap gates	:	20 thick TISCRAL/ equivalent material
	vii) Discharge Hoods overhead pulleys	:	4 mm thick M.S. with rubber curtain
c.	Inspection Doors	:	Hinged & leak proof construction (min. size 350 x 450 mm)
d.	Chute Construction	:	
	i) Corners	:	One face of removable bolted flange connection
	ii) Joints Bolted	:	Flange joints of dust tight construction
	iii) Bolt size	:	Min. M-16
	iv) Bolts spacing	:	Not more than 125 mm C/C
	v) Fixing Arrangement	:	Bolts with plain spring washers
4.4.1	**Skirt Boards**		
a.	Length	:	Entire feeding chute shall be extended minimum 3 m ahead of front edge of chute & 500 mm beyond rear edge of chute.
b.	Height	:	Not less than 750 mm
c.	Width Side plate Top cover	:	2/3 of belt width Min. 10 thick TISCRAL/equivalent 6 mm thick M.S.
4.5	**Silo Shut off Gate**		
a.	Type	:	Linear actuator operated, 2 position
b.	Travel	:	60 to 70 deg. (with limit switches on both sides).
c.	Automatic operation	:	
	i) Drive	:	Dust tight motor driven with suitable linkages
	ii) Minimum Actuator Rating	:	2500 kg with 1 m lever arm
	iii) No. of Operation / Hr.	:	15 (with 10 consecutive switchings)
	iv) Protection	:	Travel and Thrust dependent limit Switches
d.	Manual Operation	:	
	i) Maximum effort	:	Convenient for single operator by declutchable hand wheel regardless of electrical power.
	ii) Minimum Hand wheel Diameter	:	500 mm
e.	Flap gate shaft	:	
	i) Diameter minimum	:	150 mm
	ii) Material	:	EN-8
4.6	**Limestone Crusher**		
a.	Type	:	Hammer Mill type crusher
b.	Material to handle	:	Limestone
c.	Feed Size	:	(-) 120 mm, occasionally 1-2% of 400 mm size

d.	Product Size	:	<25 mm (100%)
e.	Input Limestone parameters	:	As specified elsewhere
4.6.1	**Design and construction**		
a.	Drive arrangement	:	Electric motor, scoop type hydraulic coupling, gearbox.
b.	Rotor Balancing	:	Static
c.	Type of sealing	:	Labyrinth, dust tight arrangement
d.	Type of bearing	:	Spherical roller
e.	Lubrication	:	Manual through Grease gun OR With recommended grade of oil in which case the plummer block shall be designed with oil filling, oil draining and visual oil checking facilities.
f.	Tramp collection	:	Required
g.	Output size adjustment facility	:	Required
h.	Top cover of crushers	:	Hydraulically operated
4.6.2	**Material of Construction**		
a.	Rotor shaft	:	Forged Steel
b.	Hammer heads	:	Wear resistant cast alloy steel
c.	Hammer arm	:	Forged alloy steel
d.	Housing/frame	:	Steel as per IS:2062
e.	Breaking blocks	:	Cast steel/MS fabricated
f.	Liners	:	
	i) Material	:	Suitable for duty requirement
	ii) Thickness	:	As required
4.7	**Belt Weigh Feeders**	:	
a.	Manufacturer	:	Bidder to Provide
b.	Model Number	:	Bidder to Provide
c.	Method of measurement	:	Bidder to Provide
d.	Range of measurement (kg/hr).	:	Bidder to Provide
4.7.1	**Design and Construction**		
a.	Type	:	Electronic load cell type
b.	Operation	:	Microprocessor based fully automatic
c.	No. of floating idlers	:	Minimum four (4)
d.	Load Cells	:	
	i. Type	:	Strain gauge type hermetically sealed
	ii. Minimum Nos.	:	Four (4)
	iii. Overload protection	:	100 % of rated belt scale capacity
	iv. Structural capacity	:	250 % of rated belt scale capacity
e.	Flow Rate Indicator	:	Electronic Digital Display Minimum 4 digits
f.	Flow totalizer	:	8 digit display with reset facility.
g.	Accuracy	:	For entire range of 20% to 120% of rated capacity
		:	Minimum + 0.25%
4.7.2	**Calibration**		

a.	Automatic	:	Zero & span calibration
b.	Manual	:	With test load chain
	a. Test load chain length	:	Two idler spaces more than weighing lengths
	b. Chain reel equipment	:	Complete with weight adding facility.
4.8	**Metal Separator**		
a.	Suspended Magnet	:	
b.	Location of Suspended Magnet	:	Over Conveyor (as per tender drawing)
c.	Strength of magnet at the specified mounting height	:	1000 gauss.
d.	Control		
	i. Suspended Magnet	:	Local and remote
e.	Handling Arrangement for Suspended magnet		
	i. Height adjustment	:	With turn buckle arrangement
	ii. Cross-travel	:	Electric Hoist operated cross travel facility.
4.9	**Metal Detector**		
a.	Type	:	Coil Type
b.	Sensitivity	:	- 35 mm Aluminium Spheres below limestone for steel cord belting. - 25 mm aluminium sphere below limestone for synthetic belting.
c.	Enclosure	:	Fiber glass
d.	Control	:	Through local control panel.
e.	Calibration	:	Provision for automatic static calibration with adjustable sensitivity.
4.10	**Downspout from feeder outlet to Pulverizer**	:	
a.	Manufacturer	:	Bidder to Provide
b.	inside diameter (mm)	:	Bidder to Provide
c.	Thickness (mm)	:	Bidder to Provide
d.	Material	:	Bidder to Provide
e.	Height (mm)	:	Bidder to Provide
f.	Off set between feeder outlet.. and centre line of limestone bunker, if any (m)	:	Bidder to Provide
4.11	**Limestone Pulverizers**	:	
A.	**Pulverizer lube oil system**	:	Bidder to Provide
	a) No. of lube oil pumps per pulverizer b) No. of lube oil pumps working c) No. of oil coolers per pulverizer d) No. of oil coolers per working	:	Bidder to Provide
B.	**Mill speed with Auxiliary Motor (rpm**	:	Bidder to Provide
4.12	**Hydrocyclone**	:	
	i) Stage	:	Bidder to Provide
	ii) Manufacturer	:	Bidder to Provide

	iii) Number of Hydrocyclone	:	Bidder to Provide
	iv) Diameter of Hydrocyclone	:	Bidder to Provide
	v) Diameter of Vortex Finder	:	Bidder to Provide
	vi) Diameter of Apex Valve	:	Bidder to Provide
	vii) Diameter of Feed Inlet	:	Bidder to Provide
	viii) Design Pressure	:	Bidder to Provide
	ix) Working Pressure	:	Bidder to Provide
	x) Feed Flow rate	:	Bidder to Provide
	xi) Overflow Rate	:	Bidder to Provide
	xii) Underflow Rate	:	Bidder to Provide
	xiii) Mesh of separation (50% Removed)	:	Bidder to Provide
	xiv) Solid content of feed slurry	:	Bidder to Provide
	xv) Solid content in underflow of Hydrocyclones	:	Bidder to Provide
	xvi) Solid content in Overflow of Hydrocyclones	:	Bidder to Provide
	xvii) Type of cyclone	:	Bidder to Provide
	a. Cyclone Dia/Height (mm)	:	Bidder to Provide
	b. Required Liquid Feed Pressure	:	Bidder to Provide
	c. Cyclone Connection Number/Dia. (mm)	:	Bidder to Provide
	d. Feed	:	Bidder to Provide
	e. Overflow	:	Bidder to Provide
	f. Underflow	:	Bidder to Provide
	g. Rf Value (Underflow Slurry (m3/hr/Feed Slurry (m3/hr))	:	Bidder to Provide
	h. Material	:	Bidder to Provide
	i. Shell	:	Bidder to Provide
	j. Internal Structure Part	:	Bidder to Provide
	k. Lining	:	Bidder to Provide
	l. Particle Size Distribution	:	Bidder to Provide
	m. Weight	:	Bidder to Provide
4.13	**Mill Separator Tank**	:	
	i) Capacity (m3) ii) Material/Thickness (mm) iii) Lining Material/Thickness (mm) iv) No. of Agitators	:	Bidder to Provide
4.14	**Mill circuit Pump**	:	
	i) No. per mill ii) No. of stand-by pumps iii) Make/Model iv) Impeller Type v) Material/Thickness (mm) of Impeller and lining vi) Casing Type vii) Material/Thickness (mm) of Casing/Lining viii) Rated Flow Head (m3/hr / mWCl) ix) Slurry Solid concentration (w/w %)	:	Bidder to Provide

4.15	**Agitators**	:	
	i) No./Make/Model ii) Type iii) Speed (rpm) iv) Drive Mechanism v) Shaft Material vi) Material / Thickness (mm) of Impeller / Lining vii) Power Consumption viii) Motor Rating (KW) ix) Motor Speed (rpm)	:	Bidder to Provide

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

NAME ----------

DESIGNATION ----------

ANNEXURE II- SCHEDULE OF GUARANTEES

Sl. No	Description			Data
1.	Rated capacity of WBM	TPH	:	14.0
2.	Solid content of Grinding system Product	%wt.	:	30 %wt.
3.	Limestone Fineness at Product output		:	325 mesh , 90% pass through
4.	Guaranteed power consumption of WBM System at rated capacity	kW	:	
5.	Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor	dB(A)	:	≥90 dB(A) for Wet Ball Mill ≥85 dB(A) for other equipments.
6.	Maximum vibration (peak to peak amplitude at site)	microns	:	1) For Ball Mill: 2) For pumps:
7.	Equipment Availability	%	:	90%
8.	Life of WBM Wear Parts	Hours	:	≥8000 hours operation
9.	Scheduled Maintenance (Minor Overhauls): Recommended intervals between maintenance outages	hours	:	>25000 hours operation.
10.	Scheduled Maintenance (Major Overhauls): Recommended intervals between maintenance outages shall be	hours	:	>75000 hours operation.

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

NAME ----------

DESIGNATION ----------

ANNEXURE – III

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

a) Wet Ball Mill:

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Model	Capacity of WBM TPH	Year of Commg	Qty
1.							
2.							

b) Slurry Pumps

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Model	Capacity (m3/hr) & Head (m)	Year of Commg	Qty
1.							
2.							

c) Agitators

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Model	Agitator Size & Tank Size details	Year of Commg	Qty
1.							
2.							

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

NAME ----------

DESIGNATION ----------

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

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

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

NAME ----------

DESIGNATION ----------

ANNEXURE -V

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	No of copies With proposal
1.	Specification	1
2.	Price Sheet	1
3.	Anchor Plan & Civil foundation Loading details	1
4.	Data Sheet	1
5.	Performance curve	1
6.	Proforma Packing List	1
7.	Shortest Manufacturing Time	1
8.	Approximate weight of each skid	1
9.	Reference plant details	1
10.	Required Electric power & other Utility List	1
11.	Deviation List	1
12.	General Assembly Drawing of equipment & building	1
13.	WBM and Motor Sizing Calculation	1
14.	Pipe & Valve list	1
15.	Instrument List	1
16.	Cross-sectional Drawing	1
17.	Sub-Vendor List	1
18.	Scope of Supply	1
19.	Quality Plan	1
20.	Spare List (Mandatory, Recommended)	1
21.	Start-up & Commissioning Spares	1
22.	List of Special Tools	1
23.	Delivery Schedule	1
24.	Test Arrangement & Test procedure	1
25.	T-S curve	1
26.	Hoist/Crane requirement	1
27.	P & I Diagram	1
28.	Catalogue	1

B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

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

Sl. No.	Description	No of copies After award of contract	Delivery Time
28.	Spare List (Mandatory, Recommended)	1	1 month after contract
29.	Start-up & Commissioning Spares	2	1 month after contract
30.	List of Special Tools	1	1 month after contract
31.	Delivery Schedule	1	2 weeks after contract
32.	Test Arrangement & Test procedure	2	1 month after contract
33.	T-S curve	2	2 weeks after contract
34.	P & I Diagram	2	2 weeks after contract
35.	Catalogue	2	2 weeks after contract

Any schedule for other documents mentioned as per Clause: No 21.0 shall be mutually discussed and agreed upon.

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

NAME ----------

DESIGNATION ----------

ANNEXURE –VI

FICHTNER'S SUB SUPPLIER QUESTIONNAIRE FORMAT

REFER FICHTNER'S SUB SUPPLIER QUESTIONNAIRE FORMAT - kindly fill the form and furnish the relevant documents to obtain vendor approval from BIFPCL. /BIFPCL's consultant along with the offer.

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

NAME ----------

DESIGNATION ----------

ANNEXURE-VII

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING

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

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

NAME ----------

DESIGNATION ----------

ANNEXURE-VIII

INSPECTION & TESTING

Refer to all clauses for Inspection & testing requirements.

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

NAME ----------

DESIGNATION ----------

ANNEXURE-IX

HEALTH & SAFETY MANAGEMENT MANUAL

Refer to all clauses for Health & Safety requirements.

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

NAME ----------

DESIGNATION ----------

ANNEXURE –X- ELECTRICALS SPECIFICATION

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

NAME ----------

DESIGNATION ----------

ANNEXURE – XI- PAINTING SPECIFICATION

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

NAME ----------

DESIGNATION ----------

ANNEXURE – XII- PROCESS FLOW DIAGRAM OF LIMESTONE GRINDING SYSTEM

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

NAME ----------

DESIGNATION ----------

ANNEXURE – XIII- GA DRAWING OF LIMESTONE GRINDING BUILDING (Typical)

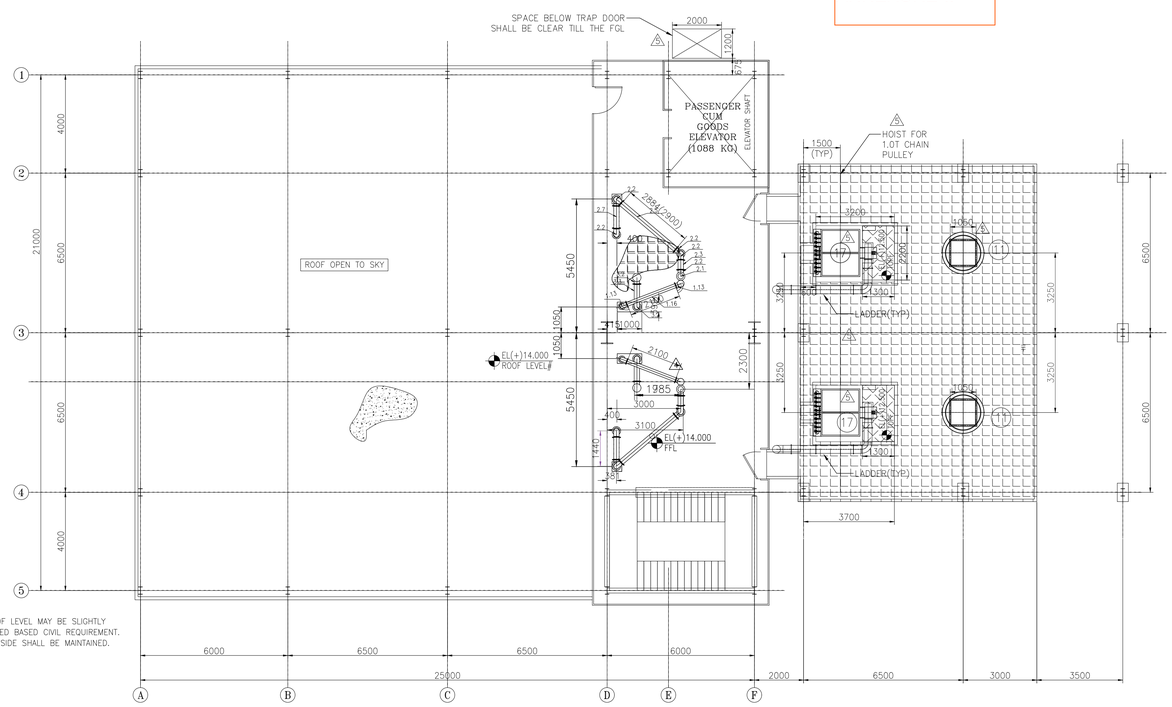
SIGNATURE OF BIDDER ----------

NAME ----------

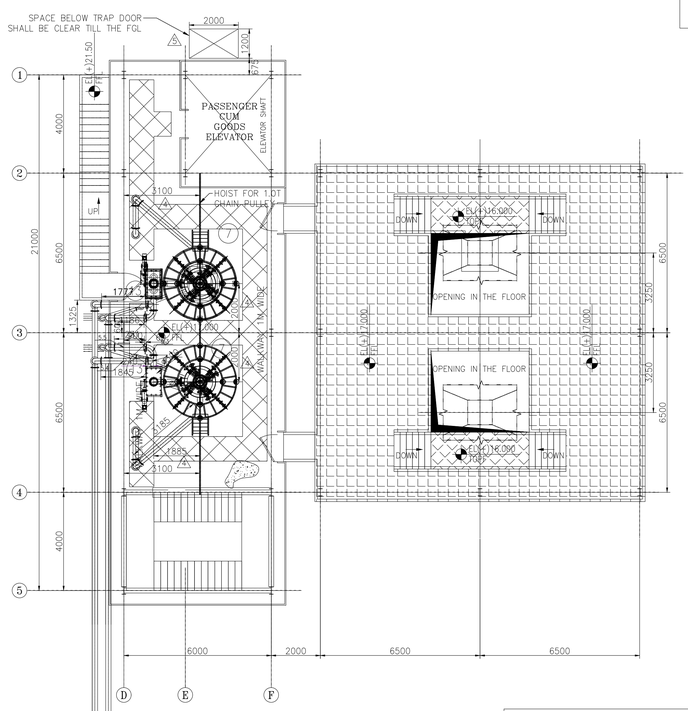
DESIGNATION ----------

DRAWING NO. 00-FW-734-00135

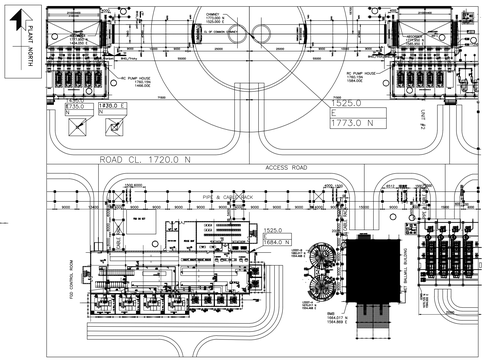
ANNEXURE-II



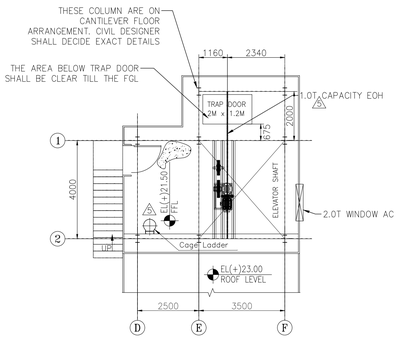
△PLAN @ EL(+)14.00M LEVEL (△FLOOR △GRILL) (ROOF AREA IS RCC)



PLAN @ EL(+)17.00M LEVEL (△HYDROCYCLONE & DISTRIBUTOR AREA) FLOOR)

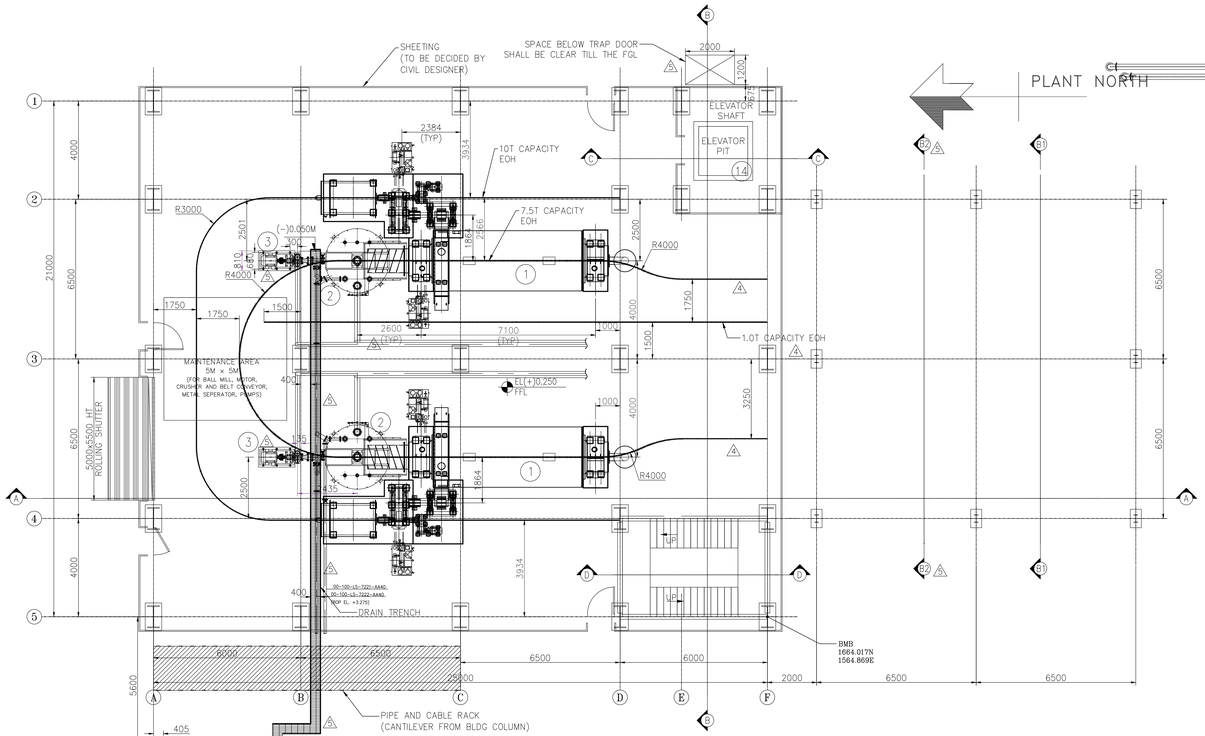


KEY PLAN

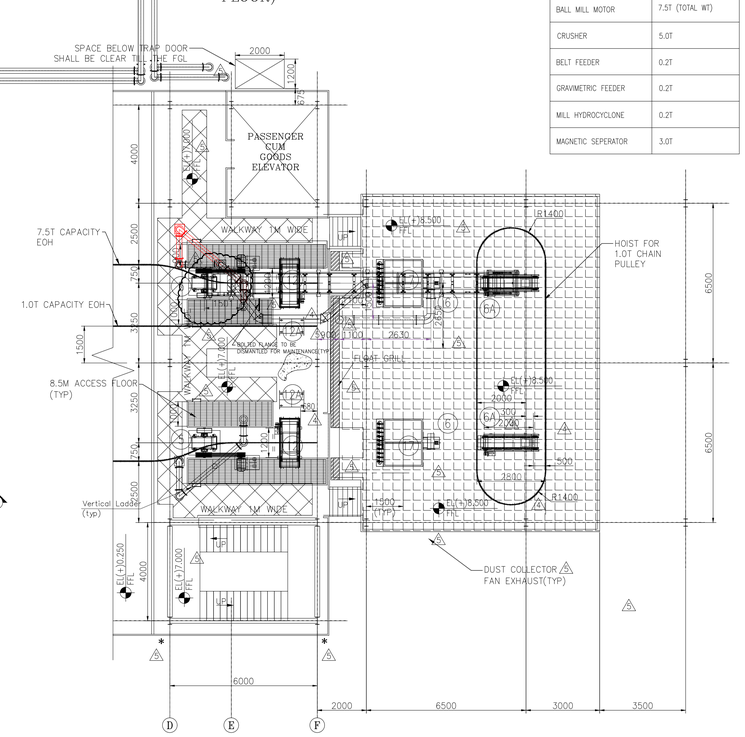


PLAN @ EL(+)21.50M LEVEL (ELEVATOR & MACHINE ROOM AREA) FLOOR)

MAXIMUM WEIGHT TO BE HANDLED FOR MAINTENANCE	
BALL MILL	3.5T
BALL MILL MOTOR	7.5T (TOTAL WT)
CRUSHER	5.0T
BELT FEEDER	0.2T
GRAVIMETRIC FEEDER	0.2T
MILL HYDROCYCLONE	0.2T
MAGNETIC SEPERATOR	3.0T



PLAN @ EL(+)0.25M LEVEL (BALL MILL BUILDING AREA)



PLAN @ EL(+)7.00M LEVEL (CRUSHER & IT'S PLATFORM) FLOOR)

△* REFER NOTE: 05

PLAN @ EL(+)8.50M LEVEL (BELT WEIGHT FEEDER AND BELT FEEDER GRILL)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS IN METRES
2. FINISH FLOOR LEVEL = RL (+)5.60 M, CORRESPONDS TO PLANT ELEVATION 0.0M WHICH IS GROUND FLOOR OF STG BUILDING.
3. FINISHED GROUND LEVEL IS RL(+)5.0M. i.e, EL(−)0.600.
4. THE EQUIPMENT SIZES SHOWN IN THIS DRAWING IS INDICATIVE ONLY AND WILL BE FINALIZED BASED ON VENDOR DETAILS.
5. △ CLADDING SHOWN IN THIS DRAWING IS INDICATIVE ONLY,REFER WET BALL MILL BUILDING CLADDING DRAWING (DRAWING NO: MAITREE-00-UVG-LC-103167-PEM) FOR MORE DETAILS.

