
TECHNICAL SPECIFICATION

FOR

RECIRCULATION PUMPS

CONFIDENTIAL

CUSTOMER : M/s. BIFPCL Bangladesh
PROJECT : Maitree 2X660MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM
TENDER REF : BIFPCL: MAI: FGD: ARP: R01



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



TECHNICAL SPECIFICATION OF RECIRCULATION PUMP -MAITREE 2X660MW

BIFPCL:MAI:FGD:ARP:R01

TECHNICAL SPECIFICATION FOR RECIRCULATION PUMP

Department	Prepared	Checked	Approved
FGD	Kabilash K.M  Senior Engineer-FGD	Shaktikanta Dash  DGM-FGD	R.Lakshmanan  AGM-FGD
Revision – 00 Dated 14/10/2017		COMMENTS : -----	
Revision – 01 Dated 12/03/2018		The following clauses are amended 1) 2.0 Applicable codes & Regulations- (6) 2) 3.0 Intent of Specification 3) 5.4 Cooling Water Analysis 4) 6.0 Scope of Supply-Supply 5) 6.0 Scope of Supply – 1-(xiv) 6) 6.2 Construction features- E) Coupling 7) 6.2 Construction features- G) Bearings – (b) 8) 6.2 Construction features- G) Bearings – (d) 9) 6.2 Construction features- G) Bearings – (e) 10) 6.2 Construction features- G) Bearings – (f) 11) 6.2 Construction features- H) Accessories-3) Pump Control – (iii) 12) 6.2 Construction features- H) Accessories-4) Provision for Vibration Monitoring 13) 10.0 Exclusion (e) 14) 11.0 Inspection and Testing- A (04) 15) 11.0 Inspection and Testing- B (13) 16) 13.3 Initial spare parts (Mandatory Spares) 17) 20.0 Delivery Condition 18) 22.0 Annexure-1, 7.0 Inspection & Testing	

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1.0 PROJECT INFORMATION:

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

Bangladesh-India Friendship Power Company (Pvt.) Ltd. (BIFPCL) is a 50: 50 Joint Venture Company of Bangladesh Power Development Board, Bangladesh (BPDB) and NTPC Limited, India (NTPC), incorporated under the laws of Bangladesh. BPDB is a statutory body constituted under the Bangladesh Water and Power Development Board Order 1972, and is vested with a significant portion of the generation and distribution of electricity in Bangladesh. NTPC Limited is a Maharatna company incorporated under the Indian Companies Act, and as India's largest power company, has a diversified portfolio covering the entire value chain of the power generation business. Pursuant to the implementation agreement dated April 20, 2013, as entered into between the Government of the People's Republic of Bangladesh, and BIFPCL, and the power purchase agreement also dated April 20, 2013, as entered into between BIFPCL and BPDB, BIFPCL has entrusted BHEL the development of the Coal fired 2x660 MW Maitree Super Thermal Power Project on Turnkey Basis at Rampal, Dist.-Bagerhat, Bangladesh, on the bank of river Possur, Bangladesh, for the purposes of supply and sale of electric power to BPDB. Wet Limestone FGD System is also envisaged by customer in this project to control SO₂ Emissions from the power plant. For the purposes of setting up the Wet Limestone FGD System for 2x660 MW Coal fired Power project at Rampal, BHEL is inviting bids from suitably qualified Bidders for Recirculation pump, pursuant to and in accordance with these bidding documents.

A) SITE CONDITIONS

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



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

Note:

- 1) Reference site conditions shall apply for the Guarantee Values as well as for the Guarantee test/Performance test
- 2) Equipment and Material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

B) PROJECT LOCATION AND APPROACH

a.	State/Division	Khulna
b.	District	Bagerhat district
c.	Place	Moithara Village, Rampal Upazila

C) APPROACH TO SITE:

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

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2.0 APPLICABLE CODES & REGULATIONS

The design of Recirculation pump shall conform to the latest edition of International codes accepted by the Buyer according to good engineering practice.

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

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

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

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

**3.0 INTENT OF SPECIFICATION**

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

- a. There are 2 units of each 660 MW and each unit is envisaged with one FGD system. Each FGD system will be provided with 5 numbers of Recirculation pump (4 working + 1 standby) which are located inside the Recirculation Pump & Oxidation Blower House.
- b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- c. The Bidder shall offer only proven design which meets the Provenness criteria indicated in the clause no: 4.0. Necessary document evidences as per **Annexure-III & VI** shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, they are denied to participate in this tender.
- d. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**Annexure-IV**)".
- e. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- f. No deviation or exception shall be permitted without the written approval of the purchaser.
- g. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- h. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- i. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

4.0 PROVENNESS CRITERIA:

The Bidders are required to meet the Qualification Requirement (QR) for Recirculation Pumps as per criteria stipulated below.

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



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5.0 TECHNICAL INFORMATION

S.No	Description	Requirement
1.	Quantity	
	Quantity of Recirculation Pumps for Unit-1	5 no's (4 working + 1 standby)
	Quantity of Recirculation Pumps for Unit-2	5 no's (4 working + 1 standby)
	Total	10 no's
2.	Parameters	
	Pump Design capacity	9,300 m ³ /hr
	Pump discharge Head	17.30 m H
	Medium to be handled	Gypsum slurry
	Temperature	~60 deg C
	Slurry Analysis	Refer Clause 5.1
	Type of Recirculation pump	Impeller Centrifugal (non- Clogging) type
	Nozzle Orientation	End Suction- Top Discharge
	Seal Type	Single Mechanical seal
	Duty	Continuous
	Location	Outdoor
3.	POWER SUPPLY	
	The following voltage levels shall apply:	
	3.3 kV ±6%, 50 Hz	: Voltage for motors equal to / bigger than 160KW and for power distribution within the plant.
	415 V ±10%, 50Hz	Standard voltage for power supplies to small electric power consumers and motors below 160 KW lighting and domestic power outlets
	Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition.	

