



**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

Product
STD NO. **BA90004**

Rev No. **00**

Page **1** of **3**

TECHINCAL PRE-QUALIFICATION REQUIREMENTS

ACCEPTANCE CRITERIA

Mill Circuit Pump for handling Limestone slurry in Wet ball milling system

SL. NO.	REQUIREMENT	ACCEPTANCE	REMARKS
1.	Capacity/Rating of the system.	Supply of similar or bigger capacity mill circuit pump for wet ball mill system, to at-least one thermal power station, and which are in satisfactory operation for a minimum period of one year as on the date of submission of bid documents.	a) Reference List of supplies made so far. b) Un-priced PO copies of the reference supplies. c) End-user certificates of the reference stations.
2.	Design / Engineering capability for designing of suitable mill circuit pump to meet customer specification requirements	Bidder must have exclusive engineering/design capabilities	Details of Design methods adopted or Collaboration documents to be furnished.
3.	Manufacturing facilities	Bidder must have manufacturing facilities for manufacture of similar rating of Mill circuit pump.	a) Detail list of Manufacture facility shall be furnished. b) Details of Manufacturing facilities at tied-up parties, in case of offloading of manufacturing, shall be furnished (if applicable)
4.	Testing facilities	Bidder must have testing facilities for similar rating of Mill Circuit Pump.	Test reports to be furnished.

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Revisions:

Refer to record of revisions:

Prepared:

K PAVAN

Approved:

KHRK

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16.05.2022**

Form No. 	PRODUCT STANDARD PULVERISERS HYDERABAD		Product STD NO.	BA90004
	Rev No. 00			
	Page 2 of 3			

COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.	5.	Inspection agencies for earlier supplies	Lloyds / TUV / NTPC / BHEL / SGS / BHEL TPIA or any other International/ Indian inspection agency.	Copies of earlier inspection certificates to be furnished.
	6.	Service after Sales & supply of spare parts	Availability of service center and technical experts to meet the after sales service requirements for the supplied equipment at project sites.	Details of the service centers and technical expertise to be furnished.
	7.	Financial capability	Financial turnover shall be atleast 50% of the value of the bid.	Financial turnover of the bidder during last three years (certified by CA) shall be submitted.
	<p><u>NOTE :</u></p> <p>The Suppliers not meeting the above criteria (OR) not submitted the required documents will be disqualified.</p>			

Revisions: Refer to record of revisions:	Prepared: K PAVAN	Approved: KHRK	Date of First Issue: 16.05.2022
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Rev No. 5

Form No.



PRODUCT STANDARD
PULVERISERS
HYDERABAD

Product | **BA90004**
STD NO.


Rev No. 00

Page 3 of 3

RECORD OF REVISIONS

REV.NO	DATE	REVISION DETAILS	REVISED	APPROVED

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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD		BA89110																				
				Rev No. 01																				
				Page 1 of 33																				
<p>TECHNICAL SPECIFICATION FOR MILL CIRCUIT PUMP</p> <p>1. Intent of specification</p> <p>This specification is intended to cover the design, engineering, manufacturing, inspection and testing at manufacturer's works, packing and delivery to site, supervision of erection and commissioning of Mill Circuit Pump along with its accessories complete in all respects.</p> <p>The pumps shall be designed for continuous operation capable of delivering the rated flow at rated head with margins as specified in the specification. The mill circuit slurry pump is used to feed the limestone slurry (mixture of limestone and water) to hydrocyclone in wet ball milling system. The pumps shall be suitable for indoor application. The pumps shall be belt driven by a motor with VFD.</p> <p>In case of additional requirement of instrumentation, controls and other accessories/auxiliaries for safe, reliable and trouble-free operation of the pump, necessary reasons for recommendation shall be furnished and the same shall be included in scope of supply with the purchaser's approval.</p> <p>2. Applicable codes and standards</p> <p>The design, manufacture and performance testing of the pumps as specified herein shall comply with requirement of all applicable codes in particular the following.</p> <table border="0" data-bbox="365 1176 1466 1585"> <tr> <td>1. IS-5120/1977:</td> <td>Special purpose pumps Centrifugal type</td> </tr> <tr> <td>2. API 682:</td> <td>Shaft sealing system for centrifugal & rotary pump</td> </tr> <tr> <td>3. API 670:</td> <td>Machinery protection system</td> </tr> <tr> <td>4. ANSI B16.5, B16.47:</td> <td>Pipe flanges and flange fittings.</td> </tr> <tr> <td>5. ANSI B16.9:</td> <td>Butt weld fittings.</td> </tr> <tr> <td>6. ANSI B16.11:</td> <td>Forged steel fittings, socket welded and threaded.</td> </tr> <tr> <td>7. ASTM:</td> <td>For various materials & tests.</td> </tr> <tr> <td>8. ISO 9906</td> <td>Rotodynamic pumps hydraulic performance acceptance.</td> </tr> <tr> <td>9. ISO 3555/1977</td> <td>Acceptance tests for centrifugal, mixed flow and axial flow Pumps-Class 'B' tests.</td> </tr> <tr> <td>10. ISO 2548/1973</td> <td>Acceptance tests for centrifugal, mixed flow and axial flow Pumps-Class 'C' tests.</td> </tr> </table>					1. IS-5120/1977:	Special purpose pumps Centrifugal type	2. API 682:	Shaft sealing system for centrifugal & rotary pump	3. API 670:	Machinery protection system	4. ANSI B16.5, B16.47:	Pipe flanges and flange fittings.	5. ANSI B16.9:	Butt weld fittings.	6. ANSI B16.11:	Forged steel fittings, socket welded and threaded.	7. ASTM:	For various materials & tests.	8. ISO 9906	Rotodynamic pumps hydraulic performance acceptance.	9. ISO 3555/1977	Acceptance tests for centrifugal, mixed flow and axial flow Pumps-Class 'B' tests.	10. ISO 2548/1973	Acceptance tests for centrifugal, mixed flow and axial flow Pumps-Class 'C' tests.
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3. Scope of supply

