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SPECIFICATION FOR QUALIFICATION FOR PROCUREMENT OF MILL CIRCUIT PUMP

Part-A

1.0 GENERAL:

This specification is intended to evaluate the Qualified Bidders technically and commercially for procurement of Mill Circuit Pump in Wet Ball Milling System.
 The Bidder shall refer to the Technical Specification Document No.BA89078 for technical details.

2.0 QUALIFYING REQUIREMENTS:

- 2.1 The bidder shall be Original Equipment Manufacturer. The Bidder should be manufacturing these items at their principal works.
- 2.2 The bidder should have manufactured and supplied Mill Circuit Pump of same or higher capacity for a wet ball milling system used in either Flue Gas Desulfurization plant or any other similar application and should be successfully working in at least minimum two different sites for at least 2 year prior to the date of techno commercial bid opening. Accordingly, necessary satisfactory performance certificates shall be submitted by the bidder.

The evidences shall be submitted in the following format.


Name of the site	Application	Slurry characteristics	Mill circuit pump capacity	Date of supply
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Traders / stockiest / mediators are not allowed to quote. Only manufacturers who are having relevant facilities, proven process and experience will be considered for the supply.


3.0 PATENTS

Successful bidder must declare that no third party has raised any patent claim against Bidder with respect to the product up to the date of this agreement. Successful bidder must further

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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.		<p>declare that in case such claims arise during the validity of this agreement, which cannot be settled with such third party, it will indemnify BHEL and make such efforts which bidder deems reasonable to make available to BHEL a technical and proven solution which will not violate such patent.</p> <p>4.0 ARBITRATION</p> <p>4.1 <u>Applicable Law:</u> This agreement is shall be construed and interpreted in accordance with the laws of India and shall have exclusive jurisdiction of Sangareddy/Hyderabad Courts, Telangana.</p> <p>4.2 <u>ARBITRATION:</u> All disputes arising in connection with the contract shall be settled by mutual consultation. If no agreement is reached the dispute shall be settled in accordance with the provisions of the Arbitration and Conciliation Act, 1996 and the rules made there under. The dispute shall be referred for arbitration to any arbitrator to be appointed by the Head of the Unit, BHEL, Hyderabad, Ramachandrapuram. The award of the arbitrator shall be final and binding on both the Parties. The venue of the Arbitration shall be Hyderabad in India. The Award to be given by the Arbitration shall be a speaking award and in English language. All questions, disputes, differences arising under, out of or in connection with this contract shall be exclusive jurisdiction of Sangareddy/Hyderabad Courts, Telangana.</p> <p>5.0 INSTALLATION AND COMMISSIONING:</p> <p>5.1 Operation and maintenance manual to be included in all supplies.</p> <p>5.2 The bidder shall express their willingness to assist BHEL during erection and commissioning, problem solving and training of end-users personnel at their Power Stations. The Bidder to quote separately the prices for the same.</p> <p>6.0 AGENTS</p> <p>6.1 BHEL shall deal directly with the manufacturer. However, if the foreign principal desires to avail the services of an Indian Agent, then the foreign principal should ensure the compliance to regulatory guidelines, which requires mandatory submission of an agency agreement.</p> <p>6.2 It shall be incumbent on the Indian Agent and the Foreign principal to adhere to the relevant guidelines of Government of India, issued from time to time.</p>				
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Part-B

**MILL CIRCUIT PUMP FOR WET BALL MILLING SYSTEM – Machining ,
assembly & testing facilities details.**

Sl. No	Type of Machines	Quantity	Make	Size	Date of Installation	Distinct Features

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Part-C

STATEMENT OF COMPLIANCE

The vendor shall complete the following statement of compliance without which the offer will not be considered for evaluation:

STATEMENT OF TECHNICAL COMPLIANCE

FOR BA89078 Rev-00

CLAUSE NO.	CONFIRMATION YES/ NO	REMARKS.
1.0		
2.0		
3.0		
4.0		
5.0		
6.0		
7.0		
8.0		
9.0		
10.0		
11.0		


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<p><u>TECHNICAL SPECIFICATION FOR MILL CIRCUIT PUMP</u></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" style="width: 100%;"> <tr> <td style="width: 40%;">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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Ref. Doc	Revisions: Refer record of revisions	Prepared: K PAVAN	Approved: KHRK	Date: 31.03.22																				