5.1 SLURRY ANALYSIS

S.No	Constituents	Parameters
1.	Slurry to be handled	Gypsum Slurry
2.	Chloride Content	<27,000 ppm
3.	Specific Gravity at pump section	1.211
4.	Vapor Pressure at Pump	20.3 KPa
5.	Viscosity at Pump	0.01 Pa.S
6.	Concentration of Solid	30% wt.
7.	SiO ₂ Content	4 to 6 g/l
8.	pH	4-8
9.	Slurry Temperature	60 deg C (Max)

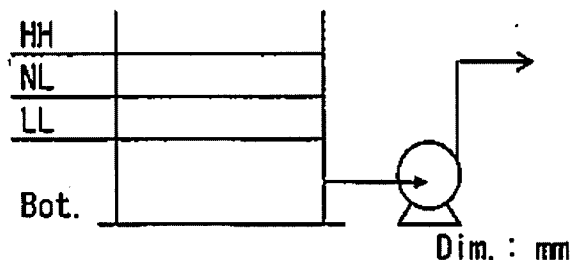


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5.2 ABSORBER TANK LEVEL

HH	Bottom +	6,500	
NL	Bottom +	5000	@ NPSH Base
LL	Bottom +	4,200	



S.No	NPSH Calculation Results	SI Unit	Value
1	Discharge Pressure	kg/cm ² G	2.665
2	Suction Pressure	kg/cm ² G	0.570
3	Differential Pressure	kg/cm ² G	2.095
4	Max. Suction Pressure	kg/cm ² G	0.752
5	NPSH av.	m	11.35

5.3 WATER ANALYSIS

The following water to be used for flushing of the Recirculation pump.

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

5.4 COOLING WATER ANALYSIS

The following Demineralized Cooling water (DMCW) will be used for Gearbox cooling (if applicable).

S.No	Constituents	Unit	Water quality
1.	pH		9 to 9.5
2.	Temperature	Deg C	38
3.	TDS	Ppm	Minimal



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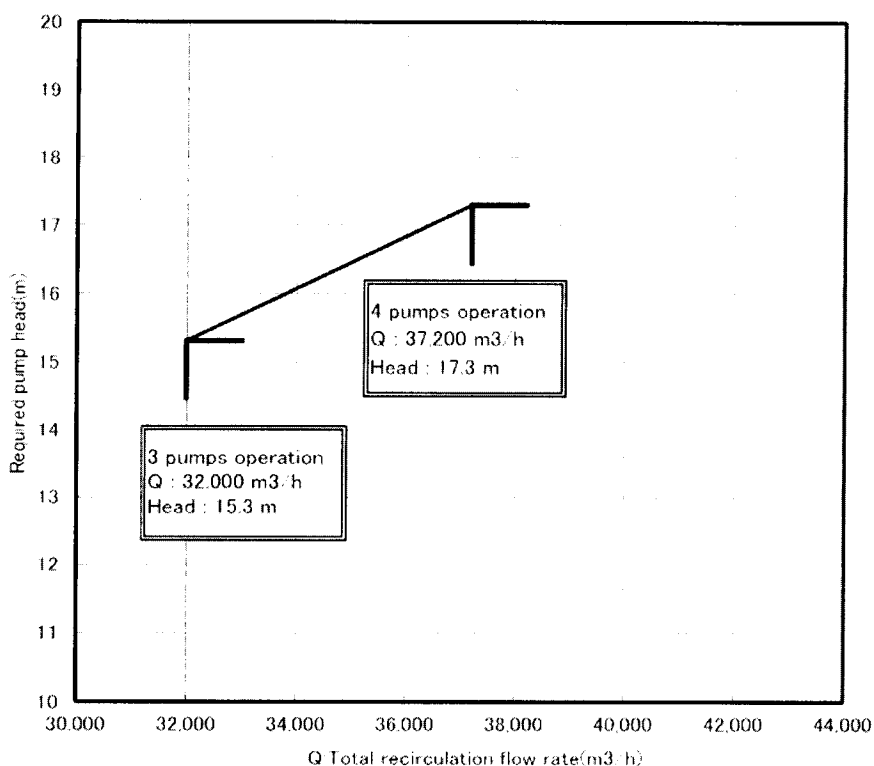
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5.5 OPERATION & PUMP PERFORMANCE

a) Operating Description:

Operating Description of the pumps is as follows. Pumps shall cover this entire operation mode

1. No of Boilers-2 No's
2. Five (05) pumps (4 working + 1 standby) are connected to the common header of the recirculation line per boiler
3. The requirement for the discharge flow rate and pump head is shown in table- 1 for every operating mode.
4. Liquid conditions is the same as the operating conditions shown above.
5. Operating modes of this pumps are:
 - (1) Sequential startup of the pumps one by one
 - (2) i) Four (04) Pumps in continuous operation per boiler
ii) Three (03) Pumps in continuous operation per boiler
 - (3) Sequential shut down of the pumps one by one
 - (4) Emergency shutdown of maximum four (04) pumps per boiler at the same time in case of power failure. In this case the discharge valve of the pumps will be fully closed within 15 sec. Pump shall endure reverse flow.
 - (5) System dynamic pressure drop curve is shown below





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Table-1 Pump Operating condition

S.No	Condition	Required total flow rate m3/hr	Required Pump Head m	Each Pump Capacity (m3/hr)	Pump Head (m)	Pump Efficiency (%)	Shaft Power consumption (KW)
1	4 Pumps in Continuous operation	37200	17.3			> 87%	
2	3 Pumps in Continuous operation	32000	15.3				

- Blanks shall be finalized by vendor

b) Pump Performance (Important):

The following are the requirement on the pump performance

- The capacity of the pump (design Condition) shall be 9300 m3/hr at the pump head of 17.3 meter Height.
- The shaft power at the design conditions specified in (1) shall be kept as minimum as possible (overall pump efficiency shall exceed 87%) and this shaft power shall be guaranteed by the vendor.