REF. DWGS

1. MAITREE-00-MA-LD-120001-PEM : MAITREE STPP PLOT PLAN
2. MAITREE-00-HT-MTL-200275-RPT : PLANT LAYOUT OF FGD SYSTEM
3. MAITREE-0-HTL-CLB-200183-RPT : FOUNDATION DETAIL WITH LOAD DATA-PIPE RACK STRUCTURE
4. MAITREE-00-HT-MFB-200277-RPT : P&ID AND WRITE UP OF FGD SYSTEM
5. MAITREE-00-HTL-MLU-200278-RPT : GENERAL ARRANGEMENT FOR PIPING – FGD AREA
6. MAITREE-00-HTL-MLU-200279-RPT : GENERAL ARRANGEMENT FOR PIPING – FGD AREA
7. MAITREE-00-HTL-MLU-200280-RPT : GENERAL ARRANGEMENT FOR PIPING – FGD AREA
8. MAITREE-00-UVG-LH-100167-PEM : FGD – WET BALL MILL BUILDING–ARCH PLAN
9. MAITREE-00-UVG-LH-100267-PEM : FGD – WET BALL MILL BUILDING–ARCH ELEVATIONS
10. MAITREE-00-HTK-MLU-200211-RPT : GA AND DATA SHEET OF LIMESTONE PULVERIZER (WET BALL MILL)

LEGENDS:-

1. RCC_FLOOR
2. FLOOR GRILL
3. T.O.S: TOP OF STEEL
4. T.O.C: TOP OF CONCRETE
5. T.O.PF: TOP OF PLATFORM
6. F.F.L: FINISHED FLOOR LEVEL
7. F.G.L: FINISHED GROUND LEVEL
8. FLOAT GRILL
9. ACCESS FLOOR

5	04.12.19	KABILASH	SUKUMAR	KB PADHI	SPACE FOR TRAP DOOR INDICATED IN ALL VIEWS, SECTION B2-B2 ADDED,DRAIN TRENCH WITH SUMP UPDATED,VENDOR EQUIPMENT DETAILS UPDATED,SECTION B2–B2 ADDED & D–D UPDATED.
4	31.10.19	FELIX/KABILASH	FELIX	KB PADHI	REVISED AS PER CUSTOMER COMMENTS AND PIPE ROUTING DATA AND REVISED AS PER LATEST PIPING DRAWING M/S HENAN HONGJI
3	13.05.19	FELIX	FELIX	BALAJI RS	REVISED AS PER CUSTOMER COMMENTS REVISED BASED ON DATA FROM VENDOR M/S HENAN HONGJI
2	12.03.19	FELIX	FELIX	BALAJI	REVISED AS PER CUSTOMER COMMENTS REVISED BASED ON DATA FROM VENDOR M/S HENAN HONGJI
1	18.11.18	KABILASH	FELIX	BALAJI	REVISED AS PER CUSTOMER COMMENTS
0	30.05.18	SRIDHAR	KABILASH	FELIX/DASH	FIRST SUBMISSION
	DATE	ALTERED	CHECKED	APPROVED	NOTE

PROJECT
2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

OWNER CONSULTANT:
FICHTNER GmbH & Co KG, Stuttgart,GERMANY

OWNER:
BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

BHARAT HEAVY ELECTRICALS LTD
BOILER AUXILIARES PLANT
RANIPET

SCALE: NTS
SHEET 01 OF 03

	DATE	NAME
DRAWN BY	30.05.2018	SRIDHAR
DESIGN BY	30.05.2018	KABILASH
CHECKED BY	30.05.2018	FELIX
APPROVED BY	30.05.2018	SK DASH
SUPERSEDES:		
SUPERSEDED BY:		
SYSTEM:		

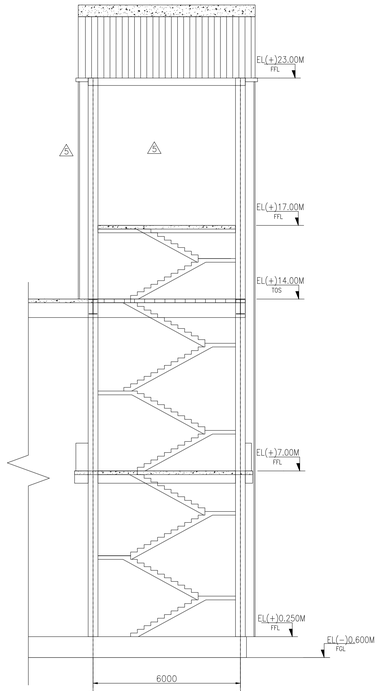
MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: GA DRAWING OF WET BALL MILL BUILDING (PLANS SHOWING MACHINERY LOCATIONS)
00-FW-734-00135 Sht-1 OF

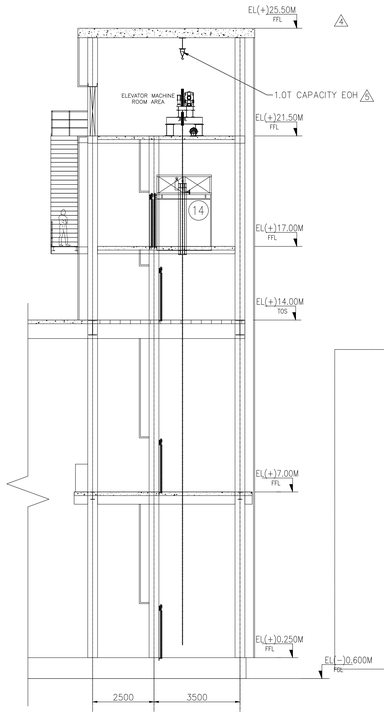
SIZE: A0 | PROJECT NO.:R4MB, R4M9 | FILE: 3
ANNEX: | DRAWING NO : MAITREE-0-HTK-MLH-200187-RPT-E (SH 1 OF 3) | REV-5

Size A0

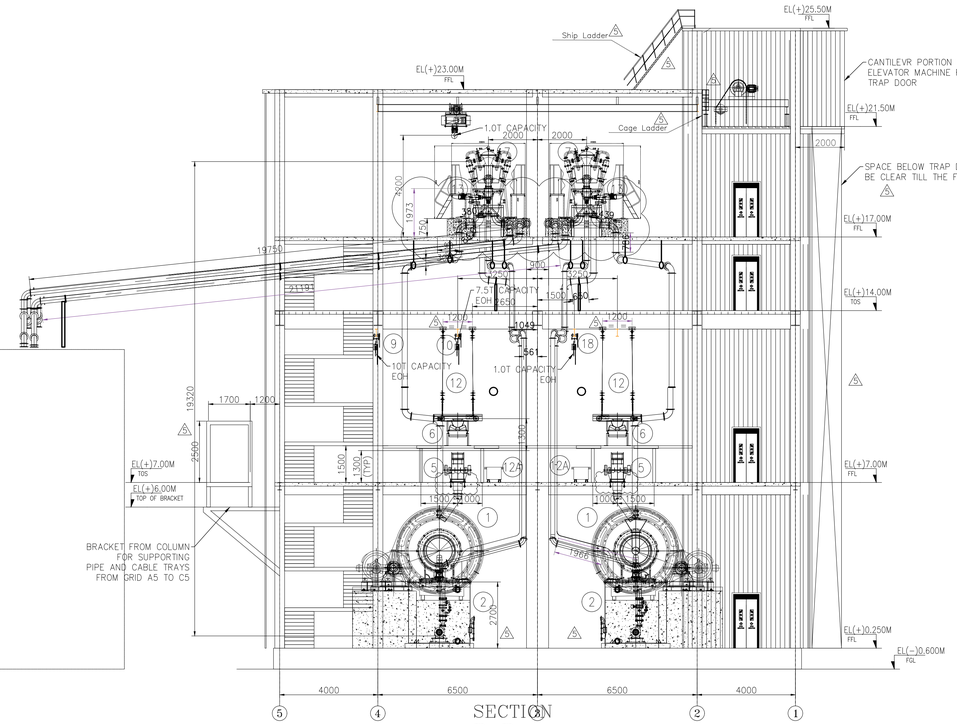
DRAWING NO. 00-FW-734-00135



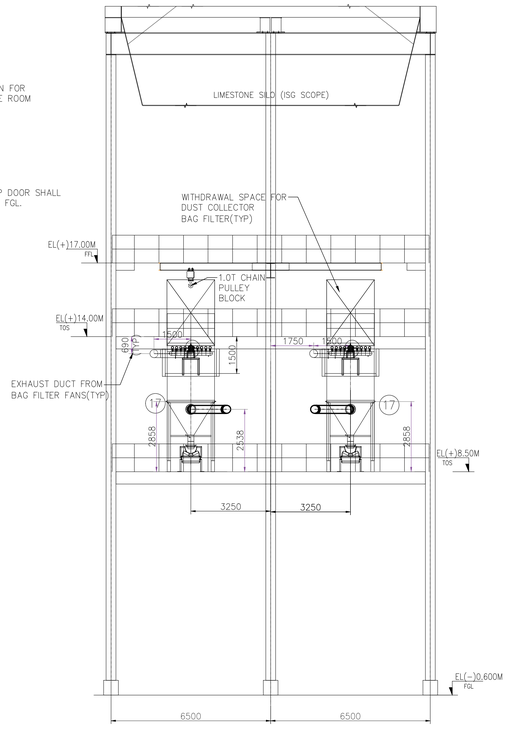
Ⓓ SECTION Ⓕ
D–D



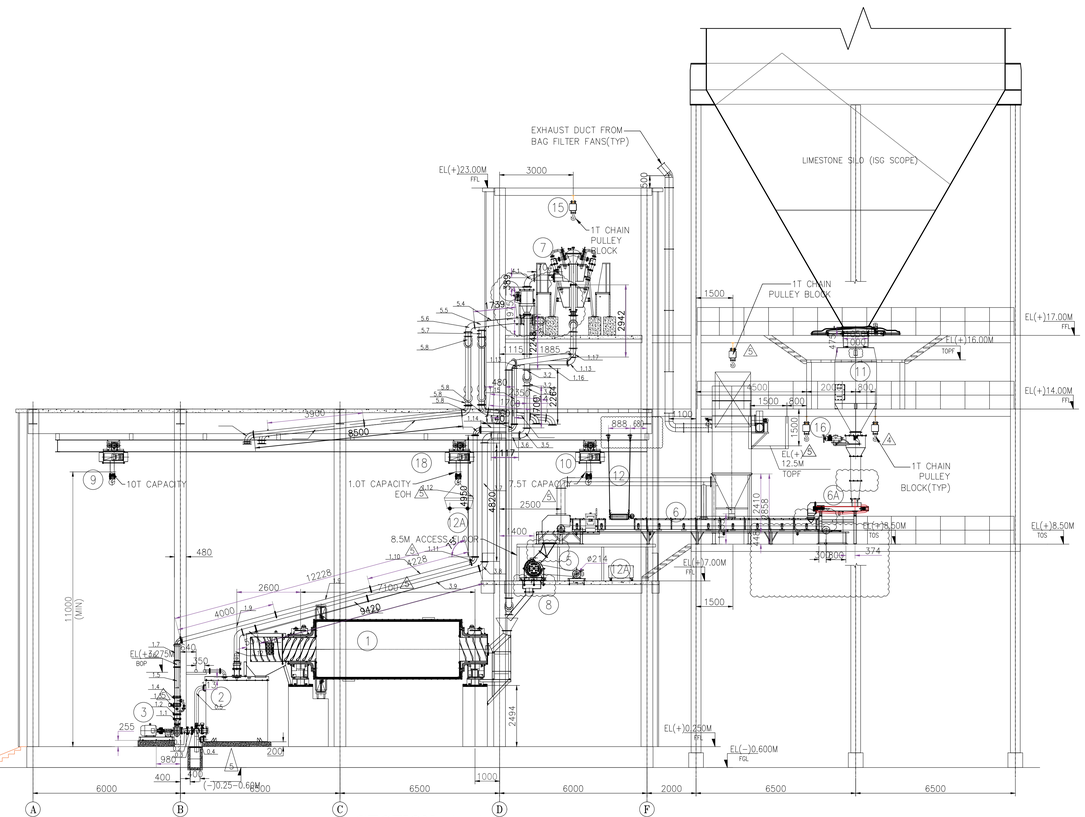
Ⓓ SECTION Ⓕ
C–C



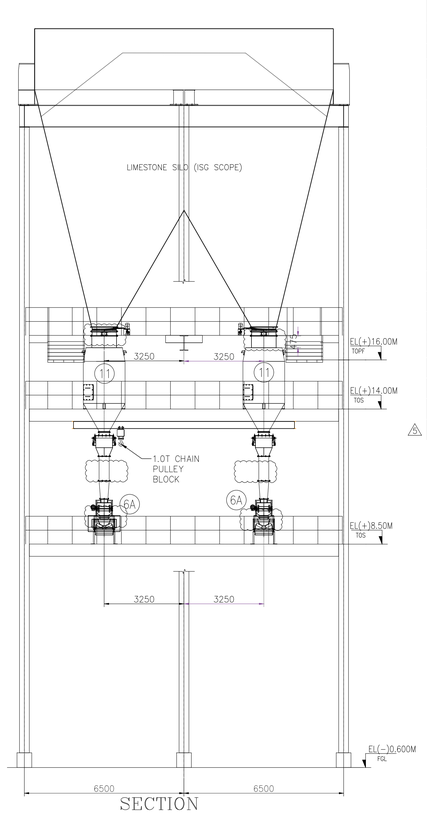
SECTION
B–B



Ⓐ SECTION B2–B2



SECTION A–A



SECTION
B1–B1

LIST OF EQUIPMENTS

EQPT NO	NOS	DISCRIPTIONS	APPX SIZE	APPX WEIGHT OF EACH EQPT ON ELEVATED FLOORS	LOCATION	REMARKS. **REFER VENDOR DWG. NUMBER
1	02	WET BALL MILL	2.8 X 5.0M DRUM	–	GROUND FLOOR @ EL(+)0.250	-UP00190410018-2
2	02	MILL CIRCUIT TANK	2.4M DIA	–	GROUND FLOOR @ EL(+)0.250	-UP00190410068
3	02	LIMESTONE SUSPENSION PUMP	1.0M X 2.0M	–	GROUND FLOOR @ EL(+)0.250	-UP00190410098
4	01	LIMESTONE AREA DRAIN SUMP	4.0M X 4.0M X 4.0M	–	GROUND FLOOR @ EL(+)0.250	–
5	02	LIMESTONE CRUSHER WITH MOTOR	2.5M X 1.75M X 1.7M	5T ⚠	ON FLOOR EL(+)7.000 RCC 400 THK SLAB TO BE PROVIDED FOR CRUSHER	-UP00190410058
6	02	LIMESTONE BELT FEEDER	1.2M WIDE	3 T/M	ON FLOOR EL(+)7.000 AND EL(+)8.500(ON SILO)	-UP00190410078
6A	02	LIMESTONE BELT WEIGH FEEDER	1.2M WIDE	3 T/M	ON FLOOR EL(+)8.500 (ON SILO)	-UP00190410078
7	02	MILL HYDROCYCLONE	2M DIA	10T	ON FLOOR EL(+)17.00	-UP00190410108
8	02	LIMESTONE CHUTE	0.90M X 0.90M	5T	ON FLOOR EL(+)7.000	–
9	01	MONO RAIL HOIST 10T	–	LIFTED WEIGHT+3T	BELOW FLOOR @ EL(+)14.000	–
10	01	MONO RAIL HOIST 7.5T	–	LIFTED WEIGHT+3T	BELOW FLOOR @ EL(+)14.000	–
11	02	SILO DOSING BIN	1.7M DIA X 2.5M HT	20.0 T	ON FLOOR EL(+)14.00 (ON SILO)	-UP00190410038
12	02	METAL SEPERATOR	–	5.0T	HANGING BELOW FLOOR @ EL(+)14.000	–
12A	02	METAL COLLECTOR BIN	–	0.5T	ON FLOOR EL(+)7.000	–
13	02	DISTRIBUTOR	1.0M X 1.5M X 1.0M	10T	ON FLOOR EL(+)17.00 ⚠	-UP00190410028
14	02	ELEVATOR 1088 KG CAPACITY	–	---	GROUND FLOOR @ EL(+)0.250	ELEVATOR PIT TO BE CONSIDERED AT GROUND FLOOR
15	01	MANUAL CHAIN PULLEY 1.0T	–	LIFTED WEIGHT+1T	BELOW FLOOR @ EL(+)23.000	
16	01	MANUAL CHAIN PULLEY 1.0T	–	LIFTED WEIGHT+1T	BELOW FLOOR @ EL(+)14.000 ON SILO STRUCTURE	
17	02	DUST COLLECTOR	APPX 1.5MX2.0M	3.0T	ON FLOOR EL(+)8.500 (ON SILO)	
18	01	MONO RAIL HOIST 1.0T	–	LIFTED WEIGHT +1T	BELOW FLOOR @ EL(+)14.000	–

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS IN METRES
2. FOR ALL OTHER NOTES, REFER MAITREE–O–HTK–MJH–200187–RPT (SH–1)

	DATE	ALTERED	CHECKED	APPROVED	NOTE
5	04.12.19	KABILASH	SUKUMAR	KB PADHI	SPACE FOR TRAP DOOR INDICATED IN ALL VIEWS, SECTION B2 ADDED,DRAIN TRENCH WITH SUMP UPDATED,VENDOR EQUIPMENT DETAILS UPDATED,SECTION B2–B2 ADDED & D–D UPDATED.
4	31.10.19	FELIX/KABILASH	FELIX	KB PADHI	REVISED AS PER CUSTOMER COMMENTS AND REVISED DATA FROM VENDOR M/S HENAN HONGJI
3	13.05.19	FELIX	FELIX	BALAJI RS	REVISED AS PER CUSTOMER COMMENTS
2	12.03.19	FELIX	FELIX	BALAJI	REVISED BASED ON DATA FROM VENDOR M/S HENAN HONGJI
1	18.11.18	KABILASH	FELIX	BALAJI	REVISED AS PER CUSTOMER COMMENTS
0	30.05.18	SRIDHAR	KABILASH	FELIX/DASH	FIRST SUBMISSION

PROJECT
2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

OWNER CONSULTANT:
FICHTNER M/S FICHTNER GmbH & Co KG, Stuttgart,GERMANY

OWNER:
BANGLADESH–INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

BHARAT HEAVY ELECTRICALS LTD
BOILER AUXILIARIES PLANT
RANIPET

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

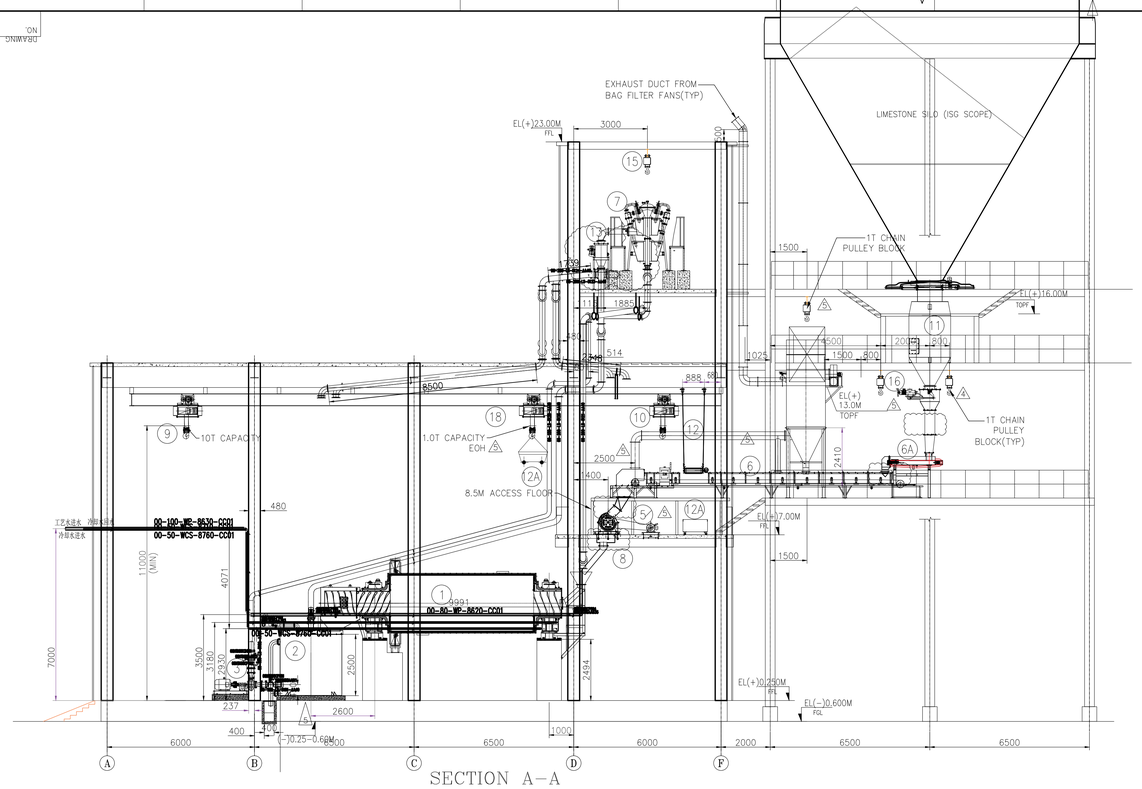
	DATE	NAME
DRAWN BY	30.05.2018	SRIDHAR
DESIGN BY	30.05.2018	KABILASH
CHECKED BY	30.05.2018	FELIX
APPROVED BY	30.05.2018	SK DASH
SUPERSEDES:		
SUPERSEDED BY:		
SYSTEM:		

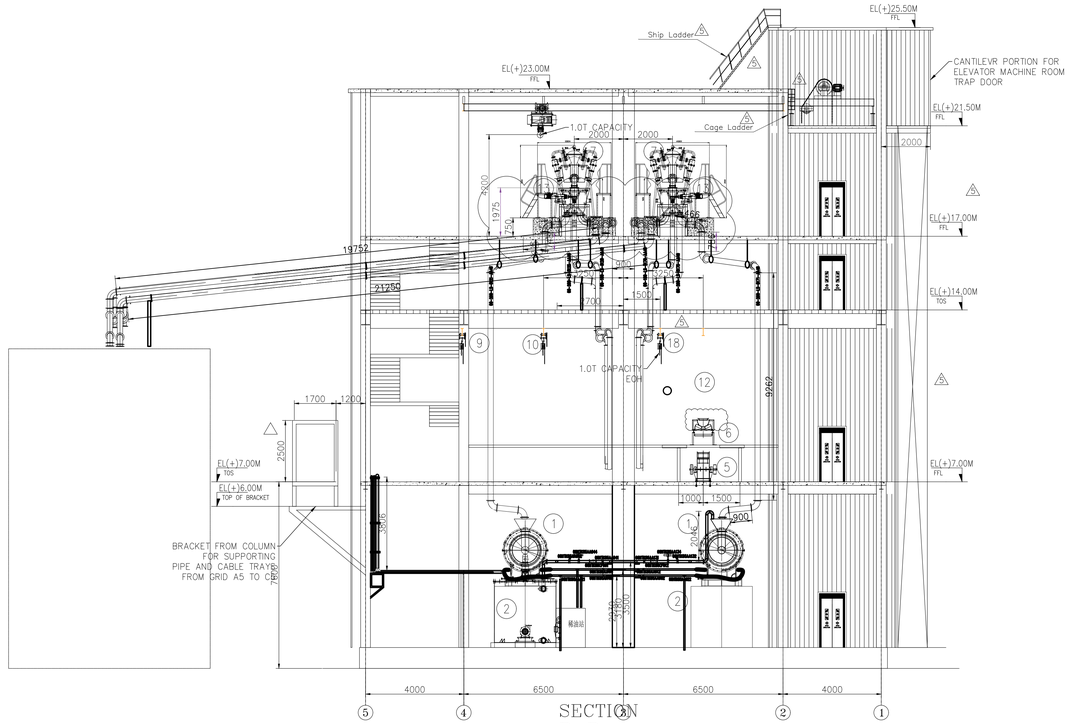
TITLE: GA DRAWING OF WET BALL MILL BUILDING (ELEVATIONS AND SECTIONS SHOWING MACHINERY)