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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	:	NTPL TUTICORIN
Ultimate Customer	:	NTPL
Location	:	Tuticorin
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	:	BA9789078005



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

Discharge flow	81 m ³ /hr
Total Head developed	40 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 driven
Acceptable noise level	85 dBA (distance of 1.0 meter from the equipment at site and 1.5 m above operating floor)
NPSH(A)	5.5 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)	0.216
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

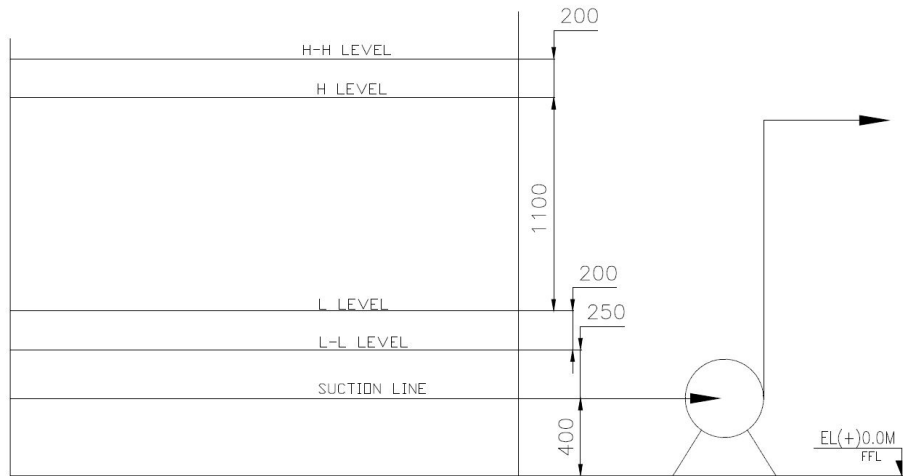
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5.3 Mill Circuit Tank Tank Level & NPSH

HH	Bottom (FFL : 0.00 M) +	2150 mm
H	Bottom (FFL : 0.00 M) +	1950 mm
L	Bottom (FFL : 0.00 M) +	850 mm
LL	Bottom (FFL : 0.00 M) +	650 mm
SL	Bottom (FFL : 0.00 M) +	400 mm



NPSH	SI Unit	Value
NPSH (A)	M of slurry	5.5

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	81	40 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.


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<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> 9.9 Each case shall contain a packing list in waterproof material or protected by shellac or varnish to prevent obliteration in transit, 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. </p> <p> 9.10 The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed. </p> <p> 9.11 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) </p> <p> 9.12 Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: </p> <p> 9.12.1 Upright position 9.12.2 Sling position and center of Gravity position 9.12.3 Storage category 9.12.4 Fragile components (to be marked properly with a clear warning for safe handling) </p> <p> 10. Supervision of Erection and Commissioning </p> <p> 10.1 The erection of Mill Circuit Pumps will be done as per Erection & commissioning Manual and check List. However, the Supplier shall make one visit 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. </p> <p> 10.2 Supplier shall include 10 working days in the visit. Per day cost of visit shall be furnished separately. This shall be considered for evaluation of offer. Separate service order shall be issued for each visit. </p> <p> 10.3 TA/DA, boarding and lodging shall be borne by the Supplier. </p> <p> 11. Exclusions </p> <p style="padding-left: 40px;">The following shall be exclusions in the scope:</p> <p> 11.1 Civil foundations. 11.2 Vibration monitoring system including sensors. </p> <p> 12. Inspection and Testing </p> <p> 12.1 Minimum Testing requirements to be considered are as below: </p> <p> 12.1.1 Hydrostatic test is to be conducted at 150 % of shut-off pressure and pressure shall be maintained for a period of not less than one hour. While arriving at the above values maximum suction pressure shall be taken into account. </p>			

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13.4.5 Total DFT : 220 micron.