6.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Supply, and Supervision of Erection & Commissioning

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

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

Supervision of Erection & commissioning: Includes supervision of erection & commissioning, supervision of trial operation, training of customer's O&M Personnel and handing over to customer.

Supplier's scope shall cover complete Recirculation pump unit including sub-systems, start-up spares and special tools (typically) as given below. The scope of supply for Recirculation pump shall include but not limited to the following:

Sl. No	Scope
1.	Recirculation pump complete with
	i. Casing
	ii. Rotor and Shaft assembly
	iii. Coupling arrangement & Gearbox
	iv. Common base frame and shock absorber
	v. Single Mechanical seal with automatic flushing with a connection for additional manual flushing.
	vi. Flushing and drain system



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Sl. No	Scope
	vii. Coupling guards
	viii. Expansion joints at Inlet and Discharge
	ix. Companion flanges with gaskets and fasteners
	x. Casing drain terminated at battery limit with flange
	xi. Bearing cooling
	xii. Lubrication system
	xiii. Foundation bolts for supplied items
	xiv. Instruments like Pressure gauge, Bearing Temperature Transmitter, Cooling water flow switch, Temperature gauge as applicable etc.
	xv. Mechanical Running and Performance test at shop
	xvi. Painting and Rust Prevention during shipment and construction
	xvii. Supervision of Erection & commissioning at site
	xviii. Export packing and Inland Transportation
	xix. Special tools & tackles as applicable
	xx. Erection and start-up spares as applicable
	xxi. Installation, operation and maintenance manuals
	xxii. Bidder to quote for the Initial Spare parts (Mandatory Spares) with breakup price.
	xxiii. Bidder to quote for the Recommended Spare Parts (for 24 months operation) with breakup price.
	xxiv. Any other items required for completeness of the equipment except the items covered in the exclusions.

6.1	TECHNICAL REQUIREMENTS
1.	All recirculation pumps shall be identical and interchangeable.
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 as specified in the respective clauses.
3.	The Absorber Recirculation Pumps shall circulate the scrubbing liquid from the absorber sump to the spray nozzles in the absorber. The pumps shall be designed as impeller centrifugal (non-clog centrifugal) pump.
4.	The Pumps shall be wear resistant be equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance.
5.	The recirculation pumps shall be equipped with oil level indication, coupling guard and collecting equipment for leakage, made of resistant material.
6.	Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be applied.
7.	Pump shall be driven by the motor with gearbox. A service factor of 1.5 or better should be constituent of Gear Box.
8.	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a Hi-chrome alloy lined pump, Carbon steel /C.I lined with highly alloyed stainless steel, a Silicon Carbide impeller and SiC lining for casing if the bidder has supplied a similar pumps for a previous



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	installation for similar service. The material used by the contractor shall be proven in previous installations.
9.	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft.
10.	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.
11.	All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions
12.	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
13.	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1m to the max NPSH required shall be provided.
14.	The Pump flow/head characteristics shall be such that within the operation range the head will continuously increase with decreasing flow, maximum head (shut off head) being at least 10% higher than the duty point head.
15.	All pumps shall be fitted with suction and discharge pressure gauges
16.	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.
17.	Design pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.
18.	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be minimum 125% of Best Efficiency Point (BEP).
19.	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising it's NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and is at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.
20.	A factor of 1.2 for "Froth" should be taken into account for sizing the pump. If Bidder, from their own experience, specifies that froth factor should not be taken into account or a different factor to be taken into account for FGD pump, the same should be clearly specified. Suction size of the pump should be adequate to take this extra capacity and the same should be reflected in master curve suction specific speed of pump should not exceed $N_s=160$ (metric), taking into account the "Froth factor".
21.	External flushing is required to remove the accumulated particles and all related information should be mentioned in data sheet.
22.	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.
23.	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.



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24.	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –Up an overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
25.	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 have dimensions for a minimum of 175 % of the required load.
26.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
27.	The sealing areas shall be designed in such a way so that solids do not precipitate in them affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
28.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
29.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
6.2	CONSTRUCTIONAL FEATURES
A)	CASING
a.	The pump casing shall preferably be split for ease of maintenance and be designed such that the impeller and shaft are capable of being withdrawn from the casing without disturbing any of the main pipework and valves carrying the pumped fluid. In general all horizontal pumps with draw-out-rotors are to be fitted with a coupling to facilitate disassembly without removing the motor.
b.	The casing and flanges shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
c.	Pressure casing shall be designed with a corrosion allowance to meet the requirement "Technical requirements" and taking into account the "Operating Parameters".
d.	Connection for suction and discharge pressure gauge shall be provided as standard feature.
e.	Lifting provision of pump as a whole and individual casing half should be provided.
f.	For all pumps, 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.
g.	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).