Supplier scope shall include Design, Supply and Supervision of Erecting & Commissioning of mill circuit pump connecting belt & pulley /couplings, baseplate, along with instrumentation and associated sub systems. It shall cover complete mill circuit pump unit including sub-systems, start-up spares and special tools and tackles.

Design includes basic and detail engineering, preparation and submission of engineering drawings, calculations, datasheets, quality assurance documents, field quality plans and storage instructions, commissioning procedures, operation & maintenance manuals and performance guarantee test procedures.

Supply includes manufacturing, shop floor testing, stage inspections, final inspections, painting, packing & transportation to site, customer clearance/port clearance and any other statutory clearances/receipts.

Supervision of Erection & commissioning includes supervision of erection & commissioning, supervision of trial operation.

The schematic showing the limits of the scope of supply is provided below. Supplier to clearly specify all terminal points in the GA drawing & P&ID and submit it during proposal to confirm scope of supply.

4. PROJECT DETAILS:

Project	:	TSGENCO KOTHAGUDEM
Ultimate Customer	:	TSGENCO
Location	:	Kothagudem
Service	:	Continuous
Installation	:	In-door
Total number of milling systems	:	2
Total pumps in each milling system	:	2 (1 working + 1 standby)
Total number of pumps	:	4
Material code	:	BA9789110006



**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 3 of 33

5. Design input data**5.1 Pump operating parameters:**

Discharge flow	92.50 m ³ /hr
Total Head developed	45 m of slurry
Medium to be handled	Limestone Slurry
Operating Temperature	65 deg C
Type of Recirculation pump	Horizontal, Centrifugal pump (non-clogging type)
Nozzle Orientation	End Suction- Top Discharge
Seal Type	Mechanical seal (Dry sealing arrangement)
Duty	Continuous operation
Location	Indoor
Drive type	Motor with VFD driven with belt drive
Acceptable noise level	85 dBA (distance of 1.0 meter from the equipment at site and 1.5 m above operating floor)
NPSH(A)	5.7 m of Slurry

5.2 Slurry Analysis

Slurry to be handled	Limestone Slurry
Chloride Content max. (ppm)	27,000
Specific Gravity at pump suction (t/m ³)	1.53
Vapour Pressure at Pump(kg/cm ²)	0.203
Concentration of Solid	55% wt.
SiO ₂ Content	4 to 6 g/l
pH	6.0 to 8.0
Slurry Temperature (deg C)	65
Maximum solid particle size	3 mm
Normal solid particle size, d 50	74 microns

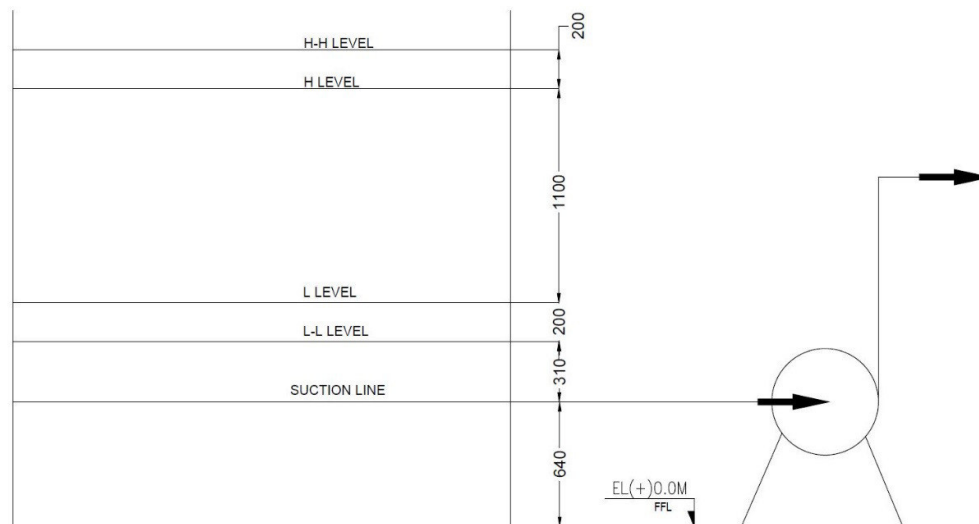
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5.3 Mill Circuit Tank Level & NPSH