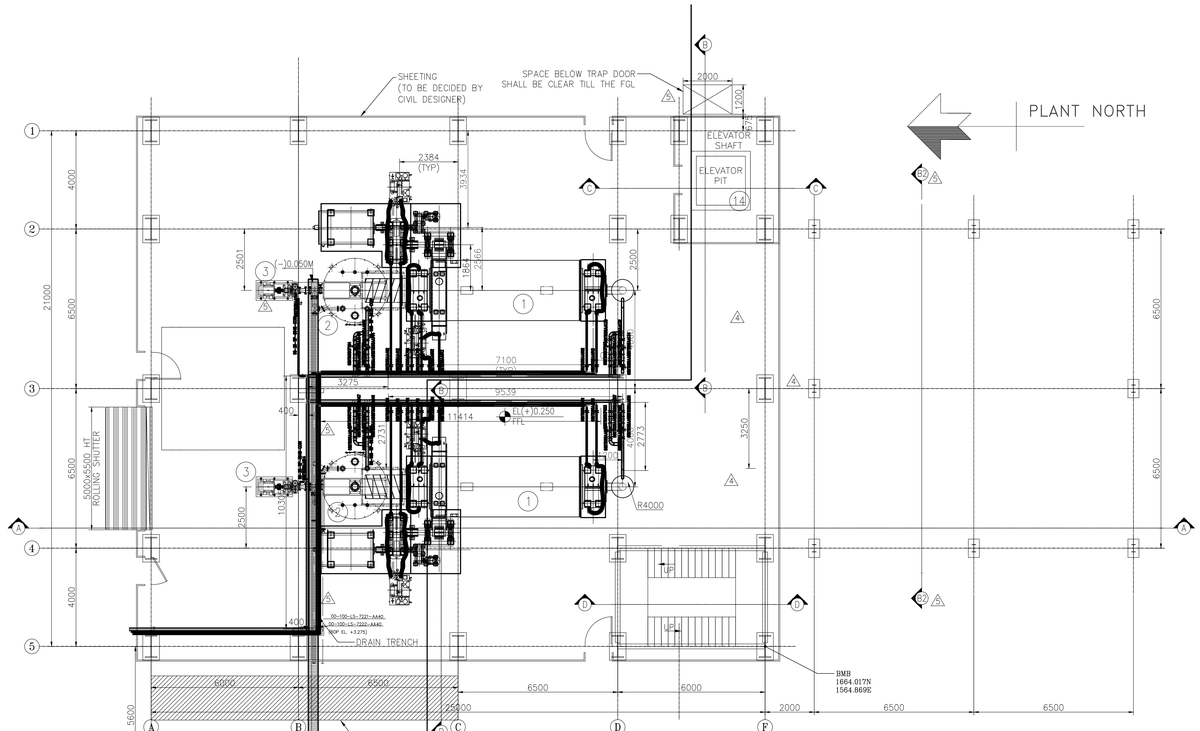
SCALE: NTS
SHEET 02 OF 03
SIZE: A0
PROJECT NO.:R4MB, R4M9
FILE: 00-FW-734-00135 SH-2 OF 3
ANNEX:
DRAWING NO : MAITREE–O–HTK–MJH–200187–RPT–E (SH 2 OF 3)
REV–5

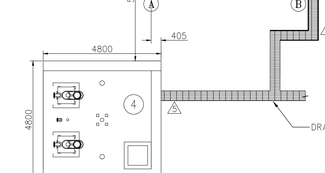
Size A0

DRAWING NO. 00-FW-734-00135





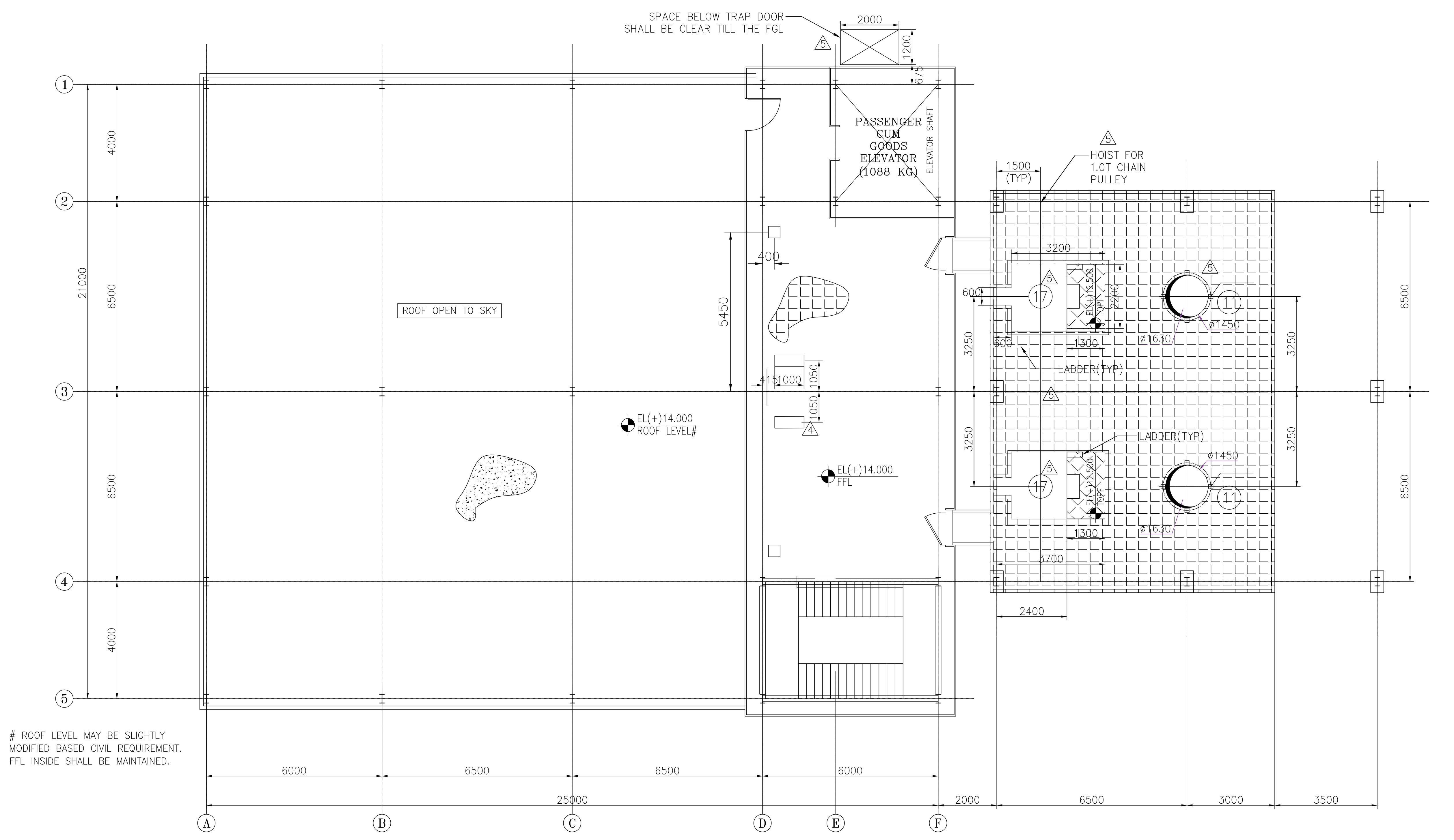




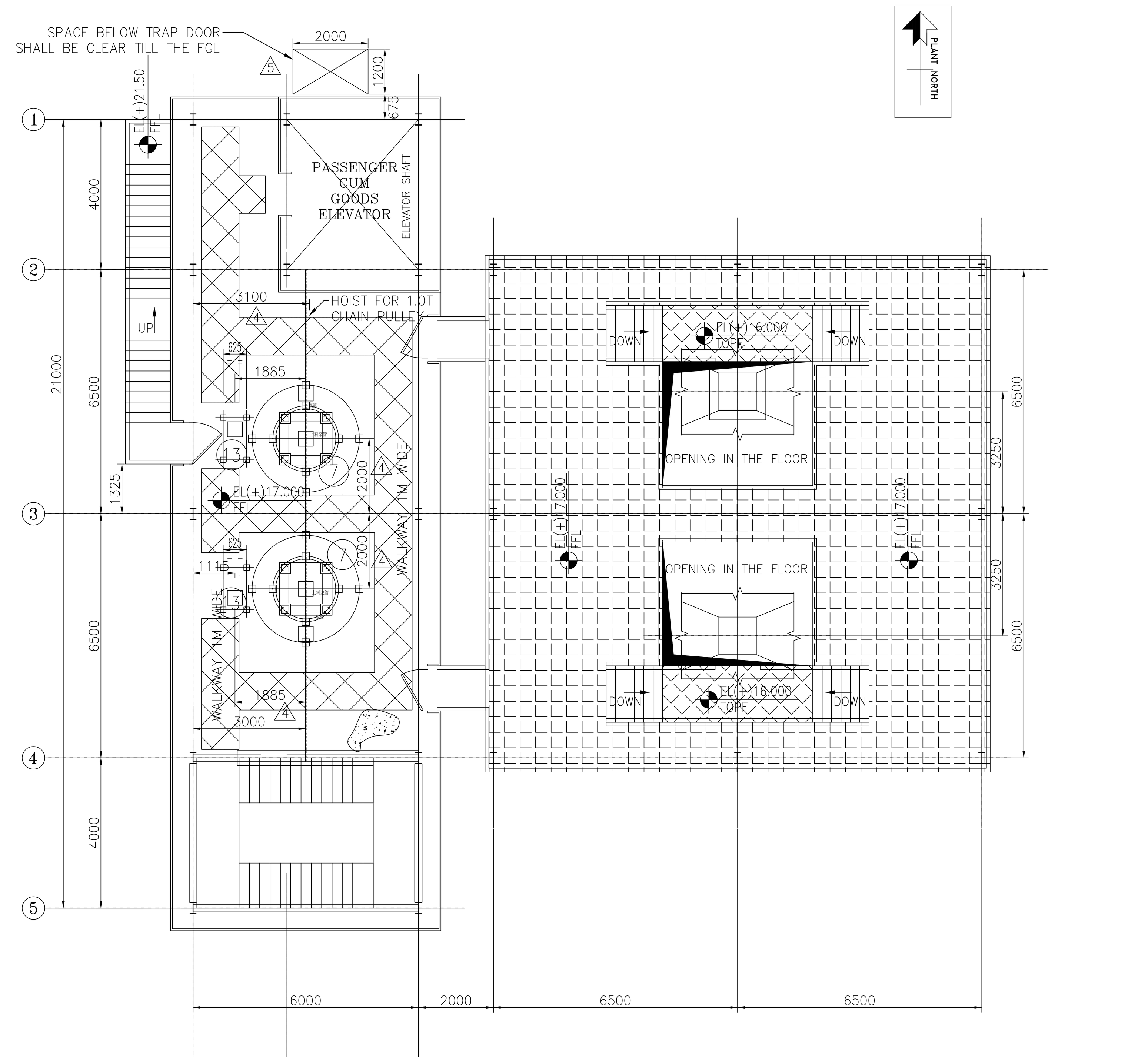
FICHTNER GmbH & Co KG, Stuttgart,GERMANY	BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH	
	BHARAT HEAVY ELECTRICALS LTD BOILER AUXILIARIES PLANT RANIPET	SCALE: NTS SHEET 01 OF 03
	MITSUBISHI HITACHI POWER SYSTEMS, LTD. AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION	
DRAWN BY: 30.05.2018 SRIDHAR	TITLE: GA DRAWING OF WET BALL MILL BUIDLING (Process water, cooling water piping drawing)	
DESIGN BY: 30.05.2018 KABILASH		
CHECKED BY: 30.05.2018 FELIX		
APPROVED BY: 30.05.2018 SK. DASH		
SUPERSEDES:		
SUPERSEDED BY:	SIZE: A0 / PROJECT NO.:R4M8, R4M9 / FILE: 3 / DRAWING NO : 00-FW-734-00135	
SYSTEM:	ANNEX: / DRAWING NO : MATREE-0-HTK-MJH-200187-RPT-E (SH 1 OF 3)	REV-5

Size A0

00-FW-734-00135

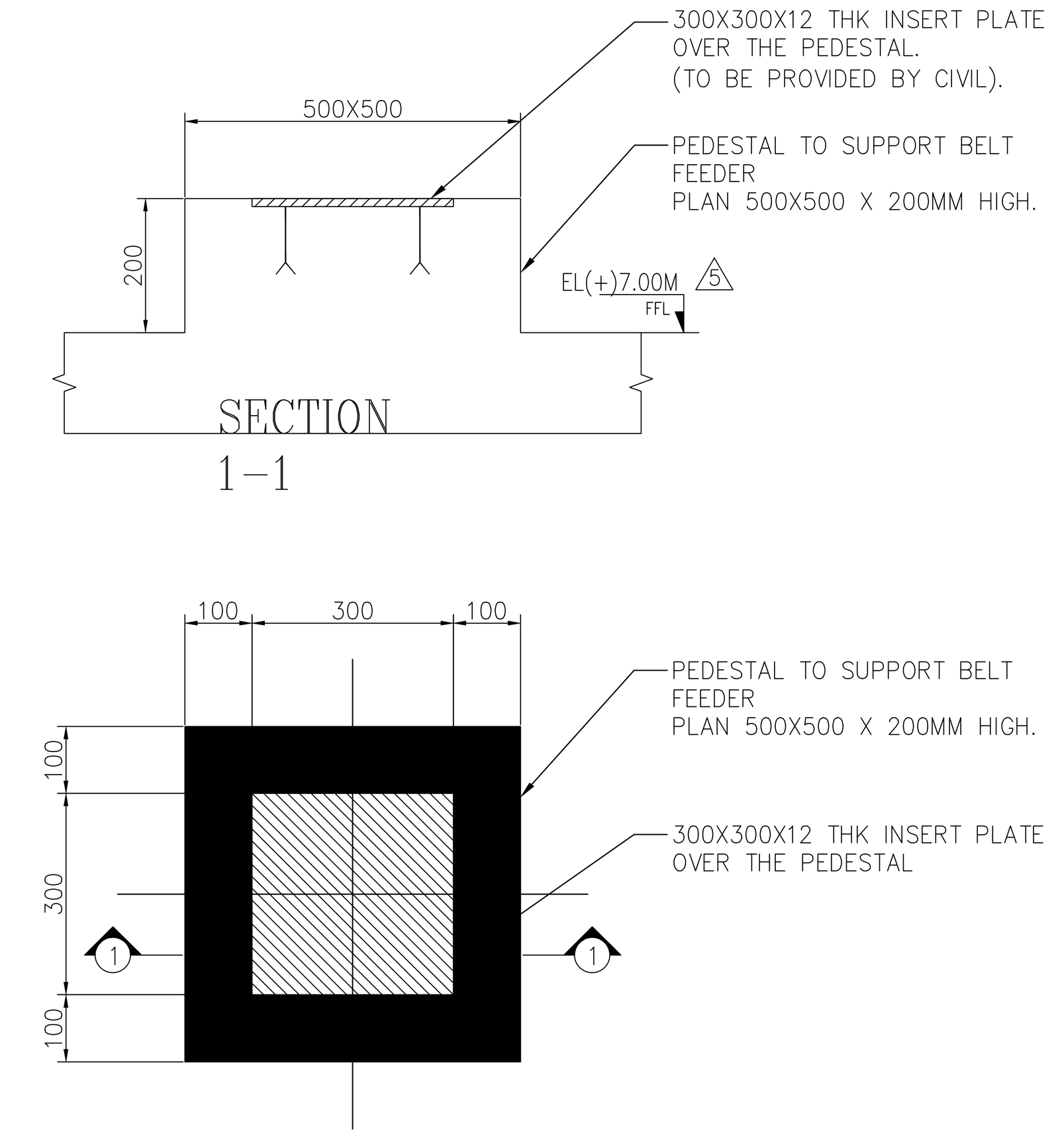


PLAN @ EL(+)14.00M LEVEL (FLOOR GRILL) (ROOF AREA IS RCC)



PLAN @ EL(+)17.00M LEVEL (HYDROCYCLONE & DISTRIBUTOR AREA) FLOOR)

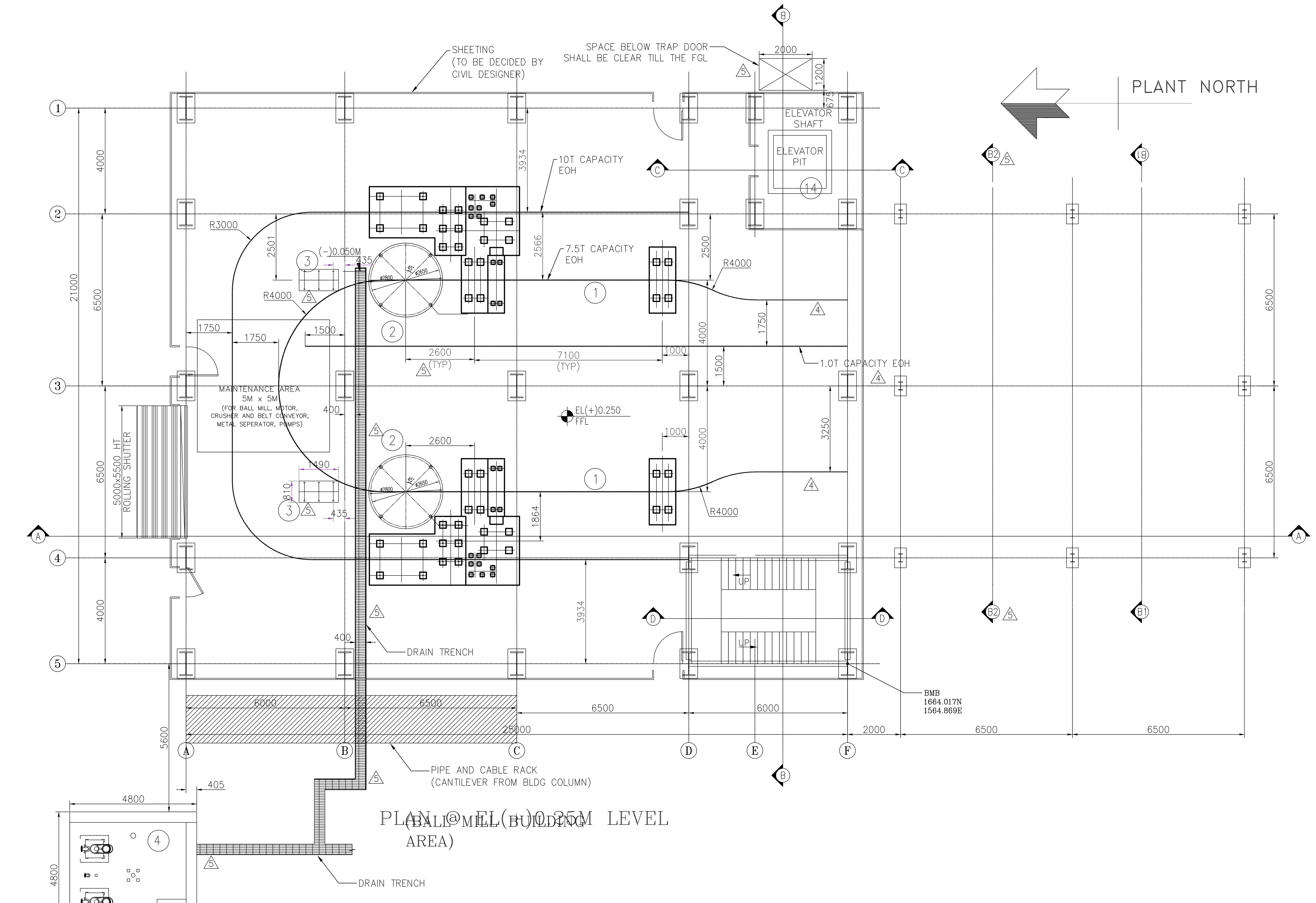
MAXIMUM WEIGHT TO BE HANDLED FOR MAINTENANCE	
BALL MILL	3.5T
BALL MILL MOTOR	7.5T (TOTAL WT)
CRUSHER	5.0T
BELT FEEDER	0.2T
GRAVIMETRIC FEEDER	0.2T
MILL HYDROCYCLONE	0.2T



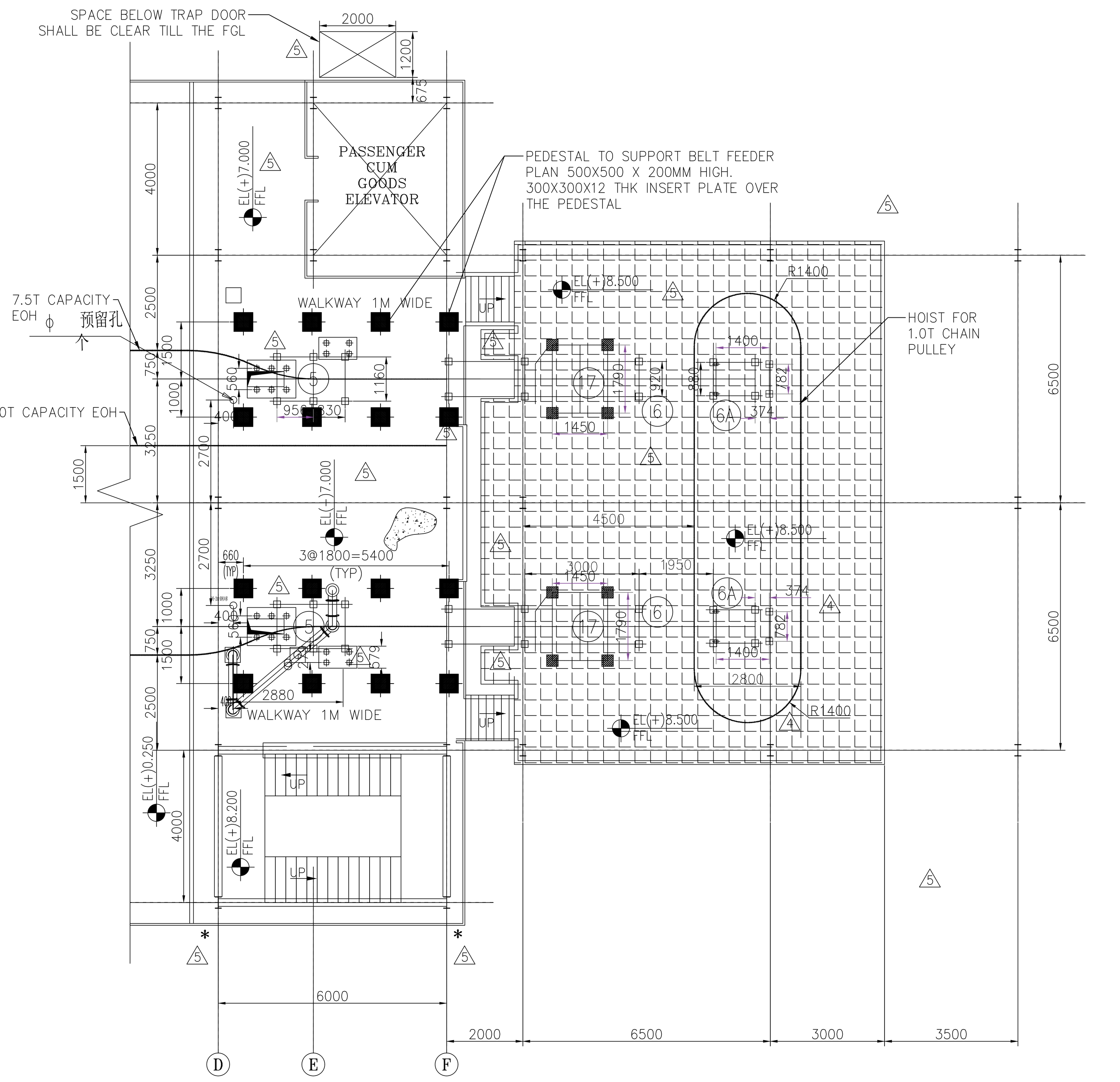
PEDESTAL PLAN FOR BELT FEEDER SUPPORTS (BALL MILL BUILDING AREA)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS IN METRES
2. FOR ALL OTHER NOTES, REFER MAITREE-0-HTK-MLH-200187-RPT (SH-1)
3. CLADDING SHOWN IN THIS DRAWING IS INDICATIVE ONLY,REFER WET BALL MILL BUILDING CLADDING DRAWING (DRAWING NO: MAITREE-00-UVG-LC-103167-PEM) FOR MORE DETAILS.