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h.	Pump casing shall be provided with a vent connection and piping with valves and fittings. Casing drain as required shall be provided complete with drain valves.
i.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs.
j.	Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials.
B)	IMPELLER
a.	Impeller material shall be either Hi Chrome or a Silicon Carbide impeller or equivalent, guided by operating parameters taking into account the corrosion and erosion effect as per slurry parameters.
b.	Miller number for the material should be justified for that pumping medium as per ASTM G75-95 as well as the corrosion effect of pumping medium.
c.	Base material for rubber-lined impeller should be capable of handling speed as specified in the respective clause without affecting adhesion of lining. Impeller as rotating assembly along with all elements should be dynamically balanced according to ISO 1940
d.	Impeller tip speed shall be within vendor's experience. And Impeller shall have air bleed holes to eliminate any air accumulation around the shaft seal
e.	Maximum size impellers for the pump body shall not be quoted for. By installation of a new impeller a head increase of 5% minimum shall be possible.
C)	SEALS:
a.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.
b.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
c.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
d.	Pump shall be supplied with mechanical seal. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
e.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
f.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, pump should have a provision of collecting of any drip leakage and flushing the same to nearby pit is to be providing without corroding the base plate of pump.
g.	Mechanical seals shall be fitted and installed in the pump before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping
h.	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Pump manufacturer to decide the same along with seal manufacturer the best seal that is suitable for the offered pump.
i.	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the



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	seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
D)	SHAFT AND SHAFT SLEEVE
a.	All Pump shafts shall be of ample size to transmit the maximum possible output from the prime mover.
b.	The pump shaft and coupling are to be so dimensioned that the maximum permissible torque of the shaft is higher than the maximum transmissible torque of the coupling and gear. Pumps with Gearbox are preferred.
c.	Pumps shall operate smoothly throughout the speed range up to their operating speeds. The first coupled critical speed must be at least 20% higher than the maximum operating speed. The determination of the shaft diameter and the distance between two consecutive bearings must include a sufficiently large safety margin to satisfy this condition.
d.	Shafts shall be conservatively designed to transmit maximum power required and to assure rigidity. Shafts shall be machined and ground to close tolerances and shall be tapered to permit easy removal of the seals and bearings.
e.	Shaft shall run in high precision heavy duty roller bearings. Lubrication system provided shall be such that visual checking of lubricant level is possible
f.	The shaft shall be finished to close tolerance at the rotor, coupling and bearing diameters. The size of shaft shall be calculated on the basis of maximum combined shear stress. This shear stress shall not exceed 30 percent of the elastic limit in tension or 18 percent of ultimate tensile strength.
g.	Shaft shall be carbon steel. No parts of the shaft should come in contact with the liquid medium.
h.	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.
i.	Shaft should have a keyed joint at impeller hub. No thread connection between impeller and shaft is acceptable.
E)	COUPLING
a.	The HT drive motor is excluded from the scope of supply. However, the bidder shall supply coupling and gearbox for secondary transmission.
b.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings and gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
c.	Coupling shall be of flexible type made of cast steel. The Bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the gearbox and the motor by bidder.



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d.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. If weight of the coupling is heavy (>40 kgs), provision of tapped hole should be incorporated in right place of hub to handle the same effortlessly
F)	BASE PLATE
a.	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.
b.	Suitable holes shall be provided for grouting and these shall be so located that the base plate can be grouted in place without disturbing the pump and motor.
c.	Common base plate for pump and Motor shall be in the scope of the bidder and the details of the Motor will be furnished to the bidder to provide Motor mounting bolts.
d.	Base plate must have provision of aligning driver and driven shaft in both directions of base plate so that shafts can be aligned. Similarly, provision must be provided for alignment of shaft in vertical plane.
e.	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, "Taper wedge" and the necessary fastener for Pump and Motor with Base plate. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem.
f.	Base plate must be provided with a trough, material of which must be compatible of pumping liquid. Leaked liquid, collected in trough, can be systematically routed at designated point
g.	Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.
G)	BEARINGS
a.	The bearings may be ball, roller or sleeve bearing. If sleeve bearings are used these shall be machined for close running fit. 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. Oil level indication shall be provided.
b.	The bearings shall be of automatic oil lubricated type. Bearing Temperature transmitter shall be provided with local monitoring of the bearing metal temperature of blowers.
c.	Bearing housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.
d.	If Gearbox requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet. Cooling water for gearbox cooling: 1) Inlet temperature 38 Deg C 2) Maximum Allowable Temperature increase- 5 to 10 Deg C at the outlet 3) Inlet Pressure : 4 to 6 bar 4) Maximum Allowable Pressure Drop - $\leq 1.0 \text{ Kg/cm}^2$. Cooling water flow switch and sight glass shall be provided to monitor the flow of cooling water



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	to Gearbox for each pump.
e.	Bearing temperature Transmitter shall be provided with local monitoring of the bearing metal temperature of pump. Bearing temperature Transmitter shall provide signals to FGD DCS for continuous monitoring.
f.	If heat exchanger is provided to cool gearbox then Temperature gauges and pressure gauges upstream and downstream, both tube side and shell side is to be provided for each pump.
g.	Lubricating oil will be the responsibility of pump manufacturer. Hence, manufacturer has to make arrangement of first fill of oil at installation, and at commissioning stage. Quantity of oil and its grade is to be indicated in Drawing and Operation Manual.
H)	ACCESSORIES:
1.	Expansion Joints:
i.	Expansion Joints shall be provided at suction and discharge of each pump
2.	Pressure Gauges:
i.	Pressure Gauges shall be furnished for at suction & discharge of each pump. Pressure gauges of class 1.6 or better must be used. Pressure instrument for measurement of steady pressure at varying pressure shall operate in a band centered on 60% of its maximum range. Pressure gauges shall have a dial size of 160 mm.
3.	Pump control:
i.	Each pump shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the pumps can be controlled from the control console in the FGD Control room
iii.	Alarm Signal: - Bearing temperature high - Gearbox Cooling water flow low (if applicable) Bearing temperature sensor for alarm during when "Bearing Temperature high" shall be supplied by Bidder. Cooling water flow switch for initiating alarm during when "Cooling water flow low" shall be supplied by Bidder (if applicable).
4.	Provision for Vibration Monitoring:
i.	Provision for Vibration sensors, Key phase sensors shall be provided in equipment. For each bearing there shall be provisions for Two (02) No's of Vibration sensors (X and Y Axis) for vibration measurement. Provisions shall be provided in line with API 670 V th Edition Standard These provisions shall be covered suitably. Details to be provided along with the offer.