- 13.5 Color Code for external surface shall be Grey White RAL 9002.**
- 13.6** Rust preventive paint after inspection & before dispatch from shop is in Supplier's scope
- 13.7** Corrosion protection, coating and galvanizing, painting shall be taken care by the Supplier. Supplier shall submit the painting scheme during detail Engg and shall be subject to approval of end customer/BHEL.

14. Spares, Tools & Tackles


14.1 Start-up & Commissioning Spares
Start-up & Commissioning Spares shall be part of the main supply of the Mill Circuit pumps. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. Supplier shall provide an adequate stock of such start up and commissioning spares for the equipment erection and commissioning. The spares must be available at site before the equipment is energized. These start-up & commissioning spare part list shall not be included in "Initial Spare Parts List".


14.2 Mandatory Spares:


Supplier to quote for below mentioned mandatory spares with break up price.

Sl.No	DESCRIPTION	QTY	UNIT	MATERIAL CODE
1	Impeller	4	EA	BA9789078021
2	Casings	2	EA	BA9789078030
3	Shaft	2	EA	BA9789078048
4	Shaft Sleeves	2	SET	BA9789078056
5	Impeller/Casing Liner	2	SET	BA9789078064
6	Seals	2	SET	BA9789078072
7	Pump & Motor Bearing	2	SET	BA9789078080
8	Belt Pulley Arrangement	1	SET	BA9789078099

Supplier shall quote for the "Mandatory Spares Part List", and it will be considered for L1 evaluation. Mandatory spare parts items shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes, distinctly marked in red color with boldly written "S" mark on each face of the containers. The packing shall be sufficient for a minimum of 10 years storage in a dry weatherproof building.
All spares shall be strictly inter-changeable with the pump parts. All the mandatory spares shall have same specification and quality plan.

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<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>14.3 Special Tools & Tackles Any special tools & tackles required for disassembly, assembly or maintaining the pumps, 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 Supplier as per his proven practice. They shall be packaged in separate boxes with lugs and marked as "Special Tools". Moreover levers and eyebolts for the removal of parts to be serviced shall be included in the supply of each individual equipment.</p> <p>15. Performance Guarantee All performance tests for Recirculation pumps shall be carried out in accordance with any latest international codes/standards.</p> <p>15.1 Supplier shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Recirculation pump and its accessories.</p> <p>15.2 Capacity and its associated head of the pump to be guaranteed.</p> <p>15.3 All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.</p> <p>15.4 Scheduled Maintenance (Minor Overhauls): Recommended intervals between maintenance outages shall be >25000 hours operation.</p> <p>15.5 Scheduled Maintenance (Major Overhauls): Recommended intervals between maintenance outages shall be >75000 hours operation.</p> <p>15.6 Noise level-≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed.</p> <p>15.7 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.</p> <p>15.8 Acceptance tests to be carried out as per the procedure defined by the Supplier which shall be submitted for BHEL/end customer approval.</p> <p>15.9 In the event of unsuccessful performance test, Supplier shall take necessary remedial action at his cost and the performance test shall be repeated.</p> <p>16. Documentation</p> <p>16.1 Documents to be submitted along with the offer The Supplier shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. The following information shall be furnished along with duly filled-in Technical Data sheets at Annexure I and guarantee schedule furnished at Annexure-II.</p> <p>16.1.1 Sectional Assembly, P&ID diagram</p> <p>16.1.2 Performance curve</p> <p>16.1.3 Terminal point details.</p> <p>16.1.4 General Arrangement with civil loads and pocket details.</p> <p>16.1.5 Rotor GD2 (kg-m2)</p> </div> </div>			