PLAN @ EL(+)0.25M LEVEL (BALL MILL BUILDING AREA)



PLAN @ EL(+)7.00M LEVEL (CRUSHER & IT'S PLATFORM) (RCC FLOOR) & @EL(+)8.50M LEVEL (BELT WEIGH FEEDER AND BELT FEEDER) (FLOOR GRILL)

* REFER NOTE: 03

	DATE	ALTERED	CHECKED	APPROVED	NOTE
5	04.12.19	KABILASH	SUKUMAR	KB PADHI	SPACE FOR TRAP DOOR INDICATED IN ALL VIEWS, SECTION B2 ADDED,DRAIN TRENCH WITH SUMP UPDATED,VENDOR EQUIPMENT DETAILS UPDATED,SECTION B2-B2 ADDED & D-D UPDATED.
4	31.10.19	FELIX/KABILASH	FELIX	KB PADHI	REVISED AS PER CUSTOMER COMMENTS AND PIPE ROUTING DATA AND BASED ON DATA FROM VENDOR M/S HENAN HONGJI ITEM 13 SHIFTED TO EL(+)17.000
3	13.05.19	FELIX	FELIX	BALAJI RS	REVISED AS PER CUSTOMER COMMENTS. SH-3 ADDED REVISED BASED ON DATA FROM VENDOR M/S HENAN HONGJI
2	12.03.19	FELIX	FELIX	BALAJI	REVISED AS PER CUSTOMER COMMENTS REVISED BASED ON DATA FROM VENDOR M/S HENAN HONGJI
1	18.11.18	KABILASH	FELIX	BALAJI	REVISED AS PER CUSTOMER COMMENTS
0	30.05.18	SRIDHAR	KABILASH	FELIX/DASH	FIRST SUBMISSION

PROJECT
2x660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH (EPC MAIN PLANT PACKAGE)

OWNER CONSULTANT: FICHTNER M/S FICHTNER GmbH & Co KG, Stuttgart,GERMANY

OWNER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

BHARAT HEAVY ELECTRICALS LTD
BOILER AUXILIARIES PLANT
RANIPET

SCALE: NTS
SHEET 03 OF 03

	DATE	NAME
DRAWN BY	30.05.2018	SRIDHAR
DESIGN BY	30.05.2018	KABILASH
CHECKED BY	30.05.2018	FELIX
APPROVED BY	30.05.2018	SK DASH
SUPERSEDES:		
SUPERSEDED BY:		
SYSTEM:		

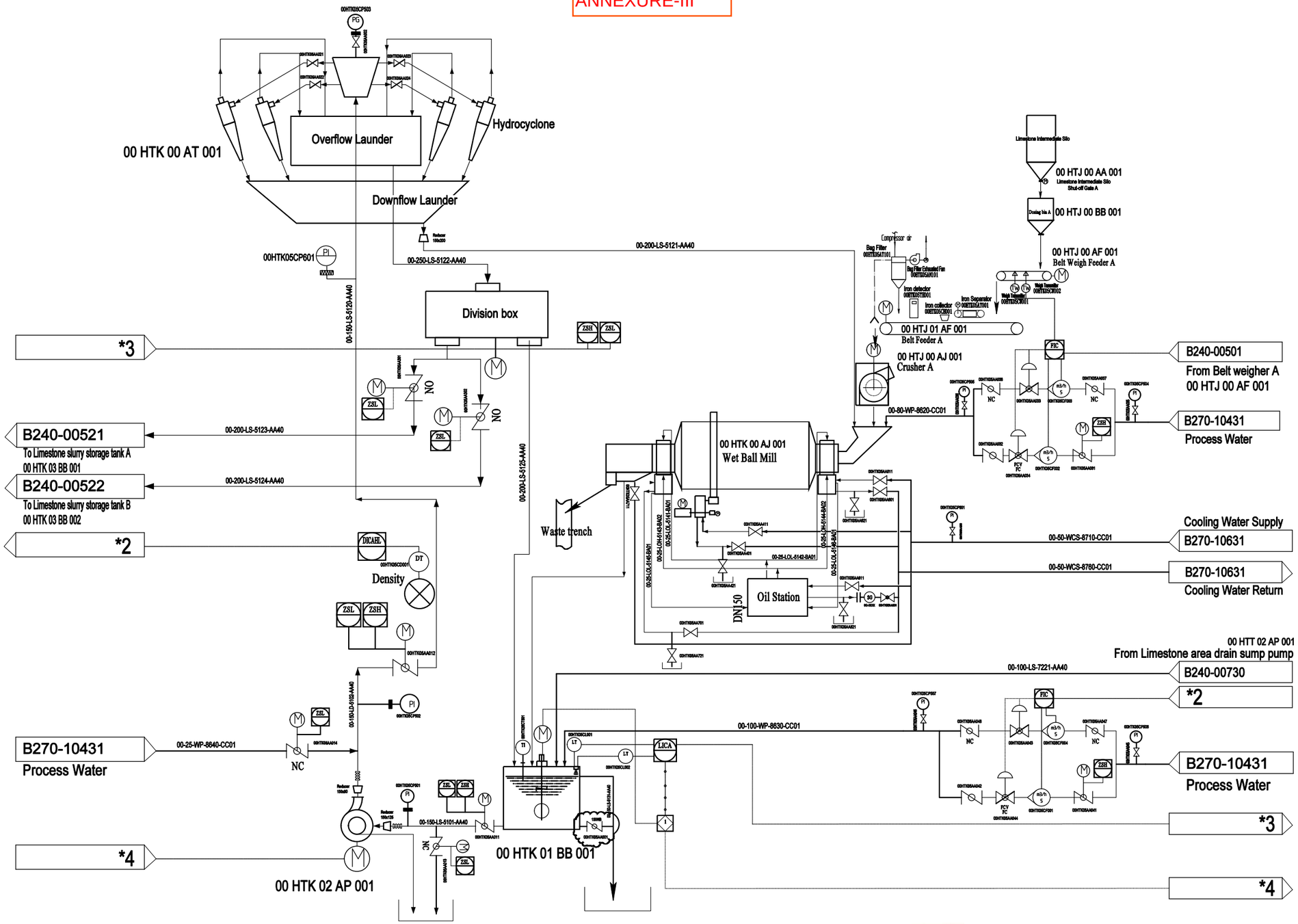
MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: GA DRAWING OF WET BALL MILL BUIDLING (PLANS SHOWING LOADING AND COLUMN POINTS)

SIZE: A0 | PROJECT NO.:R4M8, R4M9 | FILE: 00-FW-734-00135 SH-3 OF 3
ANNEX: | DRAWING NO : MAITREE-0-HTK-MLH-200187-RPT-E (SH 3 OF 3) | REV-5

Size A0

ANNEXURE-III

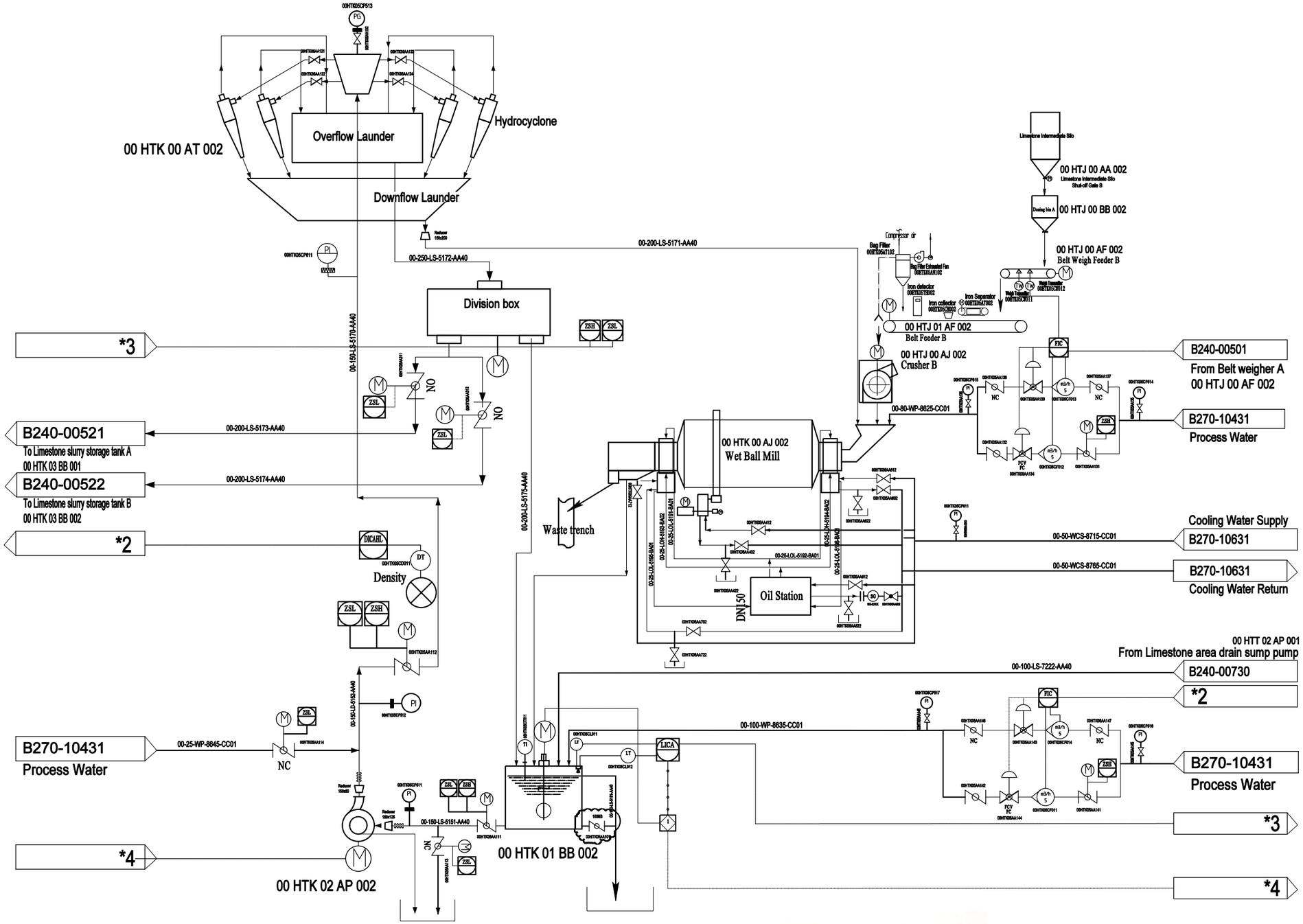


There will be a temporary strainer for pump to prevent impurities drop into pump, and will be remove after commissioning stage.

EDC / E.C.D., BHEL, RANIPET - 632 406.
1. Approved 2. Approved as Noted
3. Revise & Resubmit 4. For information
1 Approval Category
REVIEWED BY APPROVED BY
DATE DATE
This approval does not relieve the vendor from his responsibility regarding the correctness of design features like dimensions, weight, quantities. Vendor also has to ensure conformity to applicable Indian Statutory Laws.

BHEL PO No. 3880173E	Design		Standard	
	Drafting	张天权	Approval	马建保
CUSTOMER: BIFPCL Bangladesh	Review			
PROJECT: Maitree (2x660MW)	Technics		Date	
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM				
Ball Mill GA Drawing	Mark Pattern		Quanti2	Weight / Scale
	Total		No.	
HJP0019041005P-1	河南宏基矿山机械有限公司 Henan Hongji Mine Machinery Co., Ltd.			

Shared(General) Parts Register
Design
Check
General No. of original tracking drawing
General No. of drawing
Sign
Date

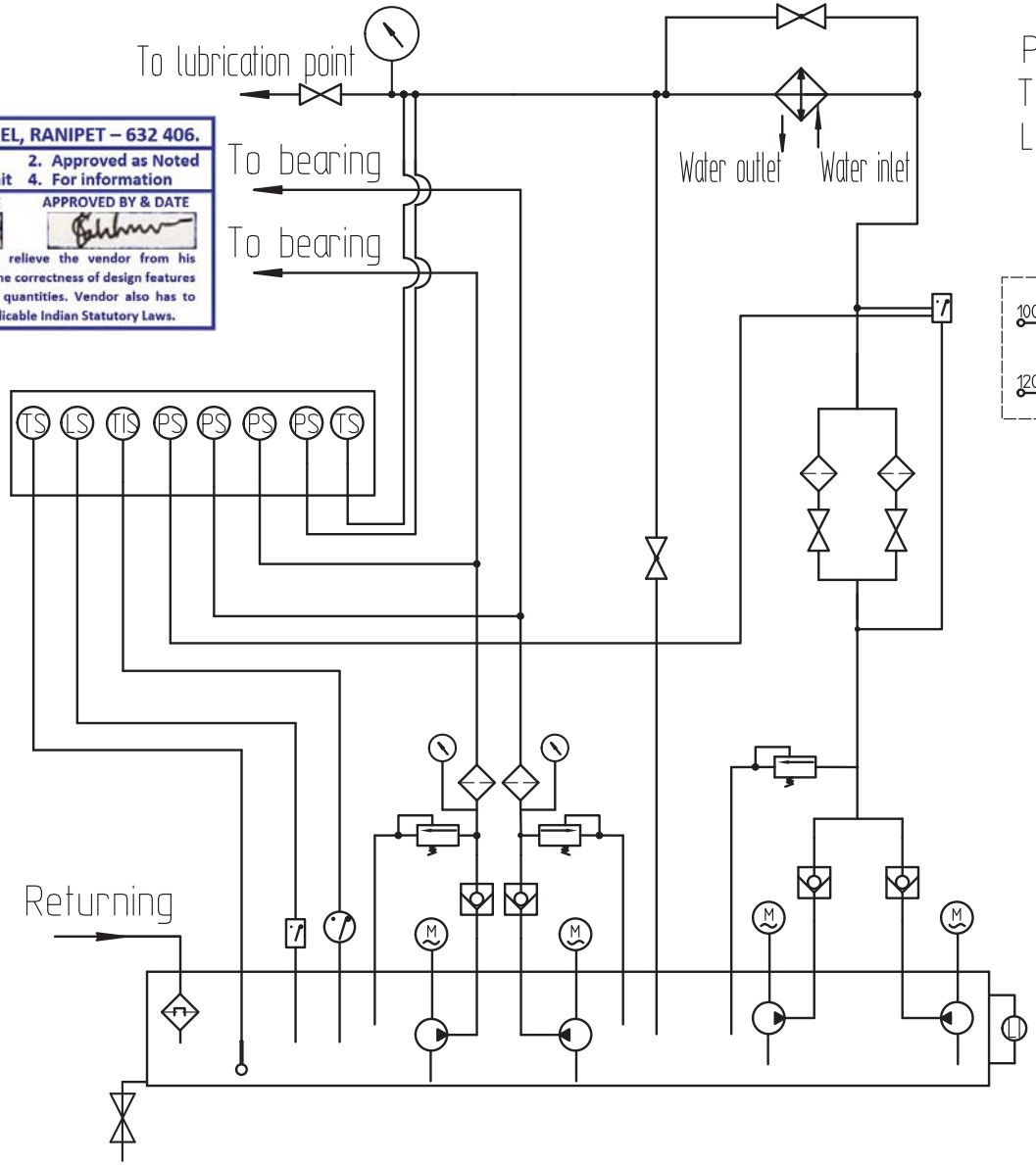


There will be a temporary strainer for pump to prevent impurities drop into pump, and will be remove after commissioning stage.

EDC / E & D, BHEL, RANIPET - 632 406.
1. Approved 2. Approved as Noted
3. Revise & Resubmit 4. For information
1 Approval Category
REVIEWED BY APPROVED BY
DATE DATE
This approval does not relieve the vendor from his responsibility regarding the correctness of design features like dimensions, weight, quantities. Vendor also has to ensure conformity to applicable Indian Statutory Laws.

BHEL PO No. 3880173E	Design		Standard		
	Drafting	张天权	Approval	马进保	
CUSTOMER: BIFPCL Bangladesh	Review				
PROJECT: Maitree (2x660MW)	Technics		Date		
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM					
Ball Mill GA Drawing	Mark Pattern		Quanti2	Weight	Scale
	Total		No.		
HJP0019041005P-2	河南宏基矿山机械有限公司 Henan Hongji Mine Machinery Co., Ltd.				

Shared(General) Parts Register
Design
Check
General No. of original tracking drawing
General No. of drawing
Sign
Date



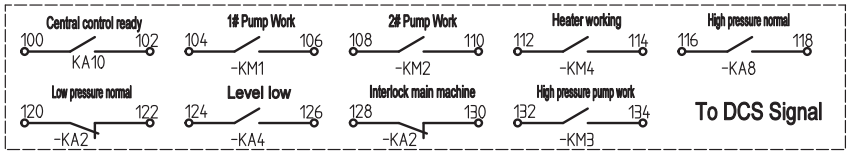
EDC / FGD BHEL, RANIPET – 632 406.

1. Approved 2. Approved as Noted
3. Revise & Resubmit 4. For information

REVIEWED BY & DATE APPROVED BY & DATE

This approval does not relieve the vendor from his responsibility regarding the correctness of design features like dimensions, weight, quantities. Vendor also has to ensure conformity to applicable Indian Statutory Laws.

P	Pressure	Pt	platinum resistance thermometer
T	Temperature	I	Display
L	Level	S	Swith

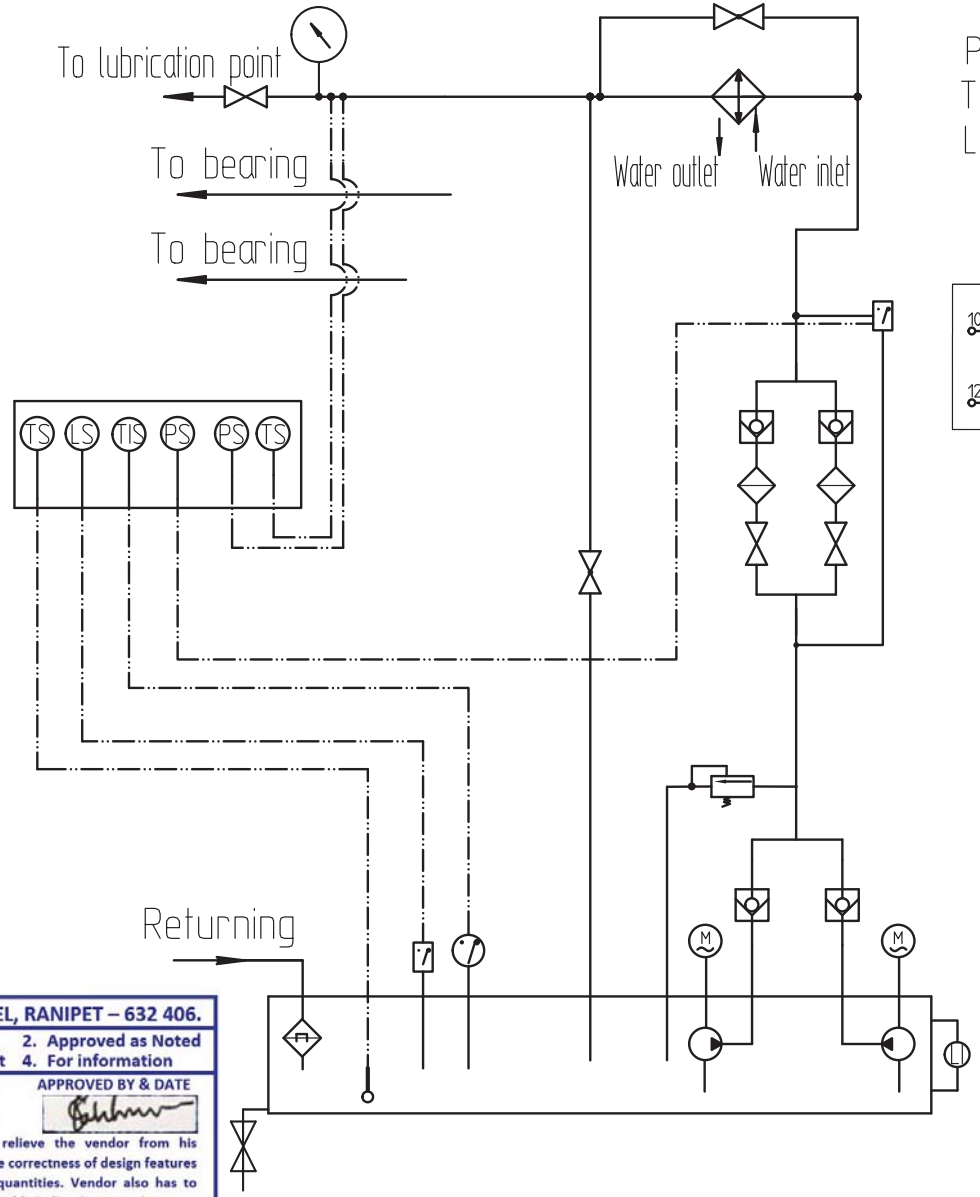


1. Tank capacity: 900L
2. LP pump: CB-B40; Q=57.2L/min; P=2.5Mpa; Two pieces
3. HP pump: PV2R1-10-FR; Q=10.0L/min; P=21Mpa; Two pcs (1W1S)
4. HP pump motor: 1TL0001-1AB53-5FA4-Z-3KW; 1435rpm
5. LP pump motor: 1TL0001-1AB43-5FA4-Z-2.2KW; 1435rpm
6. Oil piping in the system: DN25
7. Valve including: manual ball valve DN25; manual pressure regulating valve ST25

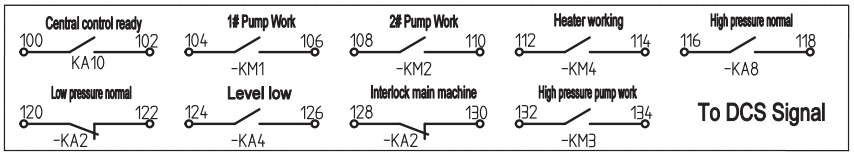
Lubrication is used to filling with bush bearing, is one part of the bearing system. 2 HP Pump, 2 LP Pump (1 Working+1 standby).

Shared(General) Parts Register
Design
Check
General No. of original tracking drawing
General No. of drawing
Sign
Date

BHEL PO No. 3880173E	Design		Standard		
	Drafting	张天权	Approval	马进保	
CUSTOMER: BIFPCL Bangladesh	Review				
PROJECT: Maitree (2x660MW)	Technics		Date	2021.04.23	
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM					
Bearing Lubrication Oil PID	Mark Pattern		Quantity	Weight	Scale
	Total		No.		
HJP0021042311B	河南宏基矿山机械有限公司 Henan Hongji Mine Machinery Co., Ltd.				