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7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipments. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English
3.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.
4.	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
5.	Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. Predicted sound pressure levels for the pump drive assemblies shall be submitted as part of the proposal data.
6.	The overall vibration level shall be as per ISO 10816.
7.	Suitable drain connections shall be provided.
8.	The equipment shall be suitable for stable operation continuously.
9.	Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities and branch piping to each nozzle. Terminal points for all utilities shall be located at skid edge. The bidder shall specify all terminal points with tie-in number in the P&ID and submit it in the proposal to confirm the scope of supply.
10.	Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load operating hours whichever is longer.
11.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable international standard.
12.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150
13.	Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.
14.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
15.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum



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S.No	Description
	shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
16.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
17.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
18.	Provide double nuts for anchor bolts
19.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
20.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
21.	The bidder shall have full responsibility for vibration control of the equipment train at the site and the units satisfactory performance, even if the foundation and drivers are provided by the BHEL.
22.	Bidder to quote for the Initial Spare parts (Mandatory Spares) for equipment
23.	Bidder shall provide the mating flanges with the necessary gaskets.
24.	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
25.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
26.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
27.	Quality Plan to be submitted along with the offer.
28.	During entire period of the project, the bidders shall strictly follow and adhere to the guidelines for effective Health & Safety Management. Supply of safety gears/PPE for bidder's/bidder's sub vendor personnel deputed at site for Supervision of E&C, PG tests etc. shall be in bidder's scope. Also refer to Annexure-IX- Health & Safety Management Manual for complying with requirements whichever is applicable.
29.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
30.	Material of construction for all equipment/components shall be subject to BHEL/BIFPCL/BIFPCL's consultant approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard

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S.No	Description
	and global references.
31.	Bidder to provide sub vendor list and Bidder shall strictly adhere to BHEL/BIFPCL approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by BIFPCL/BHEL before placing order and bidder shall submit relevant documents as per Attachment-VI-Sub-Supplier Questionnaire .
32.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BIFPCL for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of BIFPCL/ BHEL, the same may be replaced with another BIFPCL/BHEL approved sub-vendor only, without any price implications to BHEL.
33.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the BIFPCL/ BIFPCL's consultant and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the customer/customer's consultant along with BHEL.
34.	Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
35.	During detail engineering, bidder to strictly adhere to BHEL/BIFPCL/BIFPCL's consultant drawing formats, document numbering, quality plan & FQP formats
36.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).
37.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/BIFPCL/BIFPCL's consultant during detail engineering
38.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-



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S.No	Description
	Word /Excel format.
39.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/BIFPCL/BIFPCL's consultant should be addressed timely by the bidder.
40.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
41.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"
8.0	PACKING AND FORWARDING
1.	Packing shall be as per relevant clause of product packing specification – Annexure-VII-PE:TS: 888:100:A001 (Sea worthy packing)-8.4-Packing of Goods in Wooden crates/cases/Boxes-8.4.2- Cases with Lining-Packing Category IV
2.	Cardboard containers shall be enclosed in a solid wooden container
3.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
4.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
5.	Crates and packing material used for shipping will become the property of owner.(BIFPCL)
6.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
7.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.



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8.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: - Destination - Package Number - Gross and Net Weight - Dimensions - Lifting places - Handling marks and the following delivery marking
9.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (Pvt) LIMITED 2X660 MW MAITREE SUPER THERMAL POWER PROJECT BANGLADESH EPC CONTRACTOR:BHARAT HEAVY ELECTRICALS LIMITED, INDIA" In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
10.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
11.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
12.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
13.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care", "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
14.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: - Upright position - Sling position and center of Gravity position - Storage category - Fragile components (to be marked properly with a clear warning for safe handling)



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S.No	Description
15.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
16.	The packing slip shall contain the following information:- Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of pump & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.
17.	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
18.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.
19.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
20.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
21.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
9.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING
1.	The erection of Recirculation Pumps will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per boiler for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.
2.	There will be one visit per boiler and totally there will be 2 visits for 2 boilers. The bidder will be informed well in advance for the visit. Bidder shall include 15 working days per visit in the offer with minimum 2 visits.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.



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S.No	Description
10.0	EXCLUSION
	The following work associated with the recirculation pump will be by others: a. Supply of main drive HT motor b. Civil foundations c. Walkways, platforms and ladders d. Element handling hoists e. Vibration Monitoring system including sensors
11.0	INSPECTION AND TESTING
A)	Minimum Testing requirements to be considered are as below:
1.	Hydrostatic test is to be conducted at 150 % of design pressure for duration of 30 minutes, taking into consideration of the fact that actual operating temperature is 60 deg Celsius (maximum).
2.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
3.	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.
4.	List of Non-Destructive test over and above the material test are as follows: a. Casing: Material test, Magnetic particle (MPI), DP and Hydro test as applicable b. Impeller- DPT and MPI as applicable c. Shaft- Ultrasonic (UT), DPT and MPI d. Sleeve- DP and Hardness test/ Manufacturer's recommendation e. Mechanical Seal- Manufacturer's recommendation. f. Base Plate- Stress relieving of weld. g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate
5.	Once mounting is finished and operation less will be conducted on each pump to determine the characteristic curves. For dynamic pressure and volume output, and to determine the parameters at the design point, mechanical running & performance testing shall be performed & witnessed.
6.	NPSH Test, Vibration test and Noise level test shall be witnessed at shop.
7.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.