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<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>16.1.6 Torque Vs Speed curve 16.1.7 Calculation of Motor rating, Bearing capacity 16.1.8 Bill of material along with ASTM or its equivalent materials. 16.1.9 Overall space and headroom requirement during Erection, maintenance of pump. 16.1.10 Erection, Operation & Maintenance manual with lubrication schedule 16.1.11 Procedure for shop / site performance tests 16.1.12 Time schedule for delivery. 16.1.13 Deviation list 16.1.14 Spares list. 16.1.15 Hoist / Crane requirement. 16.1.16 Reference list of similar projects executed. 16.1.17 List of proposed makes and vendors 16.1.18 Equipment maintenance schedules</p> <p>16.2 Documents to be submitted after award of contract The Successful Supplier shall submit necessary data, documents and drawings for review, approval with requirements specified here under. However as minimum the following shall be submitted.</p> <p>16.2.1 Duly filled technical datasheet. 16.2.2 General arrangement drawings indicating dimension and civil loading details. 16.2.3 Motor Data. 16.2.4 Recommended repair procedure etc. 16.2.5 Operation and maintenance manuals. 16.2.6 Assembly & Dis-assembly sequence shall be submitted as a separate document prior to the submission of the Operation and Maintenance Manual. 16.2.7 Erection schedule and component list. 16.2.8 The following performance curves of the pump shall be submitted: 16.2.8.1 Flow v/s Head 16.2.8.2 Flow v/s NPSH 16.2.8.3 Flow v/s Efficiency 16.2.8.4 Flow v/s power consumption 16.2.8.5 Torque vs. speed curve for Motor selection 16.2.9 The system-resistance point at different loads shall be indicated in the above performance curves.</p> <p>Drawings that are reviewed will be returned to Supplier 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. BHEL reserves the right to return drawings unprocessed to Supplier if there exists any evidence that Supplier has not acknowledged all comments and questions.</p>			

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<p style="text-align: center;"><u>Note to supplier regarding mandatory spares:</u></p> <ol style="list-style-type: none"> 1. Supplier shall clearly indicate with a P&ID, drawings, various instruments used in the scope of supply. and the highlight the mandatory spares diagrammatically to avoid any ambiguity. Supplier shall contact the purchaser in case of ambiguity, prior to submitting the offer. Revision/ Alteration after bid submissions shall not be considered. 2. Impeller assembly shall include, impeller, impeller nut & impeller keys. 3. Complete casing shall be one to one replacement of the existing casing. 4. Casing liners shall be a complete replacement of liners in the supplied pump, if applicable. 5. Set of seals shall include Mechanical seal, oil seals, wear rings at impeller location, oil thrower & oil guards in the entire scope of supply. 6. Bearings shall include journal bearings, thrust bearings in the entire scope of supply. 7. Connecting coupling set shall include couplings between pump & gearbox, gearbox & motor. 8. Set of Transmitters along with accessories shall include all the transmitters and its accessories where ever used in the entire scope of supply. 9. Temperature elements with Thermowell shall include all temperature elements where ever used in the entire scope of supply. 10. Local gauges along with accessories shall include all local gauges where ever used in the entire scope of supply. 			

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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 Gearbox/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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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		:	With Gearbox
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		:	*



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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 -----



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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.

SIGNATURE OF SUPPLIER -----

NAME -----

DESIGNATION -----

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17.3 Annexure-3, List of Deviations

S.No	Clause No	Page No	Description of Deviation

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17.4 Annexure-4


17.4.1 Documents to be submitted along with offer


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


SIGNATURE OF SUPPLIER -----


NAME -----


DESIGNATION -----


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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	


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<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 style="text-align: center;">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, motor will be located in an area in 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 : Vendor shall select the speed range of motor with VFD as per pump functional requirement.</p> </div> </div>			

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<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. </p> </div> <div style="width: 85%; padding-left: 5px;"> <p>6. Noise Requirements : 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: 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 : 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> </div> </div>			