P Pressure
T Temperature
L Level
Pt platinum resistance thermometer
I Display
S Swith



1. Tank capacity: 630L
2. LP pump: CB-B25; Q=35.75L/min; P=2.5Mpa; Two pieces
3. LP pump motor: 1TL0001-0EB43-5FA4-Z-1.5KW; 1435rpm
4. Oil piping in the system: DN25
5. Valve including: manual ball valve DN25; manual pressure regulating valve ST25

Lubrication is used to filling with gearbox, is one part of the bearing system. 2 LP Pump (1 Working+1 standby).

Sheet(Consent) Parts Register

Design

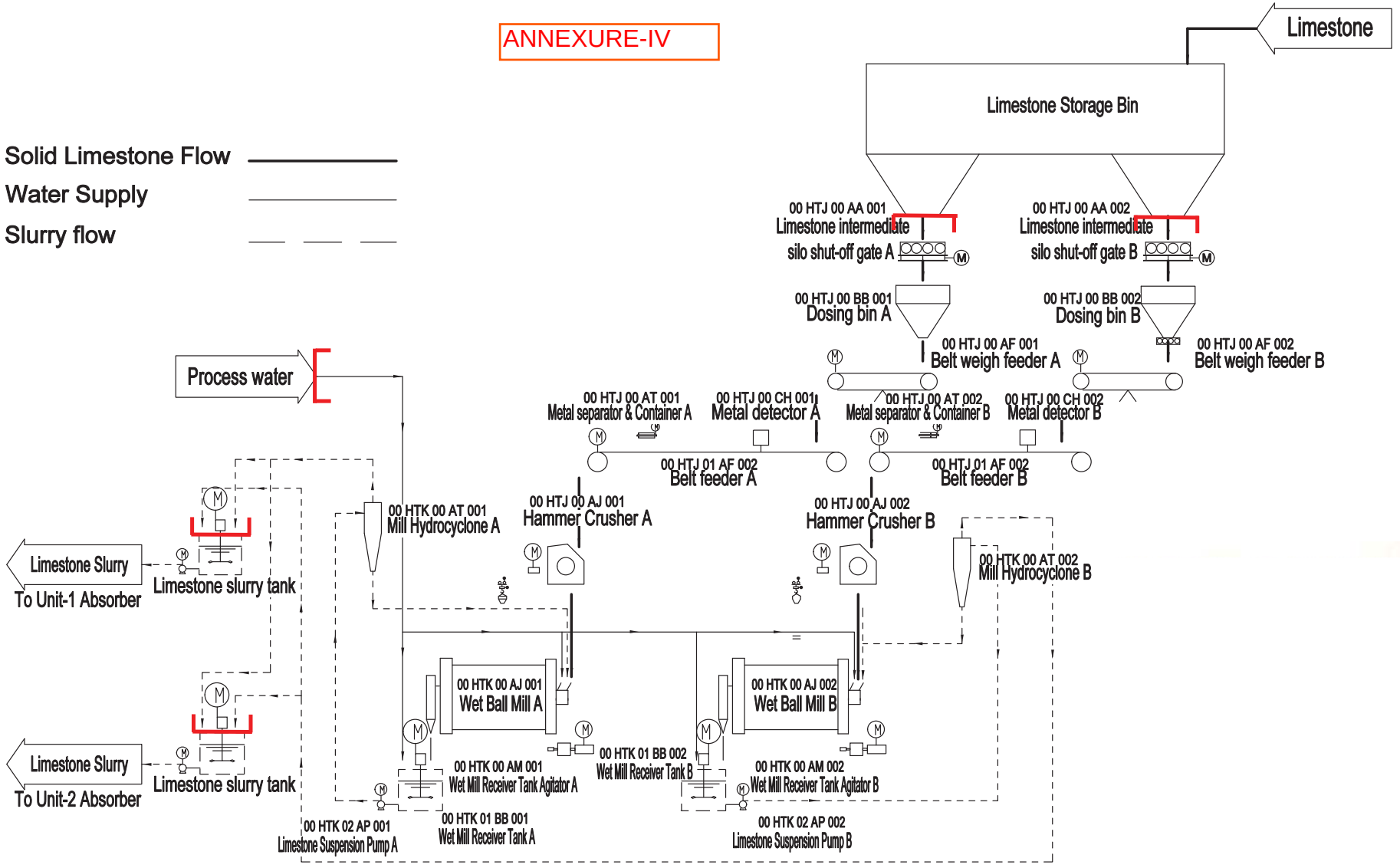
Check

Date

EDC / FGD BHEL, RANIPET – 632 406.
1. Approved 2. Approved as Noted
3. Revise & Resubmit 4. For information
REVIEWED BY & DATE APPROVED BY & DATE
This approval does not relieve the vendor from his responsibility regarding the correctness of design features like dimensions, weight, quantities. Vendor also has to ensure conformity to applicable Indian Statutory Laws.

BHEL PO No. 3880173E	Design		Standard	
	Drafting	张天权	Approval	马进保
CUSTOMER: BIFPCL Bangladesh	Review			
PROJECT: Maitree (2x660MW)	Technics		Date	2021.04.23
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM				
Gearbox Lubrication Oil PID	Mark Pattern		Quantity	Weight / Scale
	Total		No.	
HJP0021042312B	河南宏基矿山机械有限公司 Henan Hongji Mine Machinery Co., Ltd.			

ANNEXURE-IV



BHEL PO No. 3880173E	Design		Standard		
	Drafting	张天权	Approval	马建辉	
CUSTOMER: BIFPCL Bangladesh	Review				
PROJECT: Maitree (2x660MW)	Technics		Date		
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM					
Ball Mill Process Flow Diagram	Mark Pattern		Quantity	Weight	Scale
	Total		No.		
HJP0019041602B					

Design
Check
Sign
Date

Erection, Operation & Maintenance Manual

Ball Mill

I. Installation Requirement

1. Equipment Installation starts with the safety of equipment and personnel. Special attention should be given as the mill is a heavy equipment and prevent rolling during installation.

2. Before installation, Main bearings, shell gear, hollow shaft, head stock should be checked and cleaned. Also ensure that the lubricating oil isclean.

3. Check thoroughly for cleaning the contacting surfaces before installation. Grease is to be applied on the frictional surface.

4. Clean the equipment base and remove oil stain dirt before grouting.

5. The position and size of the anchor bolts and the size of the equipmentshould be checked.

6. The ball mill must be installed on a concrete foundation, which can support the weight of the equipment and material load during running of the mill. Foundation should be designed to withstand the static and dynamic loads.

7. The grouting is done by using fine stone concrete or cement slurry. The compression strength of the concrete foundation should be 75% higher than the requirement.

8. Check the axial surface level of the main bearing before fixing to avoid crack , air vent etc,.

9. Check the cylindrical shell and maintain the ovality within +- 5mm before fixing the shell and hollow shaft.

10. Examine the elevation after loading the shell onto the main bearing and checking the height of both sides. The feed end should be higher level thanthe discharge end.

11. Check the quality of liner before installing the liner.

河南宏基矿山机械有限公司
HENAN HONGJI MINE MACHINERY CO.,LTD

Ball Mill Rubber Liner Installation Instruction

Ball mil rubber liner is one of the most widely used line for ball mill, with advantages of wear-resistance, anti-corrosive, lower energy consumption, lower steel consumption, etc.

As the protection of ball mill, liner installation is quite important. Please read follow steps carefully.

1. Check the bolt hole and bolt shape carefully. Clean the bolt and hole carefully, to make sure the bolt can reach required position.

2. The full set of liner bolt shall include T type bolt, sealing rubber washer, U bowl cover, plain washer. In order to avoid leakage, need to make sure to use sealing rubber washer.

3. After all rubber components finished installation, shall rotate the ball mill and tighten again. The torque requirement for tightening shall be no less than 208Nm for shell liner, and no less than 422Nm for end liner.

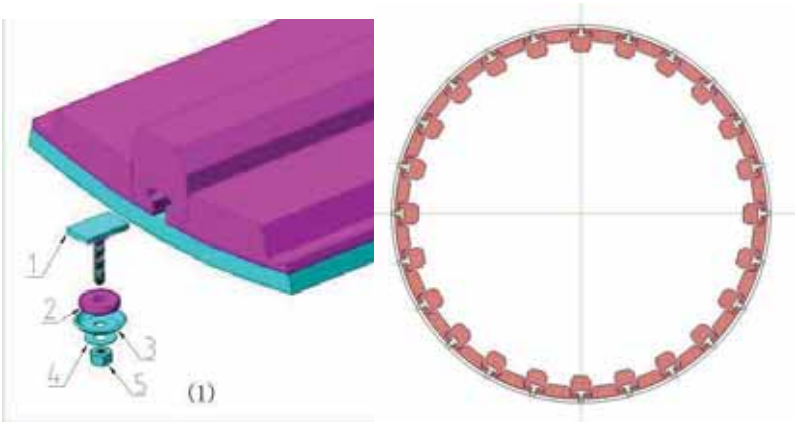
4. Installation sequence: Inlet side end liner – discharging side end liner – shell liner – Manhole door liner

(1) Ball mill end liner installation

Firstly put end liner on the end plate, adjust bolt hole. Insert T bolt into the hole, as well as sealing rubber liner, U bowl cover, flat washer and nut in sequence. Repeat this till all 16pcs end liner complete, and then lock the nut.

(2) Please pay attention that the liner is longer than shell normally, (20mm designed reserved for compression). There would be some cutting during installation according to the installation condition. Please take reference by follow drawing. After one row liner installed by the worker inside ball mill, the people

outside shall lock the nut immediately. Whenever there is rotation of ball mill, all nut shall be locked to the bolt, otherwise lifting liner may got moved.



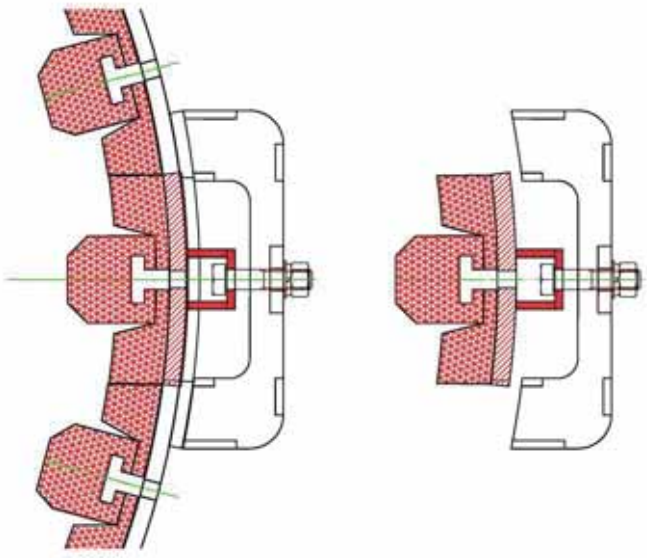
1. T bolt; 2. Sealing rubber washer; 3. U bowl cover; 4. Plain washer; 5. Nut

Installation: put the rubber liner on the both sides of bolt hole, set the T bolt at the inner slip channel of lifting liner. After insert the T bolt through mill shell's hole, fix sealing rubber washer, U bowl cover, plain washer and nut one by one.

(3) Manhole door liner preparation

The liner where there is manhole shall be cut at site. Make sure there is certain gap at the edge of door. Those been cut shall keep well and install on the manhole cover plate.

(4) Manhole rubber liner shall installed as follow drawings



II. Operation

After installation the ball mill you need trial operation for zero load and full load then come into working condition.

a) Remove sundries around the ball mill and check for the safety.

b) Examine the ball mill and keep it safe of people.

c) Check the central distance of grate plate and ball mill surface if it is according to the requirement.

d) Fix up the manhole top tightly.

e) Examine the mill linner bolts if there is loosen between mill head and join bolts.

f) Lubricating oil should be according to the standard oil height.

g) The main bearing should be cooled with cooling water when the temperature higher than 10 degree centigrade and examine the moving water in the pipes before operation.

h) Oil the hollow shaft before starting the ball mill or on the trial operation and manual grinding for one round to make sure that there is no stop then start with the motor.

i) After getting confirmation signal then start the ball mill.

Start in turns

1. Start the output conveyor fixture.
2. Start the bearing water cooling system.
3. Start the ball mill.
4. Start the mill feeding fixture.

Stop in turns

1. Stop the feeding fixture

2. When processing the cement concrete products, the ball mill need to go on operation for half an hour to stop.

3. Stop the main bearing water cooling system.

4. Stop the output feeding system.

河南宏基矿山机械有限公司
HENAN HONGJI MINE MACHINERY CO.,LTD

Notes

1. Remove the balls if it needs to stop for a long period.

2. Check the oil height of main bearing frequently.

3. Running the ball mill half round 5-10 minutes after stopping the ball mill until its get fully cooled.

4. Clean the cooling water of main bearing when the ball mill is not in use during winter.

河南宏基矿山机械有限公司
HENAN HONGJI MINE MACHINERY CO.,LTD

III. Maintenance of Ball Mill.

1. Examine the foundation bolts and linner bolts and mill head bolts frequently.

2. Examine the oil condition every hour and keep the temperatures of main bearing less than 55 oC, temperature of drive bearing should be less than 70 oC.

3. Examine if there is water/oil/material leakage in the mill.

4. Record the electric current amperage. if any abnormity found mill is stopped and checked.

5. Examine the sound of gear wheel and pinion.

6. Check all important part as per the standard schedule.

IV. Lubrication oil

1. In winter HT-40
2. In summer HT-50
3. Driving bearing: Thick gear oil

V. Trail Running

After installation and examination start the trial operation as follows:

1. Keeps the ball mill running without loading for 24 hours.

2. Add 1/3 grinding media for trial operation for 8 hours.

3. Add 2/3 grinding media for trial operation for 72 hours.

After every trial operation, need to examine the grinding condition of shaft neck and tile, joggle condition of drive gear, fasten the foundation bolts, hollow shaft, liner bolts and gear wheel and check the water/material leakage.

河南宏基矿山机械有限公司
HENAN HONGJI MINE MACHINERY CO.,LTD

Henan Hongji Mine Machinery. Co., Ltd.

Hammer crusher

I. Installation Requirement

1. The installation of crusher with drive should be made as per the foundation drawing.
2. To minimize the vibration level, impact pads (wooden blocks/rubber) should be fitted below the hammer mill.
3. During the installation, the center of motor and rotor should be at the same level.

II. Operation

1. Ensure adequate lubrication is supplied to the main bearing and other transmission parts.
2. Ensure the blots are tightened.
3. Check the drive connection.
4. Ensure that motor earthing and guards for rotating parts are fixed.
5. Now start the device in the given sequence.

河南宏基矿山机械有限公司
HENAN HONGJI MINE MACHINERY CO.,LTD

III. Maintenance

1. Observe the equipment while in operation.
2. Check the hammer mill during operation for any rupture of hammers with the liners and adjust the liners.
3. Check the whereof hammers and liners.
4. During the periodic maintenance all the fasten screws are to be tightened.
5. Bearing lubrication is to be made at regular intervals.

Agitator

I. Installation Requirement and Operation

1. During the installation of Agitator the direction of rotation is to be checked.
2. Proper greasing to be made before starting the equipment.
3. Check for the electrical connections and earthing .
4. The agitator motor should be started after ensuring certain availability of material in the slurry tank.
5. The agitator should be stopped only after the slurry level reaches to the minimum point in the tank.
6. If the agitator is not in use for longer period the left out material in the tank should be cleaned before re-use of the agitator.

II. Maintenance and Lubrication oil

1. The temperature of the bearing should not be higher than 65°C.
2. Lubrication of bearing is to be made at regular intervals.

Hydrocyclone

I. Installation Requirement

1. Hydrocyclones are fixed on the foundation by anchor bolts.
2. Necessary pipe connections are made using suitable reducer couplings.
3. All fasteners should be tighten properly.
4. Center shaft to be vertical (to plumb) to the ground level.
5. Ensure that any gas cutting or welding is not done near the hydrocyclone. Fire/heat may damage the inner rubber liner of the hydro cyclone.
6. Hydro cyclones are installed away from any electric supply/distributor. Make sure there is no leakage from connections.
7. Coaxiality is to be maintained while replacing parts.

II. Operation

1. Ensure that all piping and fasteners are tightened properly, nothing should be left inside chamber and all valves opened completely before starting trial run.
2. All valve shall be complete open or close (backup valves), cannot be half-open or control flow by valves.
3. Ensure initial working is done using clean water, if pump is of same capacity as hydro cyclone. The pressure gauge shall stay const
4. ant, we need to check when there is obvious fluctuation. The working pressure shall be less than 0.3MPa.
5. When equipment working with normal pressure, any leakage in the connection part is to be checked and rectified.
6. Any residue remain in hydro cyclone will cause blocking. If blocking is from feeding side, overflow and bottom flow will reduce, and if blocking is from bottom side, bottom flow will reduce or stop, even strenuous vibration.

a) Whenever there is blocking, feeding valve shall be closed.

b) Using a screen before hydrocyclone feeding tank can reduce blocking.

Before starting again after cleaning, drain the feeding tank first to avoid block due to sediment.

6. After trial running with clean water, slurry can be used.

III. Maintenance

When the machine works properly, the pressure gauge is checked frequently for stability, as well as over flow and bottom flow. The fineness from hydrocyclone also needs to be checked from time to time.

1. If feeding pressure is not stable, it will affect the performance of the equipment and classifier. Due to less slurry for pump or blocking of pump, pump wear out creates pressure drops

a) If pressure fluctuation due to less slurry, more slurry can be added or one or two cyclone can be closed or speed of the pump can be reduced. If pressure fluctuation is due to blockage or abrasion the pump is to be cleaned/repaired.

2. If the system is blocked, check all working cyclone overflow and bottom flow. If flow is reduced or even stopped, it is a block due to hydrocyclone.

If there is blockage in feeding both overflow and bottom flow is reduced, cyclone's feeding valve is stopped for cleaning. If there is blockage in discharger the bottom flow is reduced or stopped, nut is taken out and cleaned.

3. Check the fineness of bottom flow, including fineness and thickness. If density fluctuates or discharging mixing with fine particles, it is to be adjusted immediately. Normal discharging state should be similar to umbrella. When is higher, discharging will be columnar, even intermittent.

density

a) High density of discharging is because of feeding high density slurry or discharger opening too small. Shall add some water from feeding side first, and if still remainsthe same, need to change bigger discharger. b) If the discharging is in umbrella shape, but density is still low, this may because of low feeding density. c) If too much fine from bottom flow occurs it may be because of bigger size discharger, small overflow diameter, higher or lower pressure should adjust pressure and change smaller discharger.

4. Check overflow data, density and fineness. The higher or lower density from overflow may be due to high feeding density or block of discharger.

   a) If there is block of discharger adjust the feeding density.

5. Whenever thickness is less than 50%, it should be replaced immediately.

Magnetic separator

I. Installation Requirement

It is installed over the belt conveyer, usually installation angle against belt is 15-30°, with height of 450mm which could be closer but not contact with materials. Make sure discharging direction before installing to suitable position.

II. Maintenance

1. Check if the installation height is proper or not.
2. Check if movement of separator is proper and in right direction.
3. Check voltage, insulation, earthing.
4. Check electric control components and connecting terminals.

Metal Detector

I. Installation Requirement

1. Base amplitude for Sensor foundation should be <0.5mm.
2. If the vibration of belt frame is too much, individual foundation is to made for detector and make sure as the vibration as low as possible.
3. Installation inclination of Sensor to ground <18°.

II. Operation

1. This machine can be working with magnetic separator or individually.
2. When using after magnetic separator it can check if there is any missed ironparticles. When using two sets, one before the other, alarm can be added if there is any missed iron particles and can stop the conveyer to remove it manually.
3. When working with magnetic separator it is better to keep a distance of 15 meters in order to avoid any disturbance to sensor.
4. If there is more than one set, wecan choose two different frequencies.
5. Sensor should be away from roller with at least 750 mm, protection shield in front of sensor should be installed 3-4 meters ahead.

TENOVA INDIA CONTRACT NO 19.2682

DOCUMENT 2682HBF001-OM-001

OPERATING AND MAINTENANCE MANUAL

Client : BHARAT HEAVY ELECTRICALS LIMITED

Contract No : 3882411 and 3882412

Project : Maitree 2X660MW

Tenova W.O. No : 19.2682

EQUIPMENT : 13M2 HORIZONTAL BELT FILTER

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
A	25.09.2019	PRELLIMINARY ISSUE	YOGESH A N		

tenova DELKOR

SECTION 1

19.2682001-OM-001

OPERATING AND MAINTENANCE MANUAL

HORIZONTAL BELT FILTERS

FOR
FLUE GAS DESULPHURIZATION SYSTEM

WARRANTY

WARRANTY PERIOD:

"FOR EQUIPMENT WARRANTY PLEASE REFER TO THE TERMS AGREED IN THE COMMERCIAL CONTRACT

1 INTRODUCTION

The **TENOVA INDIA PVT. LTD.**. Horizontal Belt Filter has been supplied for the filtration and testing of mineral sand slurry.

Drawing lists in Operating and Maintenance Manual Part 1, Section 13 should be referred to when reading this manual.

This operating manual may not be copied, reproduced or stored in a retrieval system, or transmitted in any form or by any means, to third parties for the purposes of competition, without the prior written consent of **TENOVA INDIA PVT. LTD.**

1.1 General Advice

This operating manual contains all the details concerning technical specification, operation and maintenance.

Persons operating this machine are obliged to study these operating instructions thoroughly and carefully; firstly, in order to prevent accidents and damage, and secondly, to ensure proper, efficient and economic operation of the machinery.

The items of plant described in this operating manual may only be operated, serviced and repaired by authorised and trained personnel. Qualified personnel are persons who, because of their education, experience, instruction and knowledge about relevant norms and regulations, accident-prevention regulations and business practices, have been made responsible by the plant manager for carrying out the work that may be required and, in doing so, recognising, avoiding and correcting possible problems.

1.1 Spare Parts

Wear, replacement and other parts not supplied by the manufacturer or his appointed agent shall not be covered by the guarantee. No liability shall be accepted for the parts of third parties, and their use shall invalidate the warranty.

Only by using original **TENOVA INDIA PVT. LTD.**. replacement parts, proper operation and the benefits of further technical developments can be ensured. When ordering replacement parts, they are to be specified according to the enclosed replacement parts lists and by means of the appropriate Order N° as per attached Spare and Wear parts lists or drawings and parts lists.

2 SAFETY

The machine shall be operated in accordance with these operating instructions otherwise the manufacturer's guarantee will be invalidated. Please do not hesitate to contact us in case of any questions.

New experience and knowledge gained through the operation of **TENOVA INDIA PVT. LTD** plant and equipment is incorporated immediately in the production of new machines. In some circumstances this new information may not be available at the time of printing these operating instructions.

In addition to this operating manual, please observe the following:

– The mandatory accident prevention regulations applicable to your operations

– The acknowledged technical regulations covering safe and correct working practices.

As a general rule, the safety advice contained in these operating instructions failure to comply with which can represent a danger to persons or to the machine and its operation, are characterised as follows:

Safety sign pursuant to ISO 3864 B 3.6 Electrical Hazard, e.g. when working on parts carrying voltage.

Safety Sign pursuant to ISO 3864 B. 3.1 Mechanical Hazard, e.g. When working on rotating parts and worm-type conveyers.

ATTENTION

To be obeyed in order to prevent physical damage to the machine and its function.

To be obeyed for safe and fault free operation.

2.1 Use in Accordance with the Conditions

The plant may only be installed and operated in accordance with the conditions stated in the confirmation of order.

Use of all the components of the plant in accordance with the conditions shall also be deemed to include the observance of the operating and maintenance instructions specified by the manufacturer. The machine must only be used in a technically perfect condition, as well as in accordance with the law and with an awareness of safety and the dangers, subject to adherence to the operating instructions. The machine is state of the art and has been built in accordance with officially recognised safety rules. Nevertheless, dangers to life and limb of the user or third parties, or damage to the machine or property can occur in its use. Faults in particular, which could affect safety, should be corrected immediately.

The use of process materials with properties deviating from those given for design purposes shall be deemed to be a use not in accordance with the conditions. Such use must be agreed with the **TENOVA INDIA PVT. LTD.** beforehand.

The data in the data sheets are to be understood as limit values and must not be exceeded.