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S.No	Description
8.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
9.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
10.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.
11.	For surfaces with rubber lining, Coating thickness shall be checked at 100%.A High voltage porosity test will be conducted on 100 % of the coated surface.
B)	General Inspection requirements to be considered are as below:
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BIFPCL prior to manufacture. Inspection of above mentioned tests by BHEL representative at bidder's works is envisaged.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/BIFPCL.
3.	Out of 10 Recirculation Pumps, One Number of Recirculation Pump will be inspected at the Bidder's works before dispatch or where the test facilities are available.
4.	The Bidder shall conduct performance test for the remaining pumps and submit the reports.
5.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/BIFPCL within one (1) week of the successful completion of balancing.
6.	Acceptance tolerance of actual versus guaranteed performance for capacity, head, efficiency and power absorbed shall be as per applicable standard.
7.	Vibration levels shall be measured during shop running/performance tests.
8.	Contract shaft seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition.
9.	Recirculation pumps shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
10.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
11.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
12.	Bidder to arrange all calibrated gauges, Instruments during inspection.



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13.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same/higher rating for the shop test and inspection.
14.	The performance test may be carried out using water at shop and shall be converted to the design condition.
15.	Bidder to also refer Annexure-VIII –Clause no. B.0.7 w.r.t "Inspection & Testing" for "Testing during Manufacturing" (clause B.0.7.2), and "Testing at Site" (clause B.0.7.3) (which includes Erection Tests, Commissioning Tests, PG Testing, Reliability Run Test etc.)
12.0	PAINTING
1.	Surface Preparation : Blast Cleaning SA 2.5
2.	PRIMER COAT: a. Zinc Epoxy b. DFT= 80micron per coat c. No of coats = 1. d. Primer coat thickness 80 micron.
3.	FINISH COAT: a. Epoxy High Solid b. DFT= 50micron per coat c. No of coats = 2. d. Intermediate coat thickness 100 micron. e. Total DFT : 180 micron.
4.	COLOUR CODE (based on DIN 2403:2007-05 & DIN 5381) a. Base: Signal Orange, RAL:2010 b. Lettering: Signal Black, RAL: 9004.
5.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope
6.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BIFPCL/ BIFPCL's Consultant.
13.0	SPARES,TOOLS & TACKLES
13.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Recirculation pumps. Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Commercial Operation Date (COD)/ Issuance of Provisional Acceptance Certificate (PAC) shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipments are energized. These start-up & commissioning spare part list shall not be included in "Initial Spare Parts List".



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S.No	Description
13.2	FINAL SPARE PARTS LIST (RECOMMENDED SPARES)
	Bidders shall also furnish the Final Spares Part List (i.e. recommended spares list) along with the offer. Bidder shall provide a "Final Spare Parts List" which shall comprise of all items of the Initial Spare Parts List as well as other spares required for long term routine/planned and breakdown maintenance. Bidder shall indicate all details for each item of aforesaid Final Spare Parts List, such as Bidder's/ Original equipment manufacturers (OEM's) name and location, drawings, normal delivery period, quantity, life time/ service life, Bidder's/OEM's serial numbers and price labeling according to the plant numbering code etc. The format and content of the final spare parts list shall be agreed in the basic/detailed engineering phase and shall be subject to BIFPCL's approval. Then the final spare parts list shall be submitted by the bidder to the BHEL for approval not later than eighteen (18) months prior to the Scheduled Commercial Operation Date (COD)/ Issuance of Provisional Acceptance Certificate (PAC) of 1st Unit. The bidder shall name OEM/ three (3) vendors with complete address for each of the spare parts. Bidder shall quote for the "Final Spares Part List", however it shall not be considered for L1 evaluation, but these spares items shall remain available for order anytime during the first three (3) years commencing from COD of each unit, at the initial unit prices quoted in the offer as adjusted pursuant to the indexation mechanism approved by BIFPCL/BIFPCL's consultant. However, the BHEL/BIFPCL shall have the freedom to decide at its sole discretion to purchase spare parts either from OEM (according to quoted unit price as stated above) or directly from sub-vendors or from any other source.
13.3	INITIAL SPARE PARTS (MANDATORY SPARES):
	Bidder to quote for below mentioned mandatory spares with break up price. - Impeller assembly - 1 no. of each type - Casing liners-If applicable – 1 no. of each type - Seals - 1 no. of each type - Coupling - 1 no. of each type - Oil Cups-If applicable – 1 no. of each type - Shafts & Sleeve- 1 no. of each type - Pressure gauge-4 No's - Bearing Temp Transmitter- 2 No's Bidder shall quote for the "Initial Spares Part List", and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipments. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan.
13.4	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or



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S.No	Description
	maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
14.0	PERFORMANCE GUARANTEE
	All performance tests for Recirculation pumps shall be carried out in accordance with any latest international codes/standards. 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Recirculation pump and its accessories 2) Capacity and head of the pump to be guaranteed. 3) The Bidder shall ensure a design of the equipment to achieve an average target availability of 90%. 4) All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs. 5) Scheduled Maintenance (Minor Overhauls): Recommended intervals between maintenance outages shall be >25000 hours operation. 6) Scheduled Maintenance (Major Overhauls): Recommended intervals between maintenance outages shall be >75000 hours operation. 7) Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 8) Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. 9) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BIFPCL's approval. 10) In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.
15.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION:
1.	POWER GUARANTEE Bidder to specify the guaranteed Shaft power per Pump operating at the duty point in their offer
2.	BID EVALUATION CRITERIA FOR POWER CONSUMPTION: Power consumption quoted by bidder shall be limited to the ceiling value specified below. Ceiling value for Shaft power for the designated Recirculation pump = 620 KW