HH	Bottom (FFL : 0.00 M) +	2450 mm
H	Bottom (FFL : 0.00 M) +	2250 mm
L	Bottom (FFL : 0.00 M) +	1150 mm
LL	Bottom (FFL : 0.00 M) +	950 mm
SL	Bottom (FFL : 0.00 M) +	640 mm



NPSH	SI Unit	Value
NPSH (A)	M of slurry	5.7

5.4 Cooling water analysis

Description	SI Unit	Value
Cooling water inlet temp	DegC	38
Cooling water outlet temp	DegC	< 48
Allowable increase in temp of cooling water	DegC	5 to 10

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5.5 Operating methodology of pumps

5.5.1 The offered pumps shall be capable of operating satisfactorily in the entire operating range of the pump. Preferred operating range, 40% to 120% of BEP (Best efficiency point).

5.5.2 The individual pump duty conditions are indicated at clause 5.1. The operating media details are indicated at clause 5.2.

5.5.3 Pumps shall be operated as follows:

5.5.3.1.1 One (01) pump per milling system will be in continuous operation.

5.5.3.1.2 In order to optimize power consumption of wet ball milling system at part load operation, mill circuit pump shall be capable of variable speed operation and shall be driven by Variable frequency drive (VFD). The operating range of the pump shall be 40% to 120% of BEP point and pump shall be capable of operation.


Sl.No	Condition	Required total flow rate m3/hr	Required Pump Head m	Pump Efficiency (%)	Shaft Power consumption (KW)	Remarks
1	1 Pump in Continuous operation	92.5	45 m of slurry	> 60%	##	


To be indicated by supplier & guaranteed by vendor


5.5.4 In the event of power failure, all the running pumps will be shutdown instantaneously, i.e. at the same time. Pumps discharge valve will close fully in 15 sec. During this time, pump shall be capable of handling the reverse flow.


6. Technical Requirements


- 6.1 All mill circuit pumps shall be identical and interchangeable.
- 6.2 The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type, capable of delivering the rated flow at rated head, duty parameters indicated at clause 5.1.
- 6.3 The pumps shall circulate the operating fluid from the mill circuit tank to the hydrocyclone cluster in the wet ball milling system.
- 6.4 The pumps shall be resistant to wear and be equipped with flushing devices to prevent sedimentation. They shall be designed and installed to allow easy replacements, repair and maintenance.
- 6.5 The pump bearing housings shall be equipped with oil level indicators and the collecting equipment for leakage shall made of corrosion resistant material.
- 6.6 All the equipment in scope of supply except wearing parts shall be designed and fabricated/manufactured for a service life of 30 years and at least 18000 hours of uninterrupted operation.


TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 6 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 7 of 33
<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p style="text-align: center;">Ref. Doc</p>		<p>6.22 The Antifriction bearing of the pumps shall be designed for minimum useful life (L-10) of 25,000 hours of continuous operation (Under the design condition). The thrust bearing will be selected for twice the operating load.</p> <p>6.23 Mechanical seal with dry sealing arrangement should be provided.</p> <p>6.24 The sealing areas shall be designed in such a way so that solids do not precipitate in them and affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.</p> <p>6.25 Flow induced vibration due to pressure pulsations shall be avoided by suitable design.</p> <p>6.26 Each rotating equipment shall be first statically balanced and then dynamically balanced to G2.5 or better grade according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).</p> <p>6.27 The supplier shall perform lateral and torsional vibration analysis of whole unit assembly.</p> <p>6.28 Allowable limits of foundation vibration shall be indicated in foundation drawing and general arrangement drawings.</p> <p>6.29 The allowable vibration levels shall be indicated in the inspection procedure at shop and shall be demonstrated. The maximum vibration level shall be within permissible level as per the relevant internationally accepted standard.</p> <p>6.30 Noise and Vibration level shall be specified in test procedure document and supplier shall be responsible for the values at the shop test as well as site.</p> <p>7. Constructional features</p> <p>7.1 Casing</p> <p>7.1.1 The pump casing shall be split type for ease of maintenance and shall be designed such that the impeller and shaft can be withdrawn from the casing without disturbing the main pipework and valves carrying the pumped fluid and also without disturbing/removing the motor.</p> <p>7.1.2 The casing and flanges shall be designed to withstand the 1.5 times the maximum shut-off pressure developed by the pump at the pump operating temperature.</p> <p>7.1.3 Pressure casing shall be designed with a corrosion allowance (ASTM G46 & ASTM G48) to meet all the technical requirements, taking into account the Operating Parameters.</p> <p>7.1.4 Lifting provision of pump as a whole and individual casing halves should be provided.</p> <p>7.1.5 The casing material shall be Carbon steel / C.I with rubber lining or Silicon carbide or, Hi chrome or highly alloyed stainless steel or any equivalent. The material used by the contractor shall be proven in previous installations.</p> <p>7.1.6 For replaceable rubber liner, hardness of rubber should be of Shore hardness- SA 65 (+/-) 5. Rubber should be of Type and Class as defined by ASTM D-2000 which is suitable for uninterrupted operation of 5 years (minimum). Guarantee to the affect shall be provided.</p> <p>7.1.7 Pump casing shall be provided with a vent connection and piping with valves and fittings. Casing drain shall be provided with drain valves.</p> <p>7.1.8 All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.</p>	