Do not carry out modifications and conversions to the machine/plant, which could compromise safety, without the authorisation of the manufacturer! This also applies to the fitting and installation of safety equipment, valves and to welding on weight-bearing parts.

ATTENTION!
Unauthorized conversions and/or modifications carried out without the prior approval **of DELKOR (UK) LTD.** are not permitted, and will result in the lapse of the warranty!!!

2.2 Safety Instructions

All machine components have been manufactured to state of the art and in accordance with recognised safety rules. Nevertheless, danger to life and limb of the user or damage to the machine can occur during operation.

Only operate the machine in a technically perfect condition and follow all the safety advice and notices of danger on the machine.

Do not put damaged products into operation.

Read these instructions before assembling the machine and using it for the first time, and obey the law and its schedules applicable to drives and accessories.

Safety devices must not be rendered ineffective, nor should their legal effect be altered or impaired.

Have all faults repaired immediately, especially those that impair the safety of the machine.

Use personal safety equipment if necessary or legally required.

Inform the operating personnel how to switch off the main power supply; so that the machine can be switched off immediately should danger occur.

Only qualified personnel should assemble and commission the machine, and carry out repair and maintenance work.

After any repair work, check that all the safety components have been installed on the systems concerned.

In any case, the general and local safety and accident-prevention regulations, in addition to all national and international rules on accident prevention, apply to operation and all work to be done.

ATTENTION!
All work on the drive and lifting mechanisms should only be carried out with all motors switched off and safely isolated to avoid accidentally switching on before or during the work

All parts of the plant must be cleaned thoroughly prior to commencing inspections or maintenance work. In the case of maintenance or repair work during which naked flames or flying sparks may be caused due to grinding work (e.g. with an angle grinder) and/or welding work, the danger area must be thoroughly cleaned before the work commences. All combustible residues must be removed completely. Accident prevention regulations pursuant to VBG 15 "welding, cutting and Associated Procedures" or the equivalent national regulations in the country in which the plant is erected, should be observed and obeyed.

Important advice: This work must be carried out conscientiously and carefully, otherwise **there exists a fire and explosion hazard!!!**

Voltage-carrying, pressure-impinged, pressure-transmitting and rotating or moving parts of the machine can lead to serious or fatal injuries if improperly used or in the case of failure to obey the safety rules.

2.3 Transport and Storage

The following points should be observed when transporting, delivering and storing the various parts of the machine.

2.3.1 Transport Work and Safety Advice

There is danger due to swaying loads, a slipping or falling load, falling and crushing of limbs. Preventative measures:

- Attach the load securely; only use perfect and approved means of transport and craneage with the corresponding load-carrying capacity;
- Do not stop under moving loads; avoid the corresponding danger areas;
- Secure from falling;
- Obey accident prevention regulations.

2.3.2 Transport

- All parts must be handled carefully during transport, i.e. avoid dropping, knocking or otherwise risking damage to the parts;
- Hydraulic cylinders are to be transported in wooden chests;
- Goods are to be sufficiently insured against damage in transit and loss
- Marked contact points or eyes are to be used when loading and unloading
- Damage when loading and unloading is to be avoided.

2.3.3 Delivery

- Damage in transit or damage during loading or unloading is to be recorded in writing and notified within 48 hours of receipt of goods. If validation is not provided within 48 hours **TENOVA INDIA PVT. LTD.**. will not be held responsible for any consequential costs.
- Parts from subcontract suppliers are to be inspected for completeness in accordance with packing lists

2.3.4 Storage

- No parts of the plant may be stored in the open air.
- Drive, chain drive, electrical switching devices, etc. are to be stored in a warehouse protected from dust.
- Cylinders should be stored vertically whenever possible.
- Spigots, piston rods, flanges, etc. are to be protected against damage and covered if necessary.
- All other parts not listed above, e.g. screw conveyors etc., can be stored indoors without the need for special provisions.
- All machined parts, e.g. shaft journals, close-tolerance holes for cylinder mounting bolts, etc., are to be coated with a preservative, in the case of longer periods of storage, this preservation is to be inspected at regular intervals and renewed if necessary.
- All parts of the plant are to be stored in such a way that damage by third parties is excluded.
- See Section 12 'Storage Instructions

2.4 Assembly/Disassembly Work and Safety Advice

There is danger' due to lifting, falling, transporting, assembling, disassembling and crushing of limbs, conveyance of hazardous media.

Preventative measures:

- Secure and/or attach the parts to be assembled/disassembled and their immediate area;
- Carry out work with the greatest care;
- Only use approved means of lifting gear/craneage with the corresponding load-carrying capacity;
- Do not stop under swinging loads; avoid corresponding danger areas;
- Secure from falling;
- Obey the accident-prevention regulations;
- Wear personal protective equipment;
- Obey the safety and handling regulations applicable to the conveyance of hazardous media.

2.5 Commissioning and Operation Safety Advice

There is danger due to clothing being pulled in, crushing of limbs, conveyance of hazardous media.

Preventative measures:

- Secure the machine against being switched on unintentionally by third parties;
- Operation just with safety components being installed;
- Carry out work with the greatest care;
- Secure from falling;
- Obey accident-prevention regulations;
- Wear personal protective equipment;
- Obey the safety and handling regulations applicable to the conveyance of hazardous media.

PLEASE SEE THE SAFE OPERATING PROCEDURES AND UNDERSTAND THE RISK ASSESMENTS SUBMITTED WITH THE MANUAL WHILE CARRYING OUT THE WORK ON SITE

2.6 Maintenance and Service Safety Advice

There is danger due to clothing being pulled in, crushing of limbs.

Preventative measures:

- Work required on the machine should only be carried out when all moving parts are stationary
- All associated electrical supplies should be isolated to prevent accidental starting of equipment.
- Before beginning repair and maintenance work, preventive cleaning must be carried out conscientiously and with the greatest care, to exclude the possibility of fire and explosion.
- Obey accident-prevention regulations.
- Wear personal protective equipment.
- Obey the safety and handling regulations applicable to the conveyance of hazardous media.
- Refit all protective devices prior to re-commissioning.
- Pay attention to the points listed in the chapter "Commissioning" when re-commissioning.

It is therefore essential that you observe the following:

- **The currently valid national and international rules and guidelines governing accident prevention and the general safety requirements;**
- **The provisions of the present instruction including its schedules governing drives and accessories**

DISCLAIMER:-

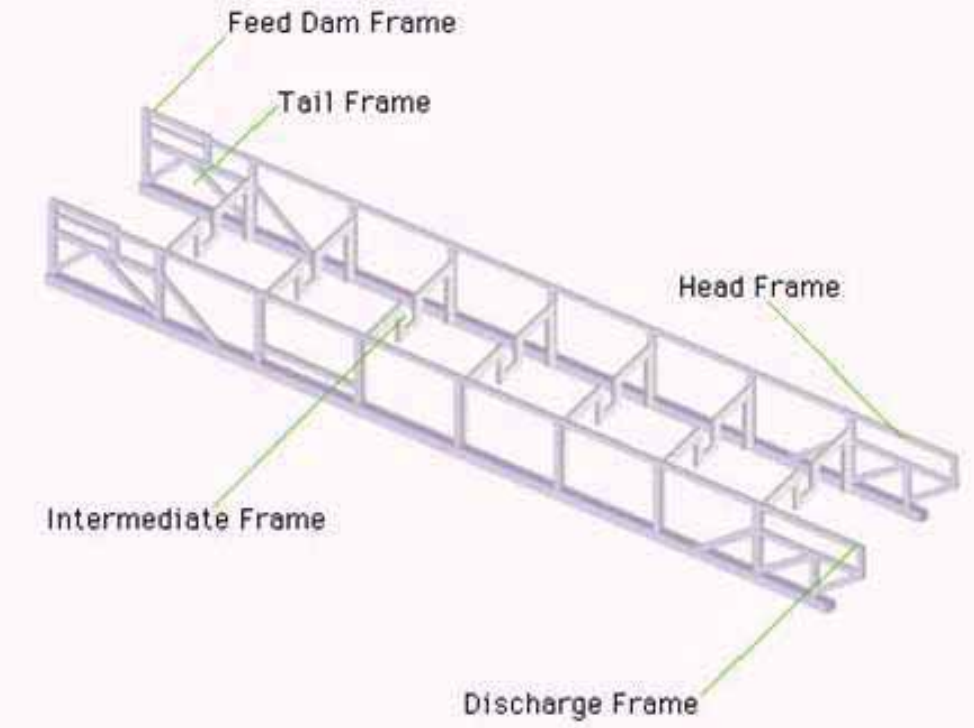
"THE SITE ERECTION TEAM MUST FOLLOW THE STRINGENT OF THE SAFETY NORMS BETWEEN "SAFETY NORMS OF THE SITE" / "SAFETY NORMS OF CONTRACTOR" / "SAFETY NORMS OF DELKOR"

3. **FILTER DESCRIPTION**

BELT FILTER ADVANTAGES OVER ROTARY DRUM FILTERS

1. Gravity assisted cake formation and reduced fines blinding
2. Non-metallic wetted parts – reduced maintenance
3. Reduced vacuum consumptions
4. Efficient separation of dewatering and washing zones allows:-
    a) Multiple, or counter-current wash applications per filter
    b) Steam drying
    c) Replacement of multiple repulp RVF's with a single HBF
5. Designs available for handling upto 900TPH with multistage washing ($100m^2$ HBF)
6. Reduced Cake Moisture (<8%w/w) and improved handling
7. Reduced Wash Waster consumption (300litre/Ton) and Cake Chloride content (<40 ppm).

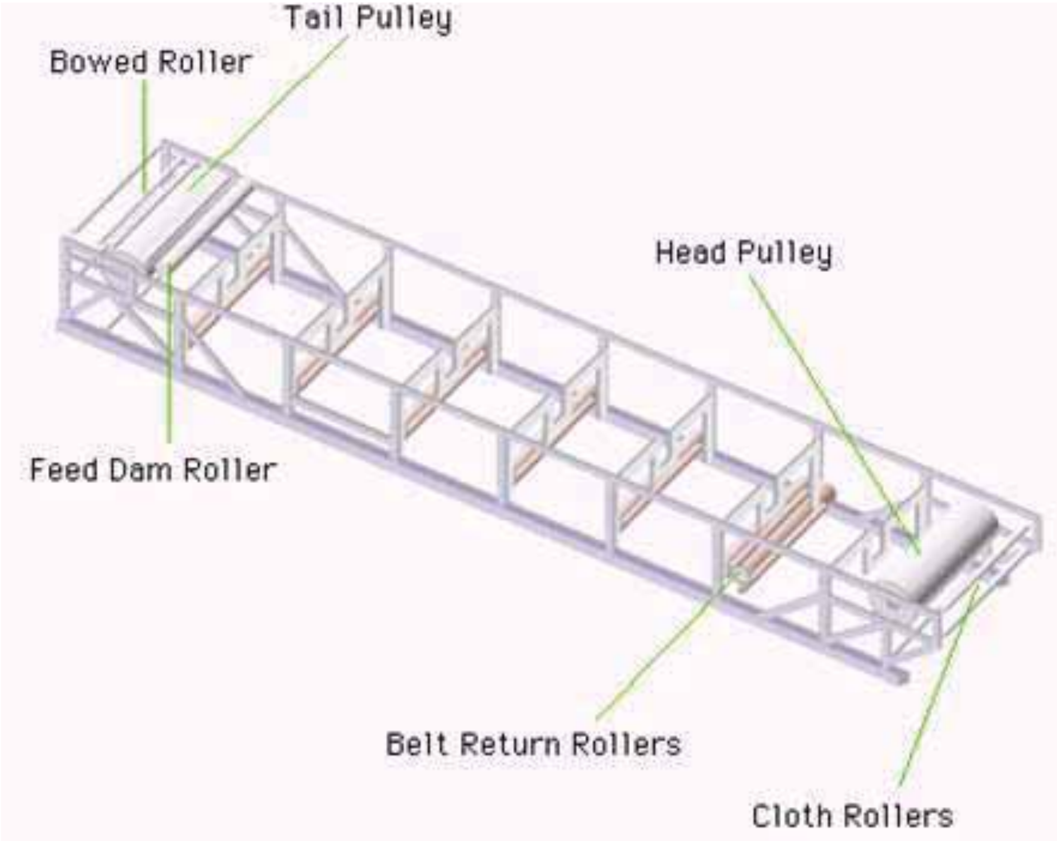
Typical Filter Frame



Delkor filters incorporate features proven on acidic/alkali and arduous conditions.

Frames are supplied in MS Epoxy Painted or Galvanised MS where appropriate to client requirements.

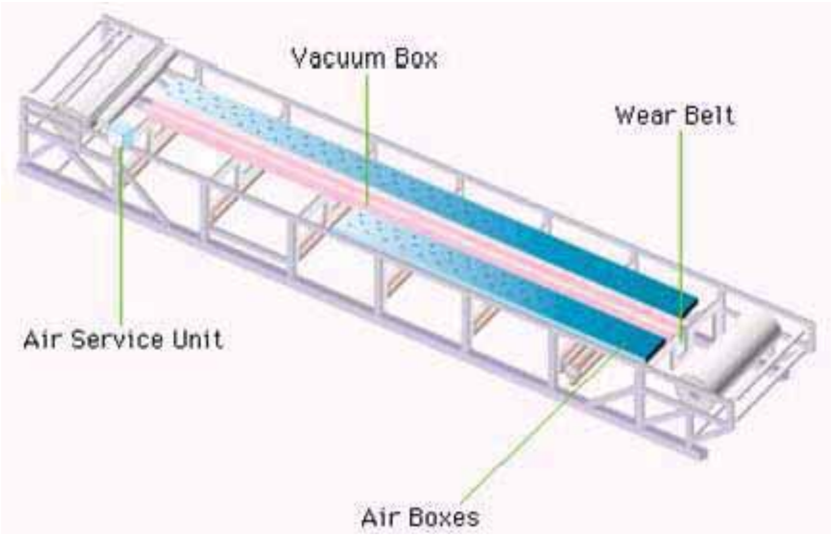
Pulleys & Rollers



Delkor Filters are supplied as standard with SS316 pulley shaft & roller shafts.

Pulleys are suppled with MSRL & Belt return rollers, Cloth Rollers are supplied in SS316.

Vacuum Box & Belt Support



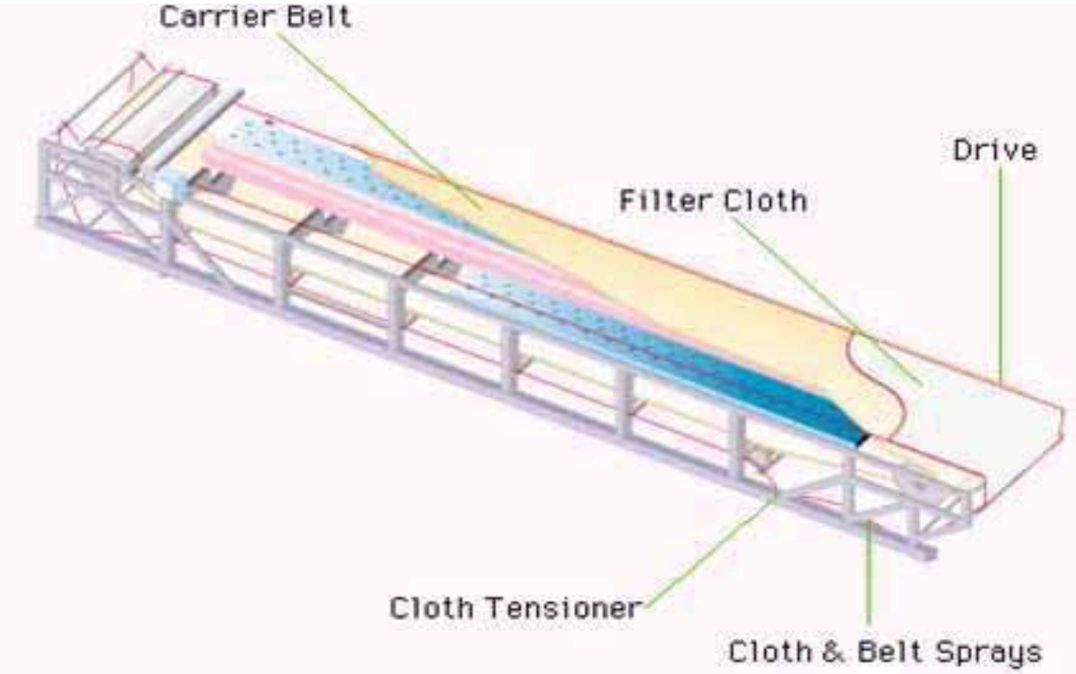
Delkor filters incorporate many options proven in the industry:-

Belt support – Airbox, Water or Belt Slide

Vacuum Boxes in either PP or high grade Stainless Steels .SS304/SS316 with Linatex Lining.

Low Drag load and Low Wear seal strip design – typical life of over 14 months.

Belt, Cloth & Remaining Components



Delkor make no compromises in material supply throughout the filter.

Belts and curbing are supplied in SBR or better grades.

Cloths are supplied in long life proven grades – upto 14 months.

Gearbox sizing includes allowance for wear, or slide belt failures unlike some vendors.

Rubber Belt & Curbing

BELT SUPPORT TECHNIQUES

Delkor offer three different support systems

- Air Box Support
  - Large High Speed/ High Capacity Filters
  - Process Water Shortage
- Wear Belt Support
  - Low Speed Filters
  - Thin Cake
- Belt/Water Slide Support
  - Large & Small Low Speed Filters
  - Highly Even Cake Thickness
  - Low Maintenance Costs

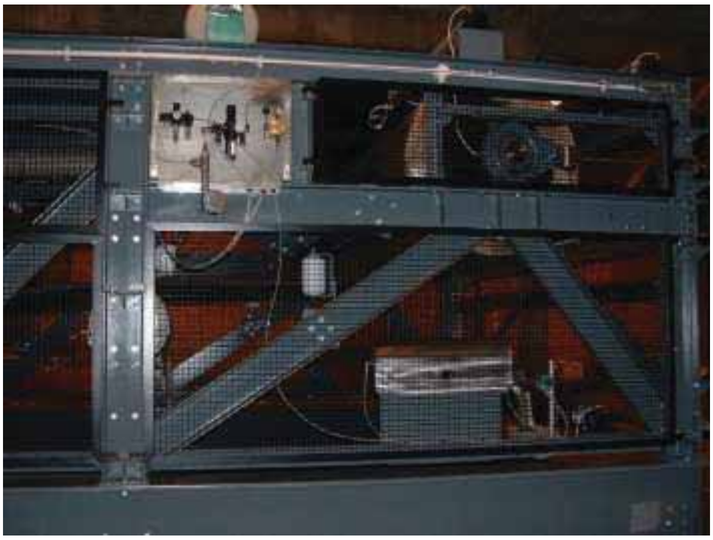
tenova
DELKOR

Cloth/Belt Washing

All Delkor filters are provided with a cloth/belt wash spray box, and integral spray bars.

These are designed to minimize spray mist in accordance with our clients wishes.

Cloth Handling



Tenova India will provide guarding as per ANSI B11 standard. Cloth tracking is via pneumatic fully proportional system to minimize stress on cloth. Cloth Tensioning is via gravity take-up to negate stretching

3.1 General Description of the Filtration Plant

The dewatering plant consists of process streams as per client specification, consisting of the following equipment supplied by Delkor:

1mtr2 Horizontal Belt Filter comprising:

- Horizontal Belt Filter
- Filtrate Receiver
- Filtrate Manifold and Hoses
- Vacuum Pump
- Filtrate Pump
- Instrument & Valve Set
- Skid for Filter

Drawing to be referred
Filter general Arrangement:
Filter P & ID:

3.1.1 Filter Feed

Filter feed slurry is gravity fed.

3.1.2 Filter cake Discharge

The dewatered solids are discharged from the filter via the filter discharge chute.

3.1.3 Filter Vacuum System

Vacuum is applied to the filter from the vacuum pumps. The vacuum draws air and liquid through the filter cloth/cake leaving a filter cake with the required moisture content.

3.1.4 Cloth and Belt Wash

Dirty water from the cloth and belt washing is collected via the cloth wash hopper, which is part of the foundations (by client).

3.1.5 Filtrate Liquid

Filtrate liquid is extracted from the cake via the vacuum box and is conveyed under vacuum through the filtrate hoses and manifold to the filtrate receiver.

4 SPECIFICATION OF EQUIPMENT

4.1 Filter Description

4.1.1 Introduction

The **TENOVA INDIA PVT. LTD.** Horizontal Belt Filter supplied is Model No: 5B/1-30V.

4.1.2 Materials of Construction

The equipment supplied consists of process-wetted parts fabricated in the following materials:

- NR--- NATURAL RUBBER
- Polypropylene(PP)/Ultra-High Density Polyethylene (UHDPE)/ Polyester
- MSEP/SS304
- FRP/GRP

The parts not in contact with the process are fabricated in the following materials:

- Mild Steel
- Plastics – PP/HDPE
- Epoxy painted mild steel

4.1.3 General Description

The **TENOVA INDIA PVT. LTD.** horizontal belt filter consists of a mild steel frame of bolted and welded construction, supporting tail and driven head rollers which carry and guide the main rubber filter belt, which in turn carries the filter cloth. The framework also supports:

- The cloth guiding and tensioning equipment
- The belt guiding and tensioning equipment
- The cloth and belt washing system comprising of 6 spray bars
- The filter belt and cloth return rollers
- The vacuum box
- The belt support assembly
- The drive unit
- The slurry feeder

4.1.4 Filter Frame

The filter frame is manufactured in mild steel, using adequately sized and folded steel to maintain belt tension and assure total framework rigidity. The framework design is sufficiently stiffened to take both the torque when the filter is in operation and full torque at filter start up.

The frame has been suitably designed to ensure that there is no vibration of the frame under all possible operating conditions.

4.1.5 Head Pulley

The head (drive) pulley is supported by two self aligning sealed roller bearings on the head frame.

The principle elements of pulley construction are listed as follows:-

Shell fabrication	:	Rolled mild steel.
End plate attachment	:	Shrink fit connection to shaft – welded to drum
Diameter	:	426 mm
Rubber Covering	:	Natural Rubber
Rubber covering thickness	:	10mm
Rubber covering hardness	:	50/60 Shore A Diamond pattern grooving
Shafts	:	EN3A

The rubber lining extends over the entire surface of the pulley.

4.1.6 Tail Pulley

The tail pulley is identical to the head pulley, differing only in stub shaft details and bearing arrangement. The bearings are mounted on slides to enable the filter belt to be tensioned.

4.1.7 Belt and Cloth Return Rollers

The rollers are manufactured to Delkor standard design. The rollers are covered as follows:

Belt Rollers	:	Main Body – Rubber Lined Mild Steel,
Cloth Rollers	:	Main Body – Rubber Lined Mild Steel,
Cloth Tracking Roller	:	Main Body – Rubber Lined Mild Steel,

4.1.8 Transporter Belt

The transporter belt forms the nucleus of the filter. It is manufactured in accordance with a specification that has been developed in conjunction with our belt supplier. In accordance with recommendations by the belt manufacturer, maximum life of the belt is achieved using 426 mm diameter pulleys and our fabric free centre zone carcass design. The belt is vulcanised in a press enabling high pressure to be applied to ensure maximum ply adhesion, which is essential for long belt life. This ensures a dense rubber, which is free from blowholes and has excellent abrasion resistant qualities. In the manufacturing process we specify extremely accurate tolerances for the width, thickness and straightness of the belt, in this way we ensure the following:

– The belt and curbing are straight and hence edge vacuum leakage between the curb and the cloth are reduced.

– That grooves are even in shape, depth and length.

– That the belt tracks straight and does not develop a "snaking effect".

The manufacturing technique provides a smooth surface to the groove, which reduces the filtrate friction and minimises deposition of solid material in the grooves. The transporter belt has a cloth impression

surface to assist with the drainage of filtrate. It is therefore essential to select an abrasion resistant rubber to ensure maximum life of this finish. A summary of the design features of the transporter Belt as supplied are:

Width	:	500 +/-10 mm
Overall thickness	:	26.5,+2/-1mm
Top Cover	:	16 mm
Bottom Cover	:	6mm
Carcass	:	3ply EE200
Cloth impression	:	Included
Method of joint	:	Factory spliced
Materials of construction	:	Natural Rubber
Hardness of bottom cover		65 ± 5 Shore A

Note:

– The belt is designed with a large safety factor to reduce stress reversal and hence increase belt life.