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S.No	Description
	In case, Guaranteed Shaft power offered by the bidder exceeds the ceiling value specified above, his bid price will be loaded for excess power consumption as per the formula given below. Adjustment factor for excess power consumption in USD = (GPC-CV) X PL X 8 No's of Working pumps GPC- Guaranteed Shaft Power Consumption quoted by bidder in KW CV- Ceiling Value for Shaft Power Consumption i.e. 620 KW PL- Power Loading @ 4060 USD/KW Exchange rate as applicable on price bid opening date will be considered. No Price advantage apart from NIL Power Loading will be given if Guaranteed Power consumption offered is less than the ceiling value.
16.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
	If actual shaft Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in USD per pump = (GPC-APC) X P X 10 No's of Working pumps Where • GPC- Guaranteed Shaft Power Consumption quoted by bidder in KW • APC- Actual Shaft Power Consumption in KW • P- Penalty @ 4060 USD per KW
17.0	WARRANTY
1.	The warranty period shall begin on the date of taking over by BIFPCL or date of issuance of the provisional acceptance certificate for the unit (whichever occurs first) and shall end after twenty-four (24) months. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.
2.	In case of failure of the equipment to meet the guarantee, BIFPCL/BHEL reserves the right to reject the equipment. However, BIFPCL/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
18.0	FIRST FILL OF CONSUMABLES:
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to COD including top up requirements at the time of issuance of PAC/declaration of COD. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site



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	consistent with good maintenance procedures as instructed in the maintenance manuals.
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the BIFPCL/BHEL's approval herein shall be furnished eighteen (18) months prior scheduled COD of the 1 st unit. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BIFPCL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
19.0	TRAINING
	Successful bidder shall provide comprehensive training for BIFPCL/BIPCL's Consultant Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Recirculation pumps - Operation & Maintenance, Troubleshooting etc.
20.0	CONFLICT
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising BIFPCL in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.
21.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. As a minimum requirement, the following information shall be furnished to fully describe the scope of work and services offered. Duly filled-in Technical Data sheets (Annexure I) and guarantee schedule furnished under Annexure-II. a. PID diagram b. Performance curve c. Terminal point details. d. General Arrangement drawings indicating dimensional data with civil loads and pocket details. e. Rotor GD² (kg-m²) f. Torque Vs Speed curve



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S.No	Description
	g. Calculation of Motor rating, Bearing capacity and selection of coupling h. Bill of material along with material and code i. Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment. j. Erection, Operation & Maintenance manual with lubrication schedule k. Procedure for shop / site performance tests l. Time schedule for delivery. m. Quality Assurance Plan. n. Make of all bought out items. o. Deviation list p. Spares list. q. Hoist / Crane requirement. r. Reference list of similar projects executed. s. Sub Supplier questionnaire format (Annexure-VI) t. List of proposed makes and vendors u. Training program and schedule for BHEL/BIFPCL's personnel v. Equipment maintenance schedules The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified here under. However as minimum the following shall be submitted. a. Duly filled technical datasheet. b. Warranted performance curves. c. General arrangement drawings indicating dimension and civil loading details. d. Motor Data e. Recommended repair procedure etc. f. Operation and maintenance manuals g. Any unique installation instructions shall be noted on the submitted drawings or be provided as a separate document prior to the submission of the Operation and Maintenance Manual. h. Erection schedule and component list. i. Successful Bidder shall submit Calculation for HT Motor power requirement for sizing HT Motor within 2 weeks from the date of ordering.



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S.No	Description
	j. The characteristic curves of Recirculation pumps shall be provided along with the documents. These shall be identical and uniform for all the pumps. The pumps shall be designed for optimum power consumption and should not fall under surge point between the operating range k. The following characteristic curves of the pump shall be submitted: i. Flow v/s Head ii. Flow v/s NPSH iii. Flow v/s Efficiency iv. Flow v/s power consumption v. Torque vs. speed curve for Motor selection l. The system-resistance point at different loads shall be indicated in the above performance curves. Drawings that are reviewed by the BIFPCL / BIFPCL's Consultant will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. BIFPCL / BIFPCL's Consultant reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by BIFPCL must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDS shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. In addition, One (1) copy of operation and maintenance manuals shall be translated into "Bangla" and provided as paper copies and in electronic format. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per BIFPCL's requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL.