TD-106 Rev No. 00	Form No. 	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 8 of 33
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TD-106 Rev No. 00	Form No. 	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 9 of 33
<div style="display: flex;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); padding-right: 10px;"> <p>COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p>Ref. Doc</p> </div> <div style="flex-grow: 1;"> <p>7.4.6 The shaft shall be finished to close tolerance at the rotor, coupling and bearing diameters.</p> <p>7.4.7 Shaft shall be made of carbon steel. No exposed part of the shaft shall come in contact with the medium handled.</p> <p>7.4.8 Shaft sleeve should be CD4M Cu ASTM A-743 or equivalent. Sleeve should have this as a guaranteed value/parameter to prevent wear and corrosion of mating surface. Manufacture to indicate the diameter in data sheet.</p> <p>7.4.9 MOC of shaft: Stainless AISI-410 or equivalent/better</p> <p>7.5 Base plate</p> <p>7.5.1 A common base plate shall be provided for pump, gearbox & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting the equipment.</p> <p>7.5.2 Common base plate for pump, gearbox and Motor shall be in the scope of the Supplier and the details of the Motor will be furnished to the Supplier to provide Motor mounting bolts.</p> <p>7.5.3 Base plate must have provision for jacking the driver and driven equipment in both directions of base plate for alignment. Similarly, provision must be provided for alignment of shaft in vertical plane.</p> <p>7.5.4 Pump manufacturer is to supply base plate along with Foundation bolt & Nut, shims/spacers, "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.</p> <p>7.5.5 Base plate must be provided with a trough, material of which must be compatible to pumping liquid. Leaked liquid collected in trough, can be systematically routed to designated point.</p> <p>7.5.6 Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.</p> <p>7.6 Bearings</p> <p>7.6.1 The bearings may be ball, roller or sleeve bearing. The bearings shall be designed to take the necessary radial load as well as the net axial thrust. Bearings shall be lubricated properly and sized for an operating life of 25,000 hours on the basis of maximum load. Bearing lubrication provided shall be such that visual inspection of lubricant level is possible.</p> <p>7.6.2 The bearings shall be of automatic oil lubricated type. Bearing Temperature transmitter shall be provided with local monitoring of the bearing metal temperature. In case, external cooling water is required, flow, pressure, etc. shall be specified.</p> <p>7.6.3 Bearing housings shall be designed such that they can be replaced without removing the pump or motor from its mounting. Supplier shall inform the bearing withdrawal length for suitable selection of coupling. Bearing housings shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.</p> </div> </div>			


TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 10 of 33
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TD-106 Rev No. 00	Form No. 	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 11 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 12 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 13 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 14 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 15 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 16 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 17 of 33
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TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 18 of 33
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**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 19 of 33

17. ANNEXURES

17.1 Annexure-1, Technical Data Sheet

S.No	Description	Data
1	GENERAL	
	a. Client	: Indicated in variant table.
	b. Project	: --do--
	c. End Customer	: --do--
	d. Location	: --do--
	e. Service	: --do--
	f. Installation	: --do--
	g. No of pumps for each unit	: --do--
	h. No of stand-by pumps per unit	: --do--
	i. Total number of pumps	: --do--
2	MANUFACTURER DETAILS	
	a. Model	: *
	b. Type	: Centrifugal (non- Clogging)
	c. Type of Driver	: Motor with V Belt
3	OPERATING CONDITION	
	a. Medium to be handled	: Indicated in variant table.
	b. Maximum solid particle size	: --do--
	c. Normal solid particle size, d 50	: --do--
	d. Concentration of chloride	: --do--
	e. Viscosity of slurry	: --do--
	f. Concentration of slurry	: --do--
	g. Specific gravity of slurry	: --do--
	h. pH of slurry	: --do--
4	PERFORMANCE DATA	
	a. Capacity	m ³ /hr : *
	b. Head	M : *
	c. Pump efficiency	% : *
	d. BKW Normal / Maximum	KW : *
	e. Motor rating	KW : *
	f. Motor Speed	rpm : *
	g. Gear box Loss	% : *
	h. Differential pressure (inclusive of losses)	Kg/cm ² : *
	i. Speed Maximum/ Normal/Minimum	rpm : *
	j. Noise level	dB(A) : *
	k. Performance curve	: *

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**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 20 of 33

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5	CONSTRUCTION DATA		
a. Manufacturer		:	
b. Model No.		:	*
c. Suction Rating / Size		:	*
d. Discharge Rating / Size		:	*
e. Type of rotor		:	*
f. Size of rotor Dia	mm	:	*
g. Journal bearing: Type / Size:		:	*
h. Thrust bearing: Type / Size:		:	*
i. Bearing cooling required		:	Yes / No - Supplier to confirm
j. Cooling water required		:	Supplier to confirm the quantity
k. Type of drive		:	Belt driven
l. Shaft seal		:	Mechanical
m. Size / Code		:	*
n. Type of coupling		:	*
o. Service factor		:	*
p. GD ² at drive shaft end		:	*
q. Rotation viewed from coupling end		:	Clock wise / Counter clock wise
r. Coupling type		:	Yes / No - Supplier to confirm
s. Coupling make		:	*
t. Base plate common to pump, Gearbox, bearing housing, coupling & Motor		:	Yes / No - Supplier to confirm
u. Total weight	kg	:	*
v. Maximum Erection weight	kg	:	*
6	MATERIALS		
a. Casing		:	*
b. Impeller		:	*
c. Shaft		:	*
d. Shaft Seal		:	*
e. Base frame		:	*



**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 21 of 33

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7

INSPECTION AND TESTING

a. Material Test certificates required for : Casing, Impeller, shaft, shaft sleeve	:	[R] [O]
b. DPT & MPI Test for impeller as applicable	:	[R] [O]
c. Ultrasonic & Liquid penetrant test for shaft	:	[R] [O]
d. Dimensional & visual inspection	:	[R] [W]
e. Mechanical running test for 4 hrs.	:	[R] [W]
f. Vibration test at rated speed	:	[R] [W]
g. Performance test	:	[R] [W]
h. Balancing test of Rotor Assembly	:	[R] [O]
i. Noise level test	:	[R] [W]
j. NPSH Test	:	[R] [W]
k. Hydrostatic Test	:	[R] [W]

[R]: Required, [W]: Witnessed by BHEL/ end customer, [O]: Observed

*: Supplier to provide

SIGNATURE OF SUPPLIER -----

NAME -----

DESIGNATION -----



**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 22 of 33

17.2 Annexure-2, Schedule of guarantees

S.No	Description		Data
1.	Rated capacity of pump	m ³ /hr	:
2.	Total head at design capacity	m	:
3.	Guaranteed shaft power consumption at rated capacity & head	kW	:
4.	Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor	dB(A)	:
5.	Maximum vibration (peak to peak amplitude at site)	microns	:
6.	Equipment Availability (%)		:
7.	Pump Efficiency (%)		:
8.	Life of Pump wear parts including, Casing liners, bearing etc	Hours	: ≥25000 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.

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**PRODUCT STANDARD
PULVERISERS
HYDERABAD**

BA89110

Rev No. 01

Page 23 of 33

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17.3 Annexure-3, List of Deviations

S.No	Clause No	Page No	Description of Deviation

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NAME -----


DESIGNATION -----


TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 25 of 33		
17.4.2 Documents to be submitted after award of contract					
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		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.	General arrangement drawing	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.	Installation and assembly procedure	1	4 months after contract
		10.	Inspection and Test Procedure	1	1 month after contract
		11.	Inspection & Test record	1	In 2 weeks after test
		12.	Inspection Certificate	1	In 2 weeks after test
		13.	Sub vendors List	1	2 weeks after contract
		14.	Quality plan	1	2 weeks after contract
		15.	Pro-forma Packing List	1	2 months prior to
		16.	Approximate weight of pump	1	2 months after contract
		17.	Delivery Schedule	1	2 weeks after contract
		18.	Pump and Motor Sizing Calculation	1	2 weeks after contract
		19.	Material Test Certificates	2	In 2 weeks after test
		20.	Pre Commissioning Check List	2	4 months after contract
		21.	Scope of Supply	2	2 weeks after contract
		22.	Quality Plan	4	1 month after contract
		23.	Operation and Maintenance Manual	Hardcopies and soft copies as mentioned	4 months after contract
		24.	Spare List (Mandatory, Recommended)	1	1 month after contract
		25.	Start-up & Commissioning Spares	2	1 month after contract
		26.	List of Special Tools	1	1 month after contract
27.	Test Arrangement & Test procedure	2	1 month after contract		


S.No.	Description	No of copies After award of contract	Delivery Time
28.	T-S curve	2	2 weeks after contract
29.	P & I Diagram	2	2 weeks after contract
30.	Catalogue	2	2 weeks after contract


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 NAME -----
 DESIGNATION -----


TD-106 Rev No. 00	Form No. 	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 27 of 33
<div style="display: flex; justify-content: space-between;"> <div style="width: 15%; border-right: 1px solid black; padding-right: 5px;"> <p style="writing-mode: vertical-rl; transform: rotate(180deg);"> COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company. Ref. Doc </p> </div> <div style="width: 85%; padding-left: 10px;"> <p>17.5 ANNEXURE-5</p> <p style="text-align: center;"><u>SPECIFICATION OF VARIABLE FREQUENCY DRIVE (VFD)</u></p> <p>1. General Requirement : The VFD shall be selected for the motor (refer clause 7.9) which drives the mill circuit pump with variable speed.</p> <p>2. Application : The variable speed drive is used to drive the motor of a mill circuit pump in wet ball milling system in an electrical energy-generating power station. The motor drives the pump by means of V belt. A power plant distributed control system provides a signal to the VFD to regulate motor speed. The signal will be 4 to 20 mA DC. The motor and drive will be installed in a power plant application requiring reliable and continuous operation 24 hours per day and 365 days per year with minimal downtime maintenance.</p> <p>3. Environmental Conditions : The drive is to operate within an environment with temperatures ranging from 0°C to 50°C. The motor is to operate within an environment with temperatures ranging from 0°C to 50°C. The equipment and motor will be located in an area which is in dusty environment which will result in the material settling on the equipment. The motor will be installed less than 500 meters from the VFD.</p> <p>4. Scope of Supply : The Supplier will provide the following items:</p> <ul style="list-style-type: none"> 4.1 Variable frequency drive to meet specified electrical, control and construction requirements. 4.2 Variable frequency drive with enclosure cabinet with wired local control panel and necessary switchgears. Cabinet shall be of Rittal/ ABB or Siemens make. The cabinet shall have thermostatically controlled air conditioner. The dimension of cabinet shall not exceed 2000 x 800 x700. All the operation & display shall be possible from front door of the panel without opening the door. It should be min. IP54. 4.3 VFD shall be provided with air cooled arrangement. 4.4 Certified drawings. 4.5 The Supplier shall indicate if output line reactors are required to prevent impedance mismatches and potential damage to the motor from voltage spikes. If output line reactors are required, the Supplier must quote them as an option 4.6 It is the supplier's responsibility to ensure the supplied VFD is satisfying all functional requirements as per clause 9. Vendor to include any or all accessories/equipment for the same even if not mentioned in this specification. <p>5. Power and speed requirements :</p> <p style="text-align: right;">Vendor shall select the speed range of motor with VFD as per pump functional requirement.</p> </div> </div>			

TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 28 of 33
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company. Ref. Doc	<p>6. Noise Requirements :</p> <p>The Supplier shall furnish the drive motor to a maximum predicted sound pressure level of 85 dBA, measured 3 ft (1 m) horizontally from the surface of the motor. Allowable sound pressure level applies to one motor with negligible sound contributed by other equipment.</p> <p>7. Low Voltage Starting:</p> <p>The motor and drive must be capable of starting without damage to the motor with a supply voltage range of 90 – 110 % of motor nameplate voltage. The motor must also be capable of starting with 80% motor nameplate voltage.</p> <p>8. Surface Preparation and Paint :</p> <p>Equipment shall be prepared and painted per manufacturer’s standard for a minimum of 10 year power station operating life in a tropical environment. Equipment must arrive at the site with a finished coat.</p> <p>9. Variable Frequency Drive Requirements :</p> <p>9.1 The system offered shall be energy efficient, provide very high reliability, high power factor, low harmonic distortion, low vibration and noise. It shall be easy to install with minimum time and expense and no special tools shall be required for routine maintenance.</p> <p>9.2 The system shall be suitable for the load characteristics and the operational duty of driven equipment. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torques, resulting from short-circuit. Any damage resulting from such a short-circuit or internal fault shall be limited to the component concerned.</p> <p>9.3 The system shall be speed, torque or power controlled as dictated by the driven equipment.</p> <p>9.4 The system shall be suitable for continuous speed control of the motors in single drive system as per data sheet and soft start feature shall be provided to reduce the disturbances in the electrical system.</p> <p>9.5 The drive will vary the frequency of the supplied AC power to control motor speed according to a signal from the plant distributed control system (DCS). A 4 to 20 mA DC/0-10V DC signal from the DCS will represent 0 to 100% motor speed .VFD to have facility for user to configure range of speed for 4-20mA /0-10 V input signal.</p> <p>9.6 The drive motor shall be speed regulated to a speed corresponding to purchaser’s 4-20mA or 0-10 V reference signal. Upon complete loss of the DCS speed reference signal, the drive shall automatically run at constant speed as determined by the last speed reference available prior to the loss of signal.</p> <p>9.7 All components of the drive system shall be mounted in an IP-54 enclosure fully accessible from the front.</p> <p>9.8 In case of failure of VFD, for any reason, VFD shall have an in-built facility to immediately isolate VFD output and switch-On motor in DOL condition, via a bypass breaker.</p> <p>9.9 Power semi-conductors shall be IGBT (Isolated Gate Bipolar Transistor) type. Fast switching SCRs are not acceptable.</p>		

TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 29 of 33
<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p style="text-align: center;">Ref. Doc.</p>	<p>9.10 The drive shall also include the</p> <ul style="list-style-type: none"> 9.9.1 Electric Thermal overload protection. 9.9.2 Potential free contacts for local indication in control room for following functions : Supply Healthy, Run, Trip, Stop 9.9.3 4-20 mA signal follower. 9.9.4 Local Control panel, mounted on VFD panel, for user operation, with functions as per clause 12. 9.9.5 Connection for control keypad to be through the cabinet door. 9.9.6 Current limit adjustment 50% to 150% of drive rating 9.9.7 Independent acceleration and deceleration ramps adjustable from 0.1 of a second to 1800 seconds. 9.9.8 Slip compensation to improve speed regulation. <p>9.11 Vendor to select operation / type / quadrant of operation of VFD to be suitable for load / application characteristics.</p> <p>9.12 The modulating control scheme shall closely approximate actual sine wave current throughout the speed range of the drive.</p> <p>9.13 The regulator shall be fully digital with microprocessor control of frequency, voltage and current.</p> <p>9.14 Speed resolution shall be within +/- 1 RPM.</p> <p>9.15 All drive adjustments and custom programming, configuration etc. shall be capable of being stored in a non-volatile memory.</p> <p>9.16 The drive shall be designed to protect itself against instantaneous current levels above 200% of its rating. The drive shall continue to operate through instantaneous current spikes below 200%.</p> <p>9.17 Isolation transformers shall not be used to eliminate possible line converter notching of the input filter. The drive shall not be sensitive to line notching from other drives.</p> <p>9.18 The drive shall be capable of automatic restart upon power failure or momentary source voltage dips, and restarting into a rotating motor at any speed without tripping.</p> <p>9.19 The drive shall actively monitor its output current and frequency and shut down the drive if the motor is in a stall condition. A stall condition is defined as operating in current limit at or below 10 Hz for 10 seconds. This definition of stall shall be field adjustable to match the application.</p> <p>9.20 Power capacitor voltage levels shall be discharged below 50 volts within one minute of de-energization or less per NEMA and NFPA standards.</p> <p>9.21 The input displacement power factor of the drive shall be a minimum of 0.95 at all speeds and loads above 10% load.</p> <p>9.22 Drive efficiency shall be evaluated and the Supplier shall provide drive efficiency curves for 0% to 100% speed at 25, 50, 75, and 100% rated load. Minimum acceptable efficiency shall be 97% at full load.</p> <p>9.23 The drive shall be capable of operating with the output open circuited.</p> <p>9.24 The Total Harmonic Distortion for Voltage and Current Harmonics shall be in line with latest revision of IEEE 519 standard at the supply side of the drive system based on the short circuit capacity of the bus.</p> <p>10. Drive Protection :</p> <p style="padding-left: 40px;">Drive protection functions shall operate independent of the microprocessor control logic and shall include as a minimum:</p>		

TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 30 of 33
<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p style="text-align: center;">Ref. Doc</p>		<p> 10.1 Over current protection 10.2 Short circuit protection. 10.3 DC bus under voltage protection. 10.4 DC bus over voltage protection. 10.5 Over temperature protection. 10.6 Ground fault protection. 10.7 Electronic thermal overload monitor. 10.8 Settings for trip / alarm settings shall be user configurable either through software interface / local control panel. </p> <p> 11. Drive Diagnostics : The drive shall include first fault indication in the protection functions and ability to store 20 successive fault indications in order of occurrence. As a minimum, the following fault indications shall be displayed on the local operator control panel: </p> <p style="margin-left: 40px;"> 11.1 Over current 11.2 Short circuit 11.3 Under voltage or phase loss 11.4 Over voltage 11.5 Over temperature 11.6 Motor Thermal overload </p> <p> 12. Drive Controls : 12.1 The drive shall be supplied with a local control panel which shall include the following operating functions </p> <p style="margin-left: 40px;"> 12.1.1 Drive Start and Stop 12.1.2 Fault reset 12.1.3 Provision to increase or decrease the local speed reference with accuracy to 1 RPM. 12.1.4 Local/remote selection. </p> <p> 12.2 The local control panel shall include a digital display to monitor the following functions: </p> <p style="margin-left: 40px;"> 12.2.1 Local frequency reference 12.2.2 Motor load calibrated in amps 12.2.3 Output frequency 12.2.4 Output voltage 12.2.5 Remote frequency references 12.2.6 Fault diagnostic messages 12.2.7 Trouble shooting test points 12.2.8 Motor speed </p> <p> 12.3 The local control panel shall be the operator interface for making all drive adjustments. Internal adjustments are not permitted. </p> <p> 12.4 The drive shall also include provisions for the following hard wired inputs and outputs for remote operator controls: </p> <p style="margin-left: 40px;"> 12.4.1 Digital inputs, 24 VDC contacts from plant controls including: 1 Drive start 1 Drive stop 1 Remote control selector 1 Run at present speed. </p>	

TD-106 Rev No. 00	Form No.  HYDERABAD	PRODUCT STANDARD PULVERISERS HYDERABAD	BA89110 Rev No. 01 Page 31 of 33
<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p>The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> <p style="text-align: center;">Ref. Doc</p>	<p style="text-align: center;"> 12.4.2 Digital output relay contacts 5 Amps 125 VDC / 250 VAC rating, 1 Drive off, 1 Drive running, 1 Drive fault. </p> <p style="text-align: center;"> 12.4.3 Analog input for reference signal, 4 to 20 mA. </p> <p style="text-align: center;"> 12.4.4 Analog output signal, 4 to 20 mA and/or 0 to 10 VDC to transmit output frequency and speed. </p> <p style="text-align: center;"> 12.5 The drive is to be factory programmed and wired for: </p> <p style="text-align: center;"> 12.5.1 having the speed ramped as a function of a 4 to 20 mA signal input </p> <p style="text-align: center;"> 12.5.2 any trouble with the drive is to give a dry fault contact </p> <p style="text-align: center;"> 12.5.3 the drive is to get its start and stop signal as an input contact from the DCS. </p> <p style="text-align: center;"> 12.5.4 the drive is to output a signal indicating the motor speed. </p> <p style="text-align: center;"> 12.5.5 the drive is to be programmed for an acceleration ramp of 60 Hz/180 seconds. </p> <p style="text-align: center;"> 12.5.6 the drive is to be programmed for a deceleration ramp of 60 Hz/180 seconds. </p> <p style="text-align: center;"> 12.5.7 the drive is to be programmed so that during a start cycle it will catch and stop a reversed spinning load before it starts it in the correct direction. </p> <p style="text-align: center;"> 12.5.8 the drive is to be programmed so that if there is a loss of load it will trip and send out a fault signal. </p> <p style="text-align: center;"> 12.5.9 the drive is to be programmed so that if the power (current) exceeds the motor name plate rating for more than 3 seconds, it will trip and send out a fault signal. This shall be configured from LCP. </p> <p style="text-align: center;"> 13. Quality Assurance : </p> <p style="text-align: center;"> 13.1 All work is to be done in accordance to the Manufacturing Quality Plan and so documented. </p> <p style="text-align: center;"> 13.2 All material, components and subassemblies shall be inspected and/or tested for conformance to these specifications and Supplier's engineering and quality assurance specifications. </p> <p style="text-align: center;"> 13.3 The Supplier shall on request make available for review copies of Supplier Quality Assurance Policy, documentation, and records pertinent to equipment purchased. </p> <p style="text-align: center;"> 13.4 The drive is to conform to NEMA, IEEE, UL and IEC standards. </p> <p style="text-align: center;"> 14. Testing : </p> <p style="text-align: center;"> 14.1. Type Test & Routine Tests like, No load tests, Insulation test, Functional test, Rated current test & Visual inspection, etc. </p> <p style="text-align: center;"> 14.2. No load tests includes: Motor shaft voltage & Vibration severity measured at bearing housing, etc. </p> <p style="text-align: center;"> 14.3. Insulation test (vendor to specify with relevant standards). </p> <p style="text-align: center;"> 14.4. During Inspection, any physical damage or non-working of the unit shall be replaced with new units. </p>		

TD-106 Rev No. 00	Form No. 	<p style="text-align: center;">PRODUCT STANDARD PULVERISERS HYDERABAD</p>	BA89110
			Rev No. 01
			Page 32 of 33
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"> COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company. Ref. Doc. </p> <p>15. Document submission :</p> <ol style="list-style-type: none"> 1. Recommended Spare Parts List (motor and drive) 2. Drive Electrical Schematic Drawing 3. Drive Dimensional Drawing 4. Drive Parameter List -Settings 5. Drive Installation, Operation and Maintenance Manual (Electronic pdf format) 6. General Arrangement drawing, Test certificates, conformance certificates. <p>16. Preservation and Packaging :</p> <p>16.1 The material is to be preserved for long term storage (two years minimum) without additional onsite preservation activities.</p> <p>16.2 The motor and drive to be boxed in shrink-wrap covering.</p>			