– A fairly hard rubber (65 ± 5 Shore A) is issued to reduce the friction co-efficient between the belt and the supporting material.

– The carcass free centre zone and the carcass free belt edges ensure that there is no contact between process fluid and belt carcass. The process fluids are only in contact with the rubber of the belt.

4.1.9 Transporter Belt Tensioning and Tracking

The transporter belt tensioning and tracking are accomplished by adjustment of the tail pulley bearings, which are mounted on slide rails. The tension is normally fixed at installation and further adjustment is not necessary.

4.1.10 Belt Curbing

These curbs are specially designed so that they have a tendency to "fold out" when going over the Head Pulley. This results in a flattening of the cloth edges, which prevents it from creasing at the edges. The curb height is set at 75 mm, which is sufficient to allow adequate slurry depth to prevent liquid spillage over the curbs. The curbs are angled so as to assist in supporting and locating the cloth.

4.1.11 Vacuum Box and Filter Belt Support

The vacuum box and the belt support is supported on its underside by Uhmwpe sections. These are supported in turn by the filter frame and intermediate supports. The assemblies are shimmed and set accurately to within 1mm level to ensure an even loading. On completion of the truing up the tops of the belt slide sections are clamped together and holding bolts are tightened.

4.1.12 Filter Cloth

The filter cloth is a monofilament Cloth with Close type clipper joint.

4.1.13 Cloth Tracking

The cloth tracking system consists of a rubber covered cloth roller set at a position where the cloth changes direction by 135°. The roller is mounted on a high-density polyethylene slide and moves backwards and forwards at one end when activated by a pair of pneumatic bellows. The bellows are controlled by a proportional control valve actuated by a paddle which follows the edge of the cloth which enables proportional 'steering' of the cloth to ensure alignment.

Supply includes a pressure regulator complete with integral isolation valve and pressure gauge. Inlet manifold materials are SS pipe, and flexible air tubing connects the regulator and control valve.

The cloth tracking system is fully proportional and designed such that no stress is put on the cloth fabric by sudden actuation of pinch rollers or similar devices. Wear on the edge of the cloth is minimised by careful design of the tracking sensor paddle.

Air consumption is approximately 2m3/h at 2.5 bar (g).

4.1.14 Cloth Tensioning

A counter-weighted rubber lined roller tensions the filter cloth which ensures that a dynamic tension is applied to the cloth at all times. The unit is placed at the discharge end of the filter to ensure full tension through the cloth wash zone and the cake discharge roller assembly. The weight of the roller is calculated for individual plant, taking into account size of the filter, type and quality of the filter cloth, as well as the characteristics of the technological process. The tensioning can be adjusted by addition or removal of weights.

The filter cloth is also tensioned by means of a gravity take up roller of mild steel construction and rubber covered. This system is designed to provide the minimum tension required to prevent cloth slip and in practice amounts to 50 kg/m cloth width. This cloth roller will require lifting during cloth changing

4.1.15 Bearings

All pulleys, cloth and belt rollers are supported by grease lubricated double roller bearings, fitted with lip seals designed to provide an L-10 rating of 100,000 hours of operation.

Head and Tail pulley bearings are provided in standard cast iron casings, with standard machine steel bearings as these have shown to be extremely reliable and cost effective.

4.1.16 Cloth Washing/Belt Washing

The filter cloth passes a series of spray pipes which are located at the discharge end of the filter. Belt sprays are fitted on the grooved side of the transporter belt and are used to clean any solids which may be deposited in the grooves and holes. This should only be used if necessary.

The details of the spray pipes and requirements are as follows:

Cloth / Belt groove Spray Pipes

Number of pipes	:	1 No
No of Spray Nozzles	:	24 No
Diameter of pipe	:	25 NB
Spray Angle	:	30 º
Material of pipe	:	SS 304
Nozzle Material	:	SS 304
Quantity of wash liquor	:	per spray pipe 2.8 m^3/
h Pressure of water	:	3 bar gauge

Other points are:

The spray nozzles have SS 304 bodies with replaceable SS 304 spray tips. This design of nozzle lasts far longer and maintains a constant spray angle. The spray angle used is 45° to ensure maximum cleaning efficiency. It is important that the supply to these sprays be kept free from entrained solids. This will maximise cloth life and prevent spray blockage.

4.1.17 Deck Items

4.1.17.1 Slurry Feeder

The feed slurry is fed through a double fishtail feeder. This comprises of SS304 wetted parts and is supported by a mild steel structure.

4.1.18 Instrumentation and Control

The Filter has the following instrumentation:

4.1.18.1 Cloth Limit Switches

Four cloth tracking limit switches are mounted on the filter frame as follows:

- A limit switch each side of the cloth to activate a cloth tracking alarm signal
- A limit switch each side of the cloth slightly further away from the cloth than the cloth alarm limit switches to activate a cloth tracking trip switch.

The limit switch positions will be set during commissioning.

4.1.18.2 Belt Limit Switches

Four belt tracking limit switches are mounted on the filter frame as follows:

- A limit switch each side of the belt to activate a cloth tracking alarm signal
- A limit switch each side of the belt slightly further away from the belt than the belt alarm limit switches to activate a belt tracking trip switch.

The limit switch positions will be set during commissioning.

4.1.18.3 Cloth Tension Limit Switches

Two cloth tension limit switches are mounted on the filter frame as follows:

- A limit switch on the upper travel of the cloth tension roller assembly
- A limit switch on the lower travel of the cloth tension roller assembly

The limit switch positions will be set during commissioning

4.1.18.4 Speed Control

Manual speed control is provided by the or DCS. Speed indication is generated from the inverter unit.

4.1.18.5 Safety Trip Wire Assemblies

Four emergency stop pull wires/pull switches are installed on the machine, Two on each side. These are located along the full length of the machine to ensure operator safety at all times.

4.1.18.6 Instruments

Please refer to the O & M Manual Section 05, Instrument Schedule, document 15.1865-BF-30 for further details.

4.2 Filter Component

4.2.1 Introduction

This section details the specific manufacturers of the main items likely to require routine replacing or servicing during the life of the filter.

4.2.2 Drive Unit

Refer VTR Document No :

4.2.3 Filter Cloth

Type : PE monofilament type

4.2.4 Bearings

Note: All fixed bearings are mounted on the drive side of filter. (Refer to O&M Manual, Part 2 for full technical specification)

4.3 Ancillary Equipment

4.3.1 Introduction

The following ancillary equipment has been supplied for use with each **TENOVA INDIA PVT. LTD.** filter.

4.3.2 Filtrate Receiver 1( )

Diameter	:	560 mm (O.D.)
Straight height	:	2175 mm
Material of construction	:	IS:2062
Filtrate inlet (from Filtrate Manifold)	:	200 NB
Filtrate Outlet	:	200 NB

4.3.3 Vacuum Pump and Motor

For manufacturers information on Vacuum Pump and Motor see OEM manual.

4.3.4 Local Control Panel

This Local Control Panel provides for manual operation of the filter, incorporating Filter Start/Stop and speed control, Process Start/Stop and Emergency Stop. The Local Control Panel is designed by Tenova Delkor

4.3.5 Discharge Chute

The discharge chute is installed at the discharge end of the filter to channel the discharge cake into the client's storage facility.

. 4.3.6 Vacuum Pump & Filtrate Pump

Refer VTR Document No : 7

5 INSTALLATION AND PRE-COMMISSIONING CHECK

5.1 Installation

Before attempting to run the filter it is essential that erection and installation is completed to **TENOVA INDIA PVT. LTD.** recommendations. The **TENOVA INDIA PVT. LTD.** Site Supervisor, following the erection of the filter, will check this work and a Mechanical Completion Certificate must be signed by **TENOVA INDIA PVT. LTD.**. and the client. Once the installation is completed, all electrical, air and water connections have been made and belt tracking, curbing and drilling is complete, the pre-commissioning the filter can commence.
Check that all bearings are greased and the gearbox and tracking air filter/regulator are filled with the correct oil/grease.

5.2 Pre-Commissioning

5.2.1 The filter cloth has to be fitted to the correct path shown on the filter General Arrangement drawing number A310-8-60-6331(the first fitting will be supervised by a **TENOVA INDIA PVT. LTD.** Commissioning Engineer).

NOTE: The filter cloth should not be fitted until all site work is completed and feed is available.

5.2.2 Commission the vacuum pump in accordance with the manufacturers' instructions and by blanking off the vacuum connections to the filter and the filtrate pump discharge, carry out a vacuum test. If desired, a vacuum test can be carried out by blinding the belt grooves and holes with a plastic sheet loaded with water. This technique is useful for identifying leaks in the vacuum seal area, but is not necessary unless problems are expected, or if adequate vacuum cannot be obtained on commissioning the filter.

5.2.3 Check that water pressure on vacuum box and belt support system lubrication is correct and that water is flowing.

5.2.4 Wash the underside of the belt to remove all dirt and foreign matter. Also hose the upper section of the belt underside to lubricate and clean the belt at the entry to the vacuum box and belt slide zone. It is recommended that a hose be positioned so that it sprays on the belt underside before it contacts the vacuum box for the initial few hours of operation.

5.2.5 Check that the compressed air line is open, the regulator filter is not blocked and filter contains the correct oil and is filled to the correct level. The cloth-tracking device should be checked manually for operation by swinging the tracking sensor arm to simulate movement of the cloth and checking the response of the tracking roller. If satisfactory operation exists then the filter can be run. See section 10.1.6 for detailed tracking instructions.

5.2.6 Check that all bearings are greased and that the gearbox is filled with the correct type of oil and to the correct level.

5.2.7 The filter drive should be started and the belt speed should be adjusted to obtain a slow belt speed.

5.2.8 At this point all trip switches should be checked in turn for correct operation as follows:

- Two transporter belt alarm switches
- Two transporter belt trip switches

tenova DELKOR

- Two cloth alarm switches
- Two cloth trip switches

If the filter does not stop check the electrical circuit. These travel switches will be adjusted during commissioning and finally fixed down.

5.2.9 All four trip wire switches should be individually tested by pulling the relevant pull wire to stop filter.

5.2.10 The belt speed should be increased slowly and if it is running satisfactory, it should be set to approximately midpoint of the operating range, which in this case gives about 6.2 m/min

Maintain a close watch on the position of the transporter belt on the main pulleys and if necessary, adjust the tail pulley to ensure the belt tracks correctly without wandering. It may be necessary to adjust the belt guide rollers situated along the sides of the transporter belt.

5.2.11 Check that the tension of the belt is such that slip does not occur on the drive pulley and that a catenary exists between the belt return rollers. Increase the belt speed gradually to full speed once the belt is tracking satisfactorily.

5.2.12 Check the feed water to the cloth and belt wash sprays, ensuring that they all appear the same and are not blocked. Check the angle of the sprays, which should be at 60° to the cloth, or belt for maximum effectiveness. Check the spray pressure, which should be at a pressure of 3 bar gauge for the correct spray pattern. Higher pressure will cause excessive fine spray droplets and lower pressure will lessen the effective cleaning of the cloth and belt.

NOTE: STOP THE MAIN DRIVE AFTER 2-3 HOURS RUNNING AND CHECK THE GAP BETWEEN THE WEAR BELT AND THE MAIN TRANSPORTER BELT WHICH SHOULD NOT EXCEED 0,5mm AND SHOULD BE EVEN ALONG THE LENGTH OF THE VACUUM BOX AND ON BOTH SIDES.

5.2.13 Re-start the main drive and vacuum pump and check that the wear belts are moving, (with no vacuum applied it is possible that the wear belts will not move).

5.2.14 Check that the slurry feeder is correctly positioned and are not blocked.

5.2.15 Check that there are no holes in the filter cloth. Holes can be patched by welding or sewing on cloth patches. Ultrasonic welding must be done on a clean dry cloth.

5.2.16 Set up and commission the cake thickness measuring system ensuring that the range, input and output signals are correctly scaled in accordance with the manufacturers' instructions. See section 11.1.11.

6 FILTER START-UP PROCEDURE

6.1 Initial Start-Up/Commissioning

It is assumed that all pre-commissioning checks have been carried out and the filter is running at its normal operating belt speed (approximately 50% speed), cloth sprays are operating and generally satisfactory conditions prevail.

6.1.1 Start vacuum pump up (it is important that the vacuum pump is not started up before the filter is running - the electrical sequencing is designed to prevent this happening).

6.1.2 Start feed onto the filter and maintain the minimum cake thickness required to get a good cake discharge (by experiment). It may be necessary to reduce the belt speed during this initial stage, to maintain a good cake at low feed rates.

NOTE: Vacuum can only be achieved once the entire vacuum area is covered with slurry..

6.1.3 Check that all sprays are open and covering the full width of the cloth and that the cloth is being cleaned completely on both sides. Clean any sprays if they are blocked.

6.1.4 Ensure that a good cake discharge prevails by adjusting slurry rate and belt speed to design limits.

6.1.5 Check that all ancillary pumps and equipment are working.

6.2 Normal Start-Up

Following a stoppage it is a relatively simple matter to restart the filter for normal operation.

6.2.1 If starting the system in manual operation ensure that vacuum box seal water, belt slide water, cloth sprays, cloth wash and cloth tracking compressed air are on. Start filter up, followed by vacuum pump. If automatic operation is to be used follow the auto start procedure.

6.2.2 Start feed and wash systems. Check that cake is at usual operating thickness, and adjust belt speed or feed accordingly. Visually check cake discharge, cloth cleaning and cloth tracking operation before leaving filter running unattended.

7 NORMAL OPERATION

Once the filter has been started, and has been allowed to settle down to normal operation, the process can then be left unattended. It is STRONGLY recommended that at least an hourly visual check is made on the filter to check that it is functioning correctly.

During normal operation the following routine adjustments may have to be carried out:

- Adjust the feed and belt speed to optimise the filter capacity and to obtain the most economic cake thickness. In general, the thinner the cake the greater the filter throughput per area..
- Adjust cloth washing flow / pressure to completely remove residual solids from the cloth.
- The washing sprays can be adjusted to minimise the wash water required for efficient washing of the cloth.
- Washing of the belt may not be required and the condition of the belt should be checked during operation with and without wash, to decide whether a wash is necessary.
- Usually belt wash is not required on a continuous basis, and only if solids deposition in the grooves occurs at a high rate will continuous belt wash be necessary. A visual check of the belt grooves at the feed end of the filter should be carried out once a shift. Belt washing is only necessary if solids can be seen in the grooves. Usually 5-10 minutes washing once a shift will be sufficient.
- Washing of the belt may not be required and the condition of the belt should be checked during operation with and without wash to decide whether a wash is necessary.

8 NORMAL SHUTDOWN PROCEDURE

8.1 Manual Operation

8.1.1 Stop slurry feed system

8.1.2 Allow the wet cake sufficient time to dewater and dry as much as possible and discharge all the cake.

8.1.3 Stop vacuum pump

8.1.4 Allow filter to continue running in order to rotate the cloth 2-3 revolutions to ensure that both cloth and belt are clean.

8.1.5 Stop drive

8.1.6 Stop cloth wash / Vacuum pump seal water pump

8.2 Automatic Operation

8.2.1 Initiate auto stop

9 ABNORMAL OPERATION AND EMERGENCY ACTION

9.1 Introduction

The horizontal belt filter allows very good operator visibility and it should be possible to detect / identify and correct any problems without any disruption to the overall operation of the plant. However, this depends on plant operators reacting to their visual observations and taking the appropriate action.

If a mechanical problem occurs the filter may stop automatically (electrical fault or limit switches making contact) and indicated on the Control Panel lamps or will require manual stopping. This will necessitate re-starting the filter after rectifying the fault.

9.2 Trouble Shooting

The main source of problems and their solutions are listed below under distinct headings. This is not intended to be a comprehensive list of all possible faults, although the main ones that are likely to occur are covered.

9.2.1 Loss of Vacuum

An indication will be a gradual increasing of the size of the dewatering zone and increase in filter cake moisture (i.e. wet cake discharge). Check the following after having listened for a whistling noise around the filter and vacuum lines. A whistling noise may be due to a vacuum leak and if present is usually the cause of low vacuum:

- Check that the vacuum pump is running at correct speed and supplied with cold seal water.
- Check if there is sufficient feed slurry/cake on filter.
- Check wear belts are running and water is supplied to seal strips.
- Check that main transporter belt is tracking straight.
- Check that filtrate is being removed satisfactorily.
- Check all joints in vacuum system, manifold and receiver for leakage.
- Check wear belts for possible damage.
- Check vacuum box/transporter belt gap.
- Check all joints and end brackets of vacuum box.

9.2.2 Bad Cake Discharge

Check the following:

- Is the vacuum level acceptable?
- Is the cloth “blinded”?
- Is the correct filter cloth fitted?
- Thickness of cake.
- Dryness of cake.
- Belt speed.
- Cloth tension

9.2.3 Belt Tracking

Adjust head/tail pulleys/belt return rollers (see Section10.1.6)

9.2.4 Power Failure

In the event of power failure ensure that feed system has closed down. To re-start the filter, follow the instructions in Section 6.2.

9.2.5 Instrument Air Failure

In the event of instrument air failure all the equipment will shut down automatically if the plant is being run in the auto mode. In manual mode, check that the feed system has stopped, and then stop the equipment in the reverse of normal starting sequence.

- Stop filter drive
- Stop ALL pumps

9.2.6 Tearing of Cloth

In the event of the cloth tearing:

- Repeat the process as described in 9.2.5.
- Repair cloth.
- To restart repeat the process as described in 7.2.

9.3 Spare Parts

Wear, replacement and other parts not supplied by the manufacturer or his appointed agent shall not be covered by the guarantee. No liability shall be accepted for the parts of third parties.

Only by using original **TENOVA INDIA PVT. LTD.** replacement parts, proper operation and the benefits of further technical developments can be ensured. When ordering replacement parts, they are to be specified according to the enclosed replacement parts lists and by means of the appropriate Order N° as per attached Spare and Wear parts lists or drawings and parts lists.

10 PLANT MAINTENANCE

NOTE: Maintenance check sheets must be completed and forwarded to Delkor by the 10th day of every month. Failure to forward check sheets will result in the warranty being made void.

NOTE: Failure to comply with this section will void the warranty!

10.1 Filter Maintenance

10.1.1 Shift and Daily Inspection

These checks should take one **operator** one hour.

NOTE: Maintenance check sheets must be completed and forwarded to Delkor by the 10th day of every month. Failure to forward check sheets will result in the warranty being made void.

– Visually inspect the cloth at the feed end to ensure it is clean and hole free
– Visually check for solids build up on pulleys and rollers.
– Ensure underside of belt is clean.
– Check curbing for damage.
– Check wear belts for wear by inspecting the cloth.
– Check spray pipes for blocked nozzles.
– Check belt grooves for solids and any necessity for more frequent belt washing
– Check air pressure.
– Check cloth tracking unit for operation and position, including pneumatics.
– Record any deviations or observations.

For details of maintenance checks on other equipment, consult O&M Manual, Part 2 detailed literature attached.

Filter drive/ gearbox	:	O&M Manual, Page no 144
Vacuum pumps	:	O&M Manual, Page no 104
Filtrate pump	:	O&M Manual, Page no 135

10.1.2 Weekly Inspection

TENOVA INDIA PVT. LTD.. recommends that the horizontal belt filter is operated for one 8 hour shift per week with only hot water being fed through the slurry / wash feeders. This will help to re-dissolve and soften any scale which has built up in the vacuum boxes. The vacuum boxes should then be lowered, inspected and any remaining scale should be removed manually.

These checks should take one mechanic/fitter approximately 3 hours

NOTE: Maintenance check sheets must be completed and forwarded to Delkor by the 10th day of every month. Failure to forward check sheets will result in the warranty being made void.

tension roller assembly is operating correctly.

- Check seal water system for blocked or leaking hoses. It may be necessary to open control valves to full bore in order to flush out any accumulated solids in the piping and the belt slide grooves.
- Check pulleys, cloth and tracking roller and all support rollers for wear and freedom of movement.
- Check filter gearbox oil level and breather cleanliness - O&M Manual Part 2 – Filter drive
- Check pneumatic lubricators are clean.
- Check cloth wash spray nozzles

For details of maintenance checks on other equipment consult O&M Manual Part 2, detailed literature attached.

10.1.3 Monthly Inspection

This maintenance inspection is to be done during filter shutdown and will take two mechanics / fitters eight hours

NOTE: Maintenance check sheets must be completed and forwarded to Delkor by the 10th day of every month. Failure to forward check sheets will result in the warranty being made void.

- Check seal water system, clean seal water grooves and seal water connections, located in the side and top of seal strips.
- Check vacuum box hoses for damage and flush through
- Check operation of cloth and belt limit switches and trip wire switches.
- Check all bearings drawing number to see that the lubrication has been carried out.

NOTE: MAINTENANCE IS CUMULATIVE AND MUST BE SCHEDULED AS SUCH

10.1.4 Filter Cloth Replacement

10.1.4.1 Before removal of the old filter cloth, the new filter cloth must be mounted on a bar between two trestles at the feed end of the filter. Note the cloth path. Tie back the cloth tracking sensor arm.

NOTE: The new cloth location must be at the filter tail end on top of the maintenance walkway or if necessary on top of the filter frame.

IMPORTANT

CARE MUST BE TAKEN WHEN MOUNTING THE NEW CLOTH TO ENSURE THAT THE INSTALLATION MARKS ARE FACING UPWARDS AND "DIRECTIONAL" ARROWS POINT IN THE CORRECT DIRECTION.

10.1.4.2 By running the filter, position the cloth joint on top of the filter after the last cake wash station. Stop and isolate the filter.

10.1.4.3 After lifting the tension roller, remove the old cloth completely. The old cloth can then be discarded or, if necessary, portions removed for patching or minor repair work. Small holes and tears in the filter cloth can be repaired by sewing a patch of old cloth over the top of it.

10.1.4.4 When fitting the new cloth care must be taken to ensure that the new filter cloth follows the exact path of the old cloth. Centralise the cloth on the belt and return rollers.

10.1.4.5 Join the cloth using the clipper joint built into the cloth. Seal down the flap.

10.1.4.6 The filter can then be put back into operation after dropping the tension roller and untying the sensor arm, running for a short period to allow the tracking unit to centralise the new cloth.

10.1.5 Tracking Adjustment for Filter Cloth

10.1.5.1 Principle

To track the cloth the tracking roller must be steered using the analogy of car steering. Look in the direction of the cloth travel and steer the roller forward on the side where the belt is overlapping the clip edge.

10.1.5.2 Operation

Moving the paddle to the left to rotate the control valve clockwise will send air to expand the right bellows. Moving the paddle right similarly expands the left bellows. The bellows move one end of the roller, which in turn steers the moving cloth.

10.1.5.3 Adjustment

If the cloth tracking roller is predominantly to one side the tracking system will need to be adjusted. For small movements loosen the control support arm and move the control valve (sensor) in the direction you wish the cloth to move.

NOTE: Moving the arm 10mm moves the cloth about 40mm.

For large movements remove the paddle and steer the cloth by hand turning the control valve shaft. When the cloth is central, align the red mark on shaft with red line on controller body checking bellows are central. Refit the paddle carefully checking red lines line up. Check 16° offset approximately is maintained, if not, move control valve support arm to suit.

After any adjustment tracking should be checked for central running for 30 minutes to ensure alignment.

10.1.5.4 Adjustment of Bellows Movement

The two single bellows are fitted with packers to enable the total stroke to be adjusted. Additional movement of the bellows will provide a more powerful tracking action. However, a minimum of 18 mm of packing must be retained on each side or excessive bellows movement may result in the cloth tracking roller being arrested.

NOTE: Maintenance check sheets must be completed and forwarded to Delkor by the 10th day of every month. Failure to forward check sheets will result in the warranty being made void.