TECHNICAL SPECIFICATION OF RECIRCULATION PUMP -MAITREE 2X660MW

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22.0 ANNEXURES

ANNEXURE – I- TECHNICAL DATA SHEET

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Maitree (2X660 MW)
	c. Ultimate Customer	: BIFPCL
	d. Location	: Khulna, Bangladesh
	e. Service	: Continuous
	f. Installation	: In-door
	g. No of pumps for each unit	: 4 Working + 1 Standby
	h. No of stand-by pumps per unit	: 1
	i. Total number of pumps	: Unit-1 - 5 No's Unit-2 - 5 No's
2.0	MANUFACTURER DETAILS	
	a. Model	: Bidder to provide
	b. Type	: Centrifugal (non- Clogging)
	c. Type of Driver	: With Gearbox
3.0	OPERATING CONDITION	
	Medium to be handled	: Gypsum slurry
	Maximum solid particle size	: 150 mesh (140 microns)
	Normal solid particle size, d 50	: 325 mesh (43 micron) and fine particles
	Concentration of chloride	: 27,000 ppm (Max)
	Viscosity of slurry	: 10 cp
	Concentration of slurry	: 30(% by weight)
	Specific gravity of slurry	: 1.211
	pH of slurry	: 4-8
4.0	PERFORMANCE DATA	
	a. Capacity	m ³ /hr : Bidder to Provide
	b. Head	M : Bidder to Provide
	c. Pump efficiency	% : Bidder to Provide
	d. BKW Normal / Maximum	KW : Bidder to Provide
	e. Motor rating	KW : Bidder to Provide
	f. Motor Speed	rpm : Bidder to Provide
	g. Gear box Loss	% : Bidder to Provide
	h. Differential pressure (inclusive of losses)	Kg/cm ² : Bidder to Provide
	i. Speed Maximum/ Normal/Minimum	rpm : Bidder to Provide
	j. Noise level	dB(A) : Bidder to Provide
	k. Performance curve	: Bidder to Provide
5.0	CONSTRUCTION DATA	
	a. Manufacturer	: Bidder to Provide
	b. Model No.	: Bidder to Provide
	c. Suction Rating / Size	: Bidder to Provide



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	d. Discharge Rating / Size	:	Bidder to Provide
	e. Type of rotor	:	Bidder to Provide
	f. Size of rotor Dia mm	:	Bidder to Provide
	g. Journal bearing: Type / Size:	:	Bidder to Provide
	h. Thrust bearing: Type / Size:	:	Bidder to Provide
	i. Bearing cooling required	:	Yes / No - Bidder to confirm
	j. Cooling water required	:	Bidder to confirm the quantity
	k. Type of drive	:	With Gearbox
	l. Shaft seal	:	Mechanical
	m. Size / Code	:	Bidder to Provide
	n. Type of coupling	:	Bidder to Provide
	o. Service factor	:	Bidder to Provide
	p. GD ² at drive shaft end	:	Bidder to Provide
	q. Rotation viewed from coupling end	:	Clock wise / Counter clock wise
	r. Coupling type	:	Yes / No - Bidder to confirm
	s. Coupling make	:	Bidder to Provide
	t. Base plate common to pump, Gearbox, bearing housing, coupling & Motor	:	Yes / No - Bidder to confirm
	u. Total weight kg	:	Bidder to Provide
	v. Maximum Erection weight kg	:	Bidder to Provide
6.0	MATERIALS		
	a. Casing	:	Bidder to Provide
	b. Impeller	:	Bidder to Provide
	c. Shaft	:	Bidder to Provide
	d. Shaft Seal	:	Bidder to Provide
	e. Base frame	:	Bidder to Provide
7.0	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/ BIFPCL/BIFPCL Consultant 's representative, [O]: Observed		



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NAME _____

DESIGNATION _____

**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP -MAITREE 2X660MW****BIFPCL:MAI:FGD:ARP:R01****ANNEXURE II- SCHEDULE OF GUARANTEES**

Sl. 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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ANNEXURE – III

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

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limest one Based FGD Yes/No	Model	Capacity m ³ /hr.	Head m	Speed rpm	Year of Commg	Qty

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NAME

DESIGNATION



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

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

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NAME -----

DESIGNATION -----

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP -MAITREE 2X660MW
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ANNEXURE -V

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

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

**TECHNICAL SPECIFICATION OF RECIRCULATION PUMP -MAITREE 2X660MW****BIFPCL:MAI:FGD:ARP:R01****B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:**

Sl. No.	Description	No of copies After award of contract	Delivery Time
1.	Utility Consumption	1	2 weeks after contract
2.	Foundation Data including Anchor plan	1	2 weeks after contract
3.	Performance curve	2	2 weeks after contract
4.	Assembly drawings of each equipment	1	1 month after contract
5.	Cross section detail drawing	1	1 month after contract
6.	Data Sheet	1	2 weeks after contract
7.	Lubricating oil list	1	2 months after contract
8.	Special tools list	1	2 months after contract
9.	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.	Manufacturing Schedule	1	2 weeks after contract
15.	Progress report	1	Every month
16.	Proforma Packing List	1	2 months prior to shipping
17.	Approximate weight of each skid	1	2 months after contract
18.	Required Electric power	2	2 weeks after contract
19.	Pump and Motor Sizing Calculation	1	2 weeks after contract
20.	Material Test Certificates	2	In 2 weeks after test
21.	Pre Commissioning Check List	2	4 months after contract
22.	Scope of Supply	2	2 weeks after contract
23.	Quality Plan	4	1 month after contract
24.	Operation and Maintenance Manual	• 10 hardcopies and 5 electronic copies in English • 1 hardcopy and 1 electronic copy in "Bangla"	4 months after contract
25.	Spare List (Mandatory, Recommended)	1	1 month after contract
26.	Start-up & Commissioning Spares	2	1 month after contract

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Sl. No.	Description	No of copies After award of contract	Delivery Time
27.	List of Special Tools	1	1 month after contract
28.	Delivery Schedule	1	2 weeks after contract
29.	Test Arrangement & Test procedure	2	1 month after contract
30.	T-S curve	2	2 weeks after contract
31.	P & I Diagram	2	2 weeks after contract
32.	Catalogue	2	2 weeks after contract

SIGNATURE OF BIDDER

NAME

DESIGNATION



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ANNEXURE –VI

FICHTNER'S SUB SUPPLIER QUESTIONNAIRE FORMAT

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

SIGNATURE OF BIDDER -----

NAME -----

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ANNEXURE-VII

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING

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

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DESIGNATION -----



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ANNEXURE-VIII

INSPECTION & TESTING

Refer to all clauses for Inspection & testing requirements.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



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ANNEXURE-IX

HEALTH & SAFETY MANAGEMENT MANUAL

Refer to all clauses for Health & Safety requirements.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____