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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>9.9 Power semi-conductors shall be IGBT (Isolated Gate Bipolar Transistor) type. Fast switching SCRs are not acceptable.</p> <p>9.10 The drive shall also include the</p> <p>9.9.1 Electric Thermal overload protection.</p> <p>9.9.2 Potential free contacts for local indication in control room for following functions : Supply Healthy, Run, Trip, Stop</p> <p>9.9.3 4-20 mA signal follower.</p> <p>9.9.4 Local Control panel, mounted on VFD panel, for user operation, with functions as per clause 12.</p> <p>9.9.5 Connection for control keypad to be through the cabinet door.</p> <p>9.9.6 Current limit adjustment 50% to 150% of drive rating</p> <p>9.9.7 Independent acceleration and deceleration ramps adjustable from 0.1 of a second to 1800 seconds.</p> <p>9.9.8 Slip compensation to improve speed regulation.</p> <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>		

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<div style="display: flex; justify-content: space-between;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;"> <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>10. Drive Protection :</p> <p>Drive protection functions shall operate independent of the microprocessor control logic and shall include as a minimum:</p> <ul style="list-style-type: none"> 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>11. Drive Diagnostics :</p> <p>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> <ul style="list-style-type: none"> 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>12. Drive Controls :</p> <p>12.1 The drive shall be supplied with a local control panel which shall include the following operating functions</p> <ul style="list-style-type: none"> 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>12.2 The local control panel shall include a digital display to monitor the following functions:</p> <ul style="list-style-type: none"> 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>12.3 The local control panel shall be the operator interface for making all drive adjustments. Internal adjustments are not permitted.</p> </div> </div>			

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<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>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> <p style="margin-left: 40px;">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="margin-left: 40px;">12.4.3 Analog input for reference signal, 4 to 20 mA.</p> <p style="margin-left: 40px;">12.4.4 Analog output signal, 4 to 20 mA and/or 0 to 10 VDC to transmit output frequency and speed.</p> <p>12.5 The drive is to be factory programmed and wired for:</p> <p style="margin-left: 40px;">12.5.1 having the speed ramped as a function of a 4 to 20 mA signal input</p> <p style="margin-left: 40px;">12.5.2 any trouble with the drive is to give a dry fault contact</p> <p style="margin-left: 40px;">12.5.3 the drive is to get its start and stop signal as an input contact from the DCS.</p> <p style="margin-left: 40px;">12.5.4 the drive is to output a signal indicating the motor speed.</p> <p style="margin-left: 40px;">12.5.5 the drive is to be programmed for an acceleration ramp of 60 Hz/180 seconds.</p> <p style="margin-left: 40px;">12.5.6 the drive is to be programmed for a deceleration ramp of 60 Hz/180 seconds.</p> <p style="margin-left: 40px;">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="margin-left: 40px;">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="margin-left: 40px;">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>13. Quality Assurance :</p> <p style="margin-left: 40px;">13.1 All work is to be done in accordance to the Manufacturing Quality Plan and so documented.</p> <p style="margin-left: 40px;">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="margin-left: 40px;">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="margin-left: 40px;">13.4 The drive is to conform to NEMA, IEEE, UL and IEC standards.</p> <p>14. Testing :</p> <p style="margin-left: 40px;">14.1. Type Test & Routine Tests like, No load tests, Insulation test, Functional test, Rated current test & Visual inspection, etc.</p> <p style="margin-left: 40px;">14.2. No load tests includes: Motor shaft voltage & Vibration severity measured at bearing housing, etc.</p> <p style="margin-left: 40px;">14.3. Insulation test (vendor to specify with relevant standards).</p>	

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<div style="display: flex; justify-content: space-between;"> <div style="width: 15%; border-right: 1px solid black; padding-right: 5px;"> <p style="text-align: center; margin: 0;">COPYRIGHT AND CONFIDENTIAL</p> <p style="font-size: small; margin: 0;">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: right; margin: 0;">Ref. Doc</p> </div> <div style="width: 85%; padding-left: 10px;"> <p style="margin: 0;">14.4. During Inspection, any physical damage or non-working of the unit shall be replaced with new units.</p> <p style="margin: 0;">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 style="margin: 0;">16. Preservation and Packaging :</p> <p style="margin: 0;">16.1 The material is to be preserved for long term storage (two years minimum) without additional onsite preservation activities.</p> <p style="margin: 0;">16.2 The motor and drive to be boxed in shrink-wrap covering.</p> </div> </div>			