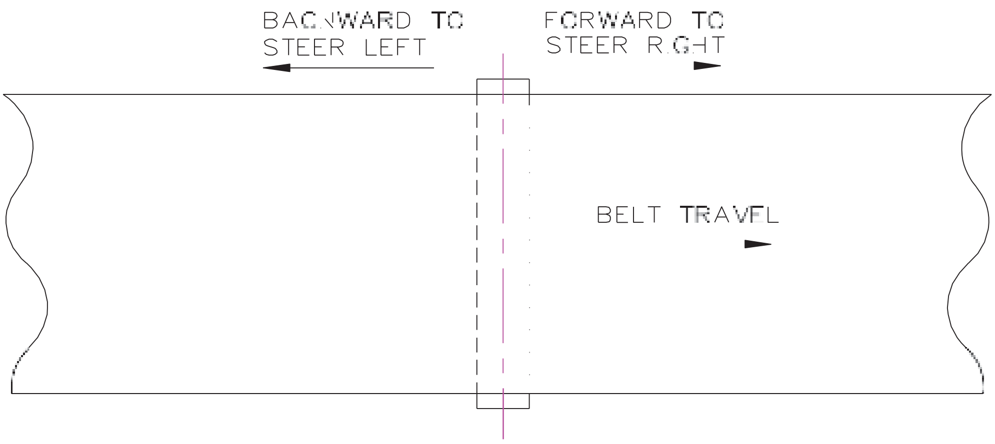


FIGURE 1

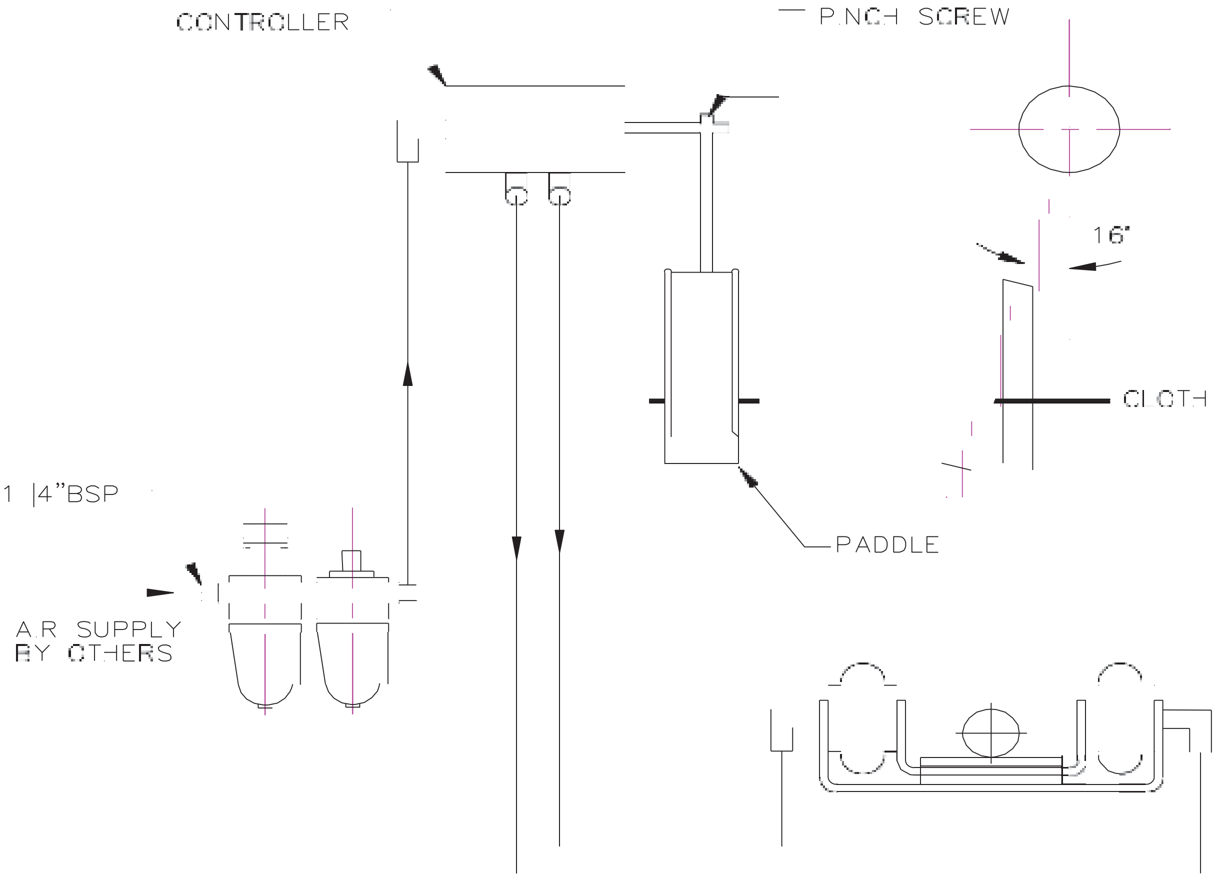


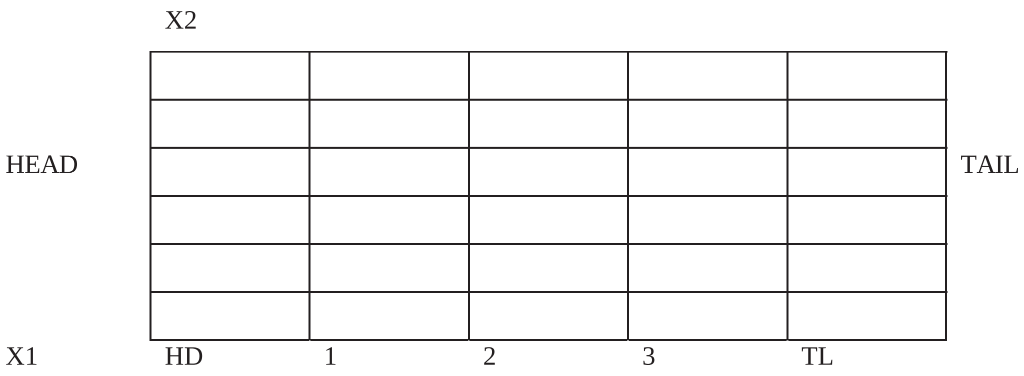
FIGURE 2

10.1.6 Belt Tracking

It is important the belt is checked for tracking at daily intervals for the first 2 weeks of operation and thereafter, if stabilised, at weekly intervals to ensure that the filtrate holes are correctly aligned to the vacuum box. Since a parallel tolerance is permitted in the belt construction at least 2 positions should be marked 180° apart on the belt and 1 position on the frame from which all measurements are made.

A TENOVA INDIA PVT.Ltd Installation Supervisor will make the initial setting. The setting dimensions for the belt return rollers and tail pulley should be recorded in Table 1 immediately after commissioning.

10.1.6.1 Settings for Belt Return Rollers



ROLLER INDENT	X1 DRIVE SIDE	X2 NON DRIVE SIDE
HEAD PULLEY		
BELT RETURN ROLLER NO 1		
BELT RETURN ROLLER NO 2		
TAIL PULLEY		

10.1.6.2 If the belt requires re tracking the following should be adhered to:

- Check all pulley bearings are securely fastened. If head or tail pulley bearings are loose they must be refastened so that head and tail pulleys are in the same position as originally after first belt tracking.
- Check pulleys to ensure no build up of debris is present.
- Check belt is clean on underside.
- Working on the belt return rollers, check settings are as in Table 1. On the bearing that is furthest adrift from the initial setting adjust roller beyond the initial setting in the direction required to bring the belt back to the centre line setting. The belt should be steered as a car steering wheel i.e. forward in the direction of belt movement to move belt to the opposite side. Just prior to reaching the initial setting of the belt, the belt roller should be returned to the initial setting to avoid over correction.
- Several revolutions should be monitored to ensure belt position remains stable.

10.1.7 Filter Belt Repairs

Damaged filter belts may be repaired, by hot or cold vulcanising, as this is a specialised procedure and requires special tooling.

NOTE: This should only be done in consultation with TENOVA INDIA PVT.Ltd

10.2 Filter Gearboxes Maintenance

See O&M Manual, Page no 144

10.3 Spares

Refer A310-P03-07205-LI-0005

Procurement of Spare Parts

NOTE: The use of spare parts not supplied by TENOVA INDIA PVT.LTD. without prior consent from TENOVA INDIA PVT.LTD. will invalidate the warranty.

In order to procure replacement parts for any of the equipment supplied by **TENOVA INDIA PVT.LTD.** a written enquiry should be sent to: -

SPARES DEPARTMENT

Tenova India Private Limited

Tenova India Pvt Limited

108/D, 6th Main Road III Phase,

Peenya Industrial Area, Peenya

Bangalore 560058 - India

T +91 80 4262 1000 F +91 80 2839 7540

delkor.india@tenova.com

A description of the item with drawing number and manufacturer /sub vendor should also be included.

PSER

RECORD OF QUALITY CHECKS

SHEET NO. OF FQP	CHECK NO.	RESULTS ACHIEVED OK / NOT OK	DRAWING / DOCUMENT REFERENCE	FORMAT OF RECORD	INSPECTED BY SIGN. & DATE	CLEARED BY SIGN. & DATE	REMARKS

Note: Any protocol made is to be numbered & mentioned in "Format of Record" column.

		SYSTEM	SUB-SYSTEM	AREA	FQP NO.: QPE-MTE-660-BR-51
PROJECT					REV. NO. : 1
UNIT NO.					LOG SHEET NO. : **L- 00**
RATING					PAGE **1** OF **1**

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

INWARD INSPECTION CHECKLIST

ITEM	VALUE CONDITION (ACTUAL)	VALUE CONDITION (REQUIRED)	DATE	INITIALS
1.0 Feed end head				
Head to Shell Bolting Flange				
a) Condition of bolting flange				
b) Condition of locating surface				
c) Condition of bolt holes				
Trunnion				
a) Condition of bearing support surface				
b) Condition of feed chute seal mounting & contact surfaces				
Liner Bolt Holes Condition of liner bolt holes				
2.0 Discharge end head				
Head to Shell Bolting Flange				
a) Condition of bolting flange				
b) Condition of locating surface				
c) Condition of bolt holes				
Trunnion				
a) Condition of bearing support surface Trommel to Trunnion Bolting Flange (if trommel is provided)				
b) Condition of bolting flange				
c) Condition of locating surface				
d) Condition of bolt holes				
Gear Bolting Flange				
a) Condition of bolting flange				
b) Condition of locating surface				
c) Condition of bolt holes				
3.0 Mill Shell				
a) Condition of feed head bolting flanges				
b) Condition of feed head locating surfaces				
c) Condition of feed head bolt holes				
d) Condition of discharge head bolting Flanges				
e) Condition of discharge head locating surfaces				
f) Condition of discharge head bolt holes				
g) Condition of gear bolting flange				
h) Condition of gear locating surfaces				
i) Condition of gear bolt holes				
j) Condition of liner bolt holes				

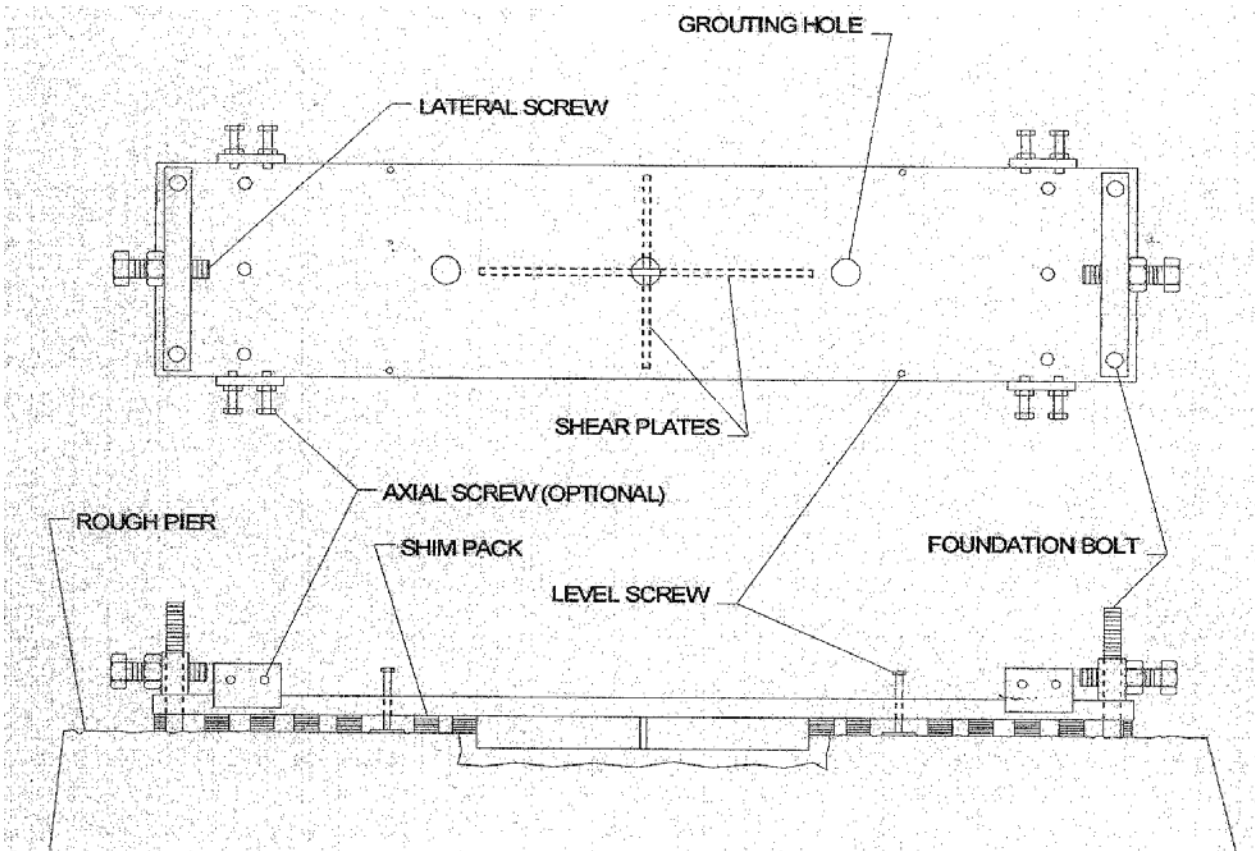
	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

INWARD INSPECTION CHECKLIST

ITEM	VALUE CONDITION (ACTUAL)	VALUE CONDITION (REQUIRED)	DATE	INITIALS
4.0 Fixed end mill bearing support				
a) Condition of bottom support surface				
b) Condition of insert support surface				
5.0 Free end mill bearing support				
a) Condition of bottom support surface				
b) Condition of insert support surface				
6.0 Bearing inserts				
a) Condition of inside surface				
b) Condition of outside surface				
7.0 Fixed mill bearing support plate (sole plate)				
a) Condition of support (top) surface				
b) Condition of grout (bottom) surface				
8. Free mill bearing support plate (sole plate)				
a) Condition of support (top) surface				
b) Condition of grout (bottom) surface				
9. Drive support plate (sole plate)				
a) Condition of support (top) surface				
b) Condition of grout (bottom) surface				
10. Trommel (if provided)				
a) Condition of trommel to trunnion flanges				
b) Condition of trommel to trunnion locating surfaces				
c) Condition of trommel to trunnion bolt holes				

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

SUPPORT PLATE



Record level measurement readings at four equally spaced locations

Fixed Trunion :

Lateral: L1: L2: L3: L4:
Axial : L5: L6: L7: L8:

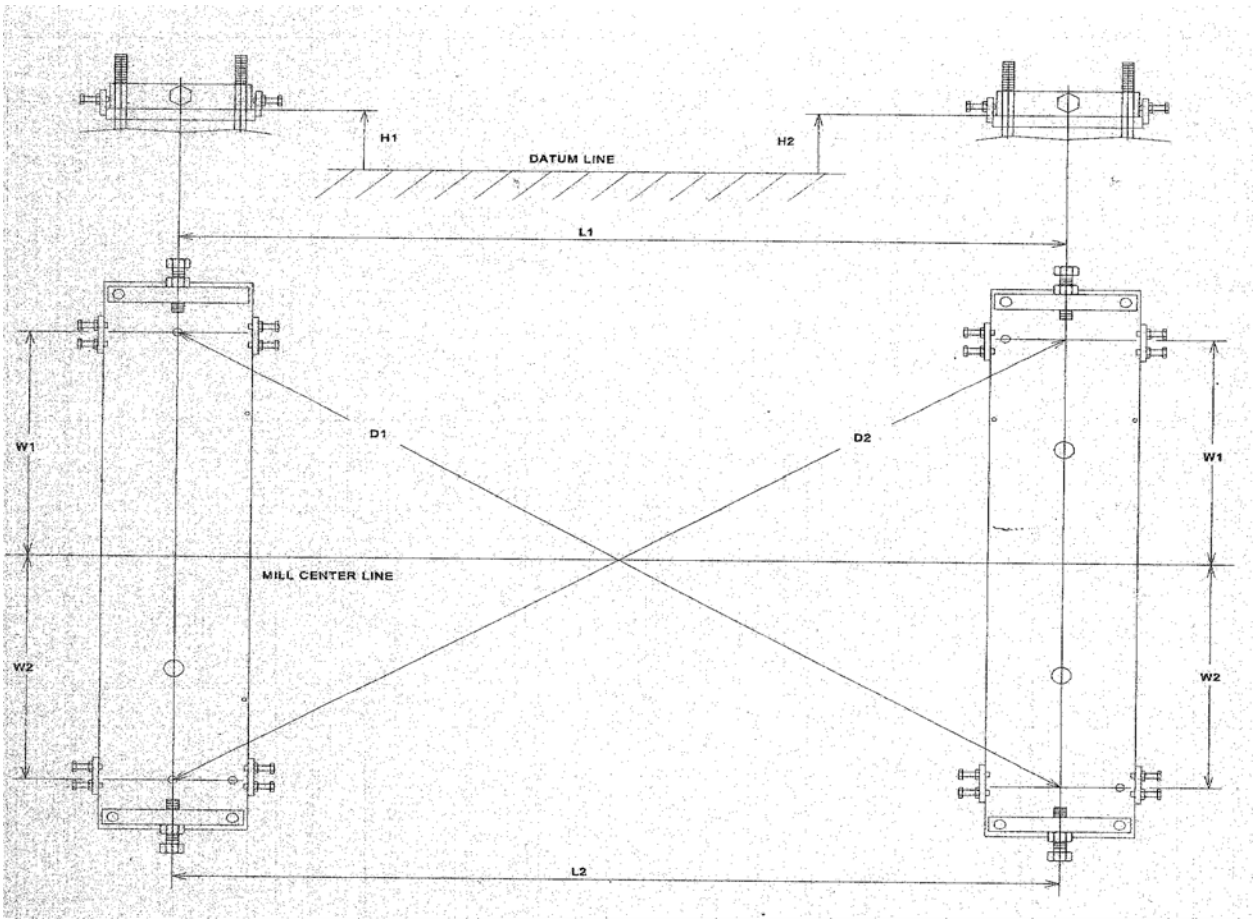
Floating Trunion:

Lateral: L1: L2: L3: L4:
Axial : L5: L6: L7: L8:

			NAME	SIG./DATE	QP NO.: QPE-MTE-660-BR-51
PROJECT		CHECKED BY			REV. NO. : 1
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-02
RATING		CUSTOMER			SHEET: 01 OF 02

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

SUPPORT PLATE



Record level measurement readings at four equally spaced locations

Fixed Trunion :

D1: D2: H1: H2:

L1: L2:

Fixed Trunion : W1: W2:
Floating Trunion : W1: W2:

			NAME	SIG./DATE	QP NO.: QPE-MTE-660-BR-51
PROJECT		CHECKED BY			REV. NO. : 1
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-02
RATING		CUSTOMER			SHEET: 02 OF 02

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

MAIN BEARING ALIGNMENT & MILL SHELL

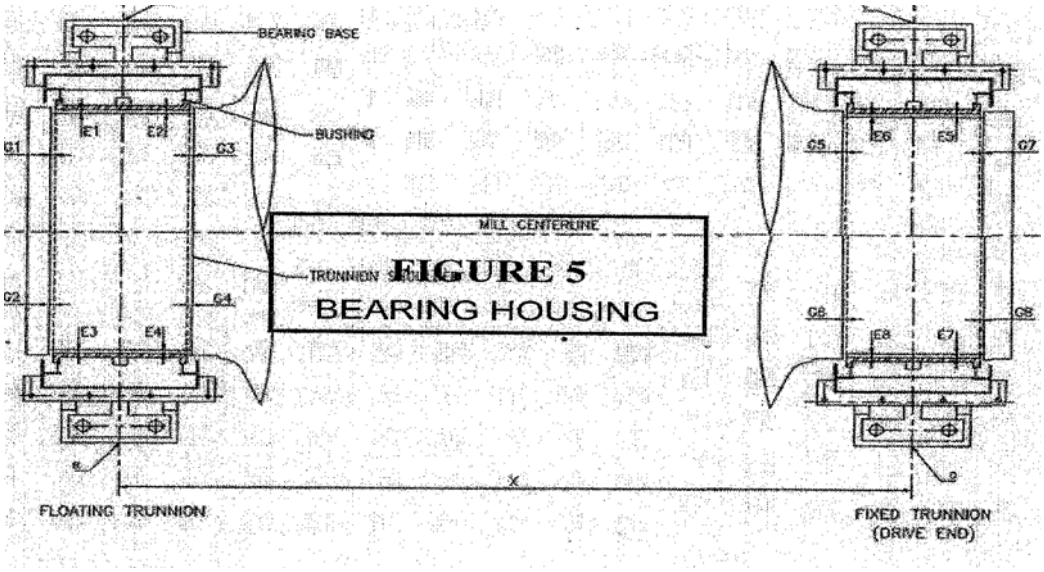


FIGURE 5
BEARING HOUSING

Where X equals the actual center to center distance of the bearing bases

AC=BD =X +/- 0.8 mm

Preliminary Bearing Alignment Mill Empty : Gear and liners not installed

Record bearing clearance

FLOATING TRUNION	FIXED TRUNION
G1:	G5:
G2:	G6:
G3:	G7:
G4:	G8:
E1:	E5:
E2:	E6:
E3:	E7:
E4:	E8:

Trunion Dye contact check : indicate % of contact area :

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

Final Bearing Alignment Mill loaded : 75 % Ball and Ore Load

Record bearing clearance

FLOATING TRUNION	FIXED TRUNION
G1:	G5:
G2:	G6:
G3:	G7:
G4:	G8:
E1:	E5:
E2:	E6:
E3:	E7:
E4:	E8:

Trunnion Dye contact check : indicate % of contact area

RTD TEMPERATURE RECORD

NO LOAD OPERATION	**Fixed Trunion**	**Floating Trunion**
Inward RTD		
Outward RTD		

PARTIAL LOAD OPERATION	**Fixed Trunion**	**Floating Trunion**
Inward RTD		
Outward RTD		

FULL LOAD OPERATION	**Fixed Trunion**	**Floating Trunion**
Inward RTD		
Outward RTD		

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

MILL FLANGE RUNOUT

HOLE No	DTI "A" READING	DTI "B" READING	MILL FLANGE AXIAL RUNOUT ALGEBRIC DIFFERENCE OF DTI 'B" AND DTI "A" READINGS	SHIM PACK THICKNESS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

			NAME	SIG./DATE	QP NO.: QPE-MTE-660-BR-51
PROJECT		CHECKED BY			REV. NO. : 1
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-04
RATING		CUSTOMER			SHEET: 01 OF 01

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

BACKLASH

GEAR TOOTH No	LEFT END OF FACE		RIGHT END OF FACE	
	CONTACT SIDE OF TOOTH	BACKLASH SIDE OF TOOTH	CONTACT SIDE OF TOOTH	BACKLASH SIDE OF TOOTH
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

	INSTRUMENT REG. NO./TAG NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

ROOT CLEARANCE

GEAR TOOTH No	ROOT CLEARANCE	
	LEFT END OF FACE	RIGHT END OF FACE
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

BIFPCL DOC. NO. : MAITREE-00-HT-QA-300087-PSE, REV. NO. : 1

PSER	INSTRUMENT REG. NO./TAG		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

PROTOCOL

			NAME	SIGNATURE & DATE	FQP NO.: QPE-MTE-660-BR-51
PROJECT		INSPECTED BY			REV. NO. : 1
UNIT NO.		CLEARED BY			PROTOCOL NO.
RATING		CUSTOMER			PAGE: