

ANNEXURE –C to Open tender ENQ. No. BAP/PUR/FGD/SLURRY PUMPS/4230425E dt.20.06.2013

S.NO	MATERIAL CODE	ITEM DESCRIPTION	SPECIFICATION REFERENCE	QUANTITY (NO)	DESTINATION
1	RFW000360001	TECHNICAL DATA SHEET -I GYPSUM BLEED PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	6	BHEL STORES RANIPET
2	RFW000360002	TECHNICAL DATA SHEET -II FILTRATE WATER PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	2	BHEL STORES RANIPET
3	RFW000360003	TECHNICAL DATA SHEET -III SECONDARY HYDROCYCLONE FEED PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	2	BHEL STORES RANIPET
4	RFW000360004	TECHNICAL DATA SHEET -IV AUXILIARY ABSORBENT PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	1	BHEL STORES RANIPET
5	RFW000360005	TECHNICAL DATA SHEET -V PRIMARY OVERFLOW TRANSFER PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	2	BHEL STORES RANIPET
6	RFW000360006	TECHNICAL DATA SHEET -VI WASTE WATER PUMPS	NTPC:BONG:FGD:SPUMPS-SPEC-005:REV-01	2	BHEL STORES RANIPET
7	RFW000350000	LIMESTONE SLURRY PUMPS	NTPC:BONG:FGD:LPUMPS-SPEC-004:REV-01	6	BHEL STORES RANIPET
8	RFW000530000	DRAIN PIT PUMPS	NTPC:BONG:FGD:DPUMPS-SPEC-013:REV-01	5	BHEL STORES RANIPET

1) SUPERVISION OF ERECTION AND COMMISSIONING CHARGES TO BE QUOTED ON PER MAN DAY BASIS ONLY WHICH SHOULD BE INCLUSIVE OF ALL CHARGES (BOARDING, LODGING, TRANSPORTATION CONVEYANCE & MISCELLANEOUS CHARGES). BHEL WILL DECIDE THE NUMBER OF DAYS FOR ERECTION AND COMMISSIONING FOR COMPARISON

**BONGAIGAON– 3X250 MW
FLUE GAS DESULFURIZATION SYSTEM**


**TECHNICAL SPECIFICATION
FOR
DRAIN PIT PUMPS**

CUSTOMER : NATIONAL THERMAL POWER CORPORATION LIMITED




NTPC: BONG: FGD: DPUMPS-SPEC-013: REV-01

Flue Gas Desulphurization Group
Air Quality Control Systems
BAP:: BHEL :: Ranipet

	BHEL Document No.:	4-FW-000-00117
	NTPC Document No.:	4610-101-03RP-PVM-Y-099
Technical Specification for Drain Pit Slurry Pumps		


Technical specification for Drain Pit Slurry Pump

Prepared	Checked	Approved
Sashi Kumar Sr Engineer - FGD	Sashi Kumar Sr Engineer - FGD	Shaktikanta Dash Manager - FGD
R00 dated 16 09 2010		----
R01 dated 04 06 2013		Specification revised <ul style="list-style-type: none"> • Painting procedure included • Bearing life revised from 25000 hrs. to 25000 hrs. as per standard API-610


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1.0.0	PROJECT INFORMATION	
	▪ Owner	NTPC
	▪ Buyer	BHEL, Ranipet
	▪ Process / application	Wet Lime Stone FGD system
1.1.0	SITE CONDITIONS	
	▪ Ambient temperature (Guarantee)	27 Deg C
	▪ Ambient temperature (Design)	50 Deg C
	▪ Relative Humidity	60 %
1.2.0	LOCATION AND APPROACH	
	▪ Project location	
	▪ Place	Kumkuri near Salakati, Bongaigaon
	▪ District	Kokrajhar
	▪ State	Assam
	▪ Height above sea level	47 m

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2.0.0 INTENT OF SPECIFICATION

The Bidder shall offer only proven design in successful operation.

This specification together with the attendant Technical Data Sheet and other specifications/attachments to inquiry / order defines the minimum requirements for vertical centrifugal submerged pumps including pumps and their accessories /auxiliaries for use in the process of Flue gas Desulphurization (FGD), involving Limestone (Calcite) slurry. The scope details the requirement for design and manufacturing of vertical centrifugal pumps that are to be used for slurry, containing particles of hardness (Moh scale 7 and below).

Bidder shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.


In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), these shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (Annexure-VI)". Deviation shall be listed separately for each document with cross reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable. No deviation or exception shall be permitted without the written approval of the purchaser.

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.

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, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.

2.1.0 CODES AND STANDARDS

The design, manufacture, inspection and testing of vertical centrifugal pumps shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/International (ASME/Japanese/EN) standards. Other Internationally acceptable standards, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the Contractor of the required statutory responsibility.

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In particular the pumps shall conform to the latest edition of the following standards:

IS:5120	Technical requirements for Roto -Dynamic special purpose pumps
IS:5639	Pumps handling chemicals & corrosive liquids
IS:5659	Pumps for process water.
IS:6536	Pumps for handling volatile liquids.
API:610	Centrifugal pumps for general refinery service.
	Standards of Hydraulic Institute of U.S.A.

2.2.0 SCOPE OF SUPPLY

a. Pump Quantity :

5 number of drain pit pumps of 20 m³/hr capacity and 20 m head to be supplied along with Motor Assembly with Base Plate, coupling and Foundation Bolt.

b. Service Engineer Visit :

Bidder's Service Engineer shall visit the site for supervision of commissioning the pumps. It is the bidder's responsibility to commission all the pumps to the satisfaction of end user/BHEL. Duration of visit of engineer may be planned and agreed mutually as per site condition.

c. Erection and commissioning supports:

Inspection for Erection, Testing, commissioning, operation and maintenance.

d. Operation & Erection Manuals :

Containing all details of reference drawings and technical data shall be furnished by the Bidder.

e. First Fill of Consumables, Oil & Lubricants.

3.0.0 BASIC DESIGN


3.1.0 GENERAL

This section covers the manufacturing and performance requirement of the pump and its accessories.

3.2.0 PUMP TYPE AND OPERATION

a. Pumps shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.

b. Pump shall be either belt drive or Gear Box type and the stand-by pump shall be the same type. If the belt drive is chosen by the vendor, vendor should

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adhere to the applicable standards for ensuring the performance of the pumps as per the specification. Necessary spares for the belt filter (Mandatory/ Recommended/ Commissioning spares) required also to be specified by vendor.

- c. The wearable parts of the pump which are in contact with slurry shall be provided with replaceable with rubber or Elastomer liners suitable for the slurry. The vendor can also offer alloy line pump if he has previous experience for the same for similar applications. The material used shall be proven in previous installations.
- d. The pumps shall be designed for continuous operation.

3.3.0 SERVICE CONDITIONS


- a. Capacity of the Pump = 20 m³/hr
- b. Head of the pump = 20 mlc
- c. Maximum operating temperature = 60 deg Celsius
- d. Minimum operating temperature = 10 deg Celsius

3.3.1 SITE POWER SUPPLY SPECIFICATION

- a. All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.
- b. The auxiliary AC voltage supply arrangement shall have 6.6 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition :
 - (a) 6.6 kV +/- 6%
 - (b) 415/240V +/- 10%
- c. The voltage level for motors shall be as follows :-
 - i) Upto 0.2KW : Single phase 240V AC / 3 phase 415V AC
 - ii) Above 0.2KW and upto 200KW : 3 phase 415V AC
 - iii) Above 200KW : 6.6 kV
- d. Fault level shall be limited to 40kA RMS for 1 second for 6.6kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.

3.4.0 PROCESS PARAMETERS

- a. Solid to be handled = Limestone
- b. Medium = Limestone slurry

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- c. Maximum solid particle size = 6-7 mm
- d. Normal solid particle size, d 50 = 325 mesh (43 micron) and fine particles
- e. Concentration of chlorine = 20,000 ppm (max)
- f. Viscosity of slurry = 10 cp
- g. Concentration of slurry = 30 (% by weight)
- h. Specific gravity of slurry = 1.12
- i. pH of slurry (Alkaline) = >9
- j. PPM of heavier particle (Silica, Aluminum Oxide, Ferric Oxide and Columbium) = 23290 ppm
- k. Total PPM of all suspended particle, including heavier particles as above in the slurry = 281300 ppm


Note: Bidder to indicate clearly in the offer what “De-ration Factor” has been taken into account for “Slurry Head to Water Head” and efficiency. This factor is to be indicated in data sheet.

3.5.0 DUTY PARAMETERS AND REQUIREMENT

3.5.1 Refer Datasheets for drain pit pumps under the scope of supply. Vendor to submit duly filled Data sheets along with the offer.

3.5.2 REQUIREMENTS

- a. Design criterion of pump and auxiliaries shall be consistent with a minimum service life of 10 years (excluding normal wear of parts as indicated in datasheets) and 16000 hrs (minimum) for all rotating and wearable parts.
- b. Pump shall be capable of operating up to at least 115% of the rated speed because of frequency variation and shall be capable of operating briefly, under emergency conditions up to the driver trip speed
- c. 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).
- d. Pump casing shall be designed to remove of the rotor or inner elements without disconnecting the suction and discharge piping or moving the driver.
- e. Pump should have a clear operating range. Master characteristics curve of the pump must indicate the same and to be submitted.
- f. Selection of Duty point should preferably at BEP 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


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without compromising its 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.

- g. Selection of point should not be at full diameter of impeller. Selected diameter should be such that extra 10% head increase is possible. Similarly, duty point should not be at minimum diameter of impeller. Margin in head may be 10 % of the rated head.
- h. 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".
- i. Motor, Electrical components and electrical installations shall be suitable for area classification (Class, Group, Division/Zone) as per the specification and shall meet the requirements of NFPA as well as local codes and furnished by end user
- j. Pumps and its driver shall perform on the test stand at shop and on the pump's permanent foundation at site within vibration limit as specified in Clause-3.17.0. After installation at site, the vibration of combined unit will be the joint responsibility of pump and motor manufacturer. Site performance of vibration is one of the "Acceptance Criteria" of accepting the equipment. Please note vibration at test stand can only be taken as for information. Pump should be supplied with mechanical seal.
- k. If external flushing is required to satisfy "**Zero Leakage**", it should be provided. If it is required, manufacturer to indicate the plan and necessary piping shall be supplied by pump manufacturer. If flushing is required occasionally to remove the accumulated particles, all related information should be mentioned in data sheet.
- l. Pump should have an 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.

3.6.0 CASING

- a. Pump casing shall have radially spilt type construction as specified.
- b. The casing 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 of section 3.5.2 and taking into account the "Process Parameters" in the 3.4.0.

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- d. For all pumps, the casing material shall be Ductile iron (65-45-12, ASTM A-536) or any other superior material with 30% Acrylonitrile NBR rubber liner with Shore hardness- SA 60 (+/-) 5. The material provided by the vendor to meet the guarantee of casing life in line with Annexure II.
- e. For replaceable rubber liner, hardness of rubber should be of Shore hardness- SA 60 (+/-) 5. Rubber should be of Type and Class as defined by ASTM D-2000 which is suitable for uninterrupted operation of 5 years (minimum).
- f. Casing with non-replaceable rubber lining can also be offered, provided the guarantee is given of rubber quality which gives guarantee of equipment as per 3.5.2.
- g. The vendor can also offer an alloy lined casing if he has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.
- 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. Connection for suction and discharge pressure gauge shall be provided as standard feature.
- j. Lifting provision of pump as a whole and individual casing half should be provided.

3.7.0 NOZZLES & MISCELLANEOUS CONNECTIONS


- a. Casing connection should be as per standard nominal pipe (NPS) or DN. However, non- standard sizes (viz. 550,650,750 NS etc.) should be avoided.
- b. For rubber-lined pump the same provisions (Flushing, Venting, Draining and Pressure gauge connection) should be provided as per requirement.
- c. Suction and Discharge flange should be of same rating and raised- face, suitable for through bolting.
- d. All connections shall be suitable for hydrostatic test pressure of that region of the casing to which they are attached.
- e. Companion flange along with necessary Bolt, Nut and Gasket shall be taken as pump manufacturer's scope of supply. Material of the companion flange should be Mild steel.

3.8.0 EXTERNAL NOZZLES FORCES & MOMENTS

Allowable nozzle load and a figure that defines the co-ordinate system, in which the load are applied, shall be supplied with tender. Permissible load and moment from pipe line should be as per HI 12.2-12.6-2005 or ISO standard.

3.9.0 IMPELLER

- Impeller material shall be either Ductile iron (65-45-12, ASTM A-536) or any other superior material, guided by 3.4.0 taking into account the corrosion and erosion

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effect as per slurry parameters.


- 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.
- Base material for rubber-lined impeller should be capable of handling speed as specified in clause 3.3.0 service condition without affecting adhesion of lining.
- Impeller as rotating assembly along with all elements should be dynamically balanced to meet the standard Gr G 6.3: ISO-1940.

3.10.0 WEAR RINGS or CASING LINER

All the Pump wear parts in contact with the slurry shall be provided with replaceable rubber / Elastomer liners suitable for the fluid handled. The contractor can also offer an alloy line pump if he has previous experience of the same for similar applications. The material used by the Bidder shall be proven in previous installations. For the waste water pumps, the wear parts are to be provided with rubber lining. The material thickness of the liners shall ensure a minimum service life of 2 years before replacement.

3.11.0 SEAL

- a. Pump shall be supplied with mechanical seal as per Clause 3.5.2. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not used.
- b. Cartridge seal shall be removable without disturbing the drive. Design and material of mechanical seal shall be suitable for the specified service condition. All parts referred to, in the definition of pressure casing shall withstand the maximum shut off pressure developed at the discharge end. If pressure rating of seals does not meet this requirement, it shall be stated, and purchaser shall be advised.
- c. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
- d. Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, will be guided by ISO: 21049. Hence, 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.
- e. Mechanical seal and glands shall be fitted and installed in the pump before shipment and shall be clean. As indicated in Clause 3.5.2, adjustment provision of axial clearance in pump is to be taken care of.
- f. 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

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suitable for the offered pump.

- g. Seal life has to be guaranteed, taking into consideration all its components, as mentioned in Table B (Process parameters). If seal manufacturer cannot give guarantee of 16000 hrs, cost of one or two seal to the pump cost will be arrived to, depending on the seal life, guaranteed by seal manufacturer. If seal fails within guaranteed period, quoted by seal manufacturer, cost will be recovered from pump manufacturer.
- h. List of spare that is required is to be identified and listed in spare list (Annexure III)

3.12.0 SHAFT AND SHAFT SLEEVE

- The design of the shaft and sleeve shall ensure that the critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- Shaft should be of Duplex Stainless steel (S31803, ASTM A-276) or equivalent. No parts of the shaft should come in contact with the liquid medium.
- Shaft sleeve should be CD4M Cu ASTM A-743 or equivalent with a minimum hardness of-275 BHN. 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 below which sleeve should not be replaced without jeopardizing pump efficiency. This is in line the Clause 3.5.2.
- Shaft and sleeve material for waste water pumps shall be of Stainless Steel-410.
- No parts of the shaft should come in contact with the liquid medium.
- Shaft should have a keyed joint at impeller hub. No thread connection between impeller and shaft is acceptable.

3.13.0 OTHER COMPONENTS


All internal fasteners, coming in contact with liquid medium should be Type A4, ISO-3506. Other fasteners should be of Class 6.6 or higher, galvanized as per ISO-898. All other components, not mentioned anywhere in the specification but required for assembly of equipment are as per manufacturer's own practice.

3.14.0 ASSEMBLY AND DISMANTLING

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

3.15.0 FLUSHING LINES AND VALVES

Flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps

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shall be taken from the process water supply. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.

3.16.0 DYNAMICS

- a. Critical speed: Operation at both sides is permissible but with 25% margin, with twice the normal wear and inter bushing clearance.
- b. Additional to the requirement of the critical speed of pump, as specified above. Pump manufacturer is to analyze the combined critical speed of Pump, Gear Box and Motor to establish that 1st critical speed is 20% above the operating speed.
- c. Torsional critical speed is to be indicated in Data Sheet.

3.17.0 VIBRATION


Pumps shall run smoothly without undue vibration and noise. Peak to peak vibration limits shall be restricted to the following values during operation.

Speed	Antifriction bearing	Sleeve bearing
▪ 1500 Rpm and below	75 micron	75 micron
▪ 3000 RPM	50 micron	65 micron

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 m from the equipment surface.

3.18.0 BEARINGS & BEARING HOUSINGS

- a. Bearing shall be of rolling type radial and thrust (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition. No thrust load should get transmitted by coupling.
- b. Thrust bearing shall provide full load capability if the pump's normal direction of rotation is reversed.
- c. It is to be noted that 80% of the rated head of the pump is static. Hence, in due course of tripping, pump may run in reverse direction. Pump should be suitable to sustain this reverse speed.
- d. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L₁₀ of 25000 hrs. (minimum as per API-610 standard). It should not be interpreted that only bearing housing as total, is guaranteed for 25000 hrs. minimum, irrespective of the number of bearings it contains. Every bearing in bearing housing will come under "Guaranteed


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requirement” individually.

- e. Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100 cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one (1) number G1/2” thread (ISO-228, Prt-1) port is required for remote control of temperature of bearing housing oil bath RTD.
- f. If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
- 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.

3.19.0 MATERIALS

- a. Pump components designated as “Full Compliance Material” shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.
- b. Pump components not designated as “Full Compliance Material” shall meet the requirements of chemical composition but need not meet other requirement of listed industry specification.
- c. Material shall be clearly identified in the proposal with their applicable industry standard number (along with equivalent ASTM, if different standard is followed) and grade.
- d. If no such designation is available, the supplier material specification, giving physical properties, chemical composition, and test requirements, shall be included in the proposal.
- e. Materials casting factors and the quality of any welding shall be equal to those required by Section VIII, Division-1 of ASME Code or equivalent.
- f. A detail quality plan is to be submitted along with offer for all items marked “ASTM Full Compliance Material”.
- g. Final acceptance of the quality plan will be approved by ultimate user (hereafter called NTPC). Hence, it is expected that manufacturer to submit quality plan (QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest
- h. Scope of supply incorporates the material, testing/inspection, painting, packing forwarding, installing at site and commissioning at site of the equipment.
- i. Certain activities may be excluded from Bidder’s scope as per “Annexure V - Scope of Supply” which shall be mutually agreed upon as per the sheet.

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4.0.0 ACCESSORIES

4.1.0 DRIVERS


- a. Driver shall be sized to meet all specified operating conditions including bearing housing , mechanical seal, external gear box and coupling loss (if any).
- b. Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in “Site Power Supply Condition” as per clause 3.3.1
- c. Continuous Motor rating (at 50 Deg C ambient) shall be at least 10 % above the maximum load demand of the Pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.
- d. The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified.
- e. Gear Box: Rating of Gear Box will be at least 10% higher than the rating of the motor. Gear Box also will be guided by same Annexure B as it is applicable for pump. This applicability is equally for life of the equipment as a whole as well for wear-out component.
- f. A service factor of 1.5 or better should be constituent of Gear Box.

4.2.0 COUPLING & COUPLING GUARD

- a. Coupling and coupling guard should be supplied between driver and driven equipment. Coupling should be designed taking into consideration adequate service factor. Coupling guard shall be made of Aluminum or galvanized steel.
- b. Design rating of the coupling (excluding service factor) should be indicated in data sheet.
- c. 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.
- d. Coupling should be Spacer-type flexible coupling, made of cast iron. Spacer length shall be sufficient to remove the rotating assembly without disturbing the driver and pump casing connection.
- e. It is desirable that for servicing of mechanical seal, coupling half should not be removed.
- f. Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.

4.3.0 BASE PLATE AND FOUNDATION BOLTS

- a. Base plate should be fabricated with mild steel of structural quality ASTM A--36 (UTS = 42 N/sq mm minimum)

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- b. Base plate should preferably be one piece item. However, if transportation and shipment is a problem, it can be split into two.
- c. 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.
- d. 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.
- e. 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.
- f. Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.

4.4.0 SPECIAL TOOLS

Pumps shall be designed to be assembled, disassembled, and maintained with standard hand tools. However, if at all the Vendor desires special tools are required, the same has to be supplied along with pump. List of the special tool is to be indicated in Annexure V (Scope of supply). This special tool is equally applicable for Gear head also, if offered with pump.

5.0.0 INSPECTION AND TESTS

- a. Material test: All material inspection and testing will be as per submitted QAP, Purchaser’s representative shall have access to review the supplier’s quality assurance program.
- b. Maximum severity level of defects in casting for the Linear Discontinuities, Shrinkage, Inclusions, Chill and Chaplets, Porosity and Welds must be indicated in QAP.
- c. The customer hold points can be altered at the discretion of ultimate customer (NTPC). The same will be intimated when approving the final quality plan.
- d. Pump shall be tested with minimum 5(Five) points, including Shut-off, BEP and Run-off. 1 point will be at the left of BEP at near 75% of BEP and other 1 point shall be at 110 % right of BEP, covering full range of curve.
- e. For shut-off condition, the permissible tolerance is (+) 10% to (-) 10%. Negative tolerance is acceptable only if test curve shows that pump is having rising characteristics curve, and shut-off head shall be no way below 125 % of BEP Head.

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- f. Pump manufacture has to give Performance guarantee of pump for all aspects viz. Hydraulic, Vibration, Power consumption etc. Guaranteed Data as indicated in Annexure II of Data Sheet shall be the final acceptance norm of equipment.
- g. All pumps will be tested or the number of pumps to be tested will be mutually agreed.

5.1.0 Non-Destructive Test

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
- b. Impeller- DPT and MPI
- c. Shaft- Ultrasonic (UT), DPT and MPI
- d. Sleeve- DP and Hardness test
- e. Mechanical Seal- Manufacture's recommendation.
- f. Base Plate- Stress relieving of weld.
- g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate

These are the components which shall be having "ASTM Full Compliance Material" as specified in Clause 3.19.0 and sub clauses.

QAP of Gear Box is to be submitted along with all necessary applicable standards.

Acceptance level of UT, DP and MPI testing must be indicated as per ASTM for Welding, casting and Shaft in QAP

5.2.0 HYDROSTATIC TEST:


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).

5.3.0 PREPARATION FOR SHIPMENT

Flanged openings shall be provided with metal closure of 4.8 mm (3/16 inch) minimum thickness with rubber gaskets and at least four full diameter bolts.

The equipment shall be protected for storage of 12 months at site, if any extra precaution is to be taken by the Purchaser for storage beyond 12 months the same shall be explicitly indicated in the operation and maintenance manuals.

For multistage pumps, in case spare rotor is ordered, the spare rotor shall be crafted in a metal container for transportation and storage. The crating method shall be suitable for at least 4 years storage in vertical position. The container shall be equipped for blanketing.

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5.4.0 SPECIFICATION OF MOTOR

- **Degree of Protection**
 - a) Indoor motors : IP 54
 - b) Outdoor motors : IP 55
 - c) CW motors (in case of Screen protected, Drip proof) : IP 23
 - d) Cable box-Indoor area : IP 54
 - e) Cable box-Outdoor area : IP 55
- **Codes and Standards**
 - a) Three phase induction motors : IS325; IEC : 60034
 - b) Single phase AC : IS: 996; IEC 60034
- **Rating**
 - a) Up to 0.2kw : Single Ph 240V AC/ 3Ph 415V AC
 - b) Above 0,2 kw and up to 200kw : 3Ph 415V AC
 - c) Above 200kw : 6.6 KV

5.5.0 AC Motors Type

AC Motors: All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. **Rating of motor must be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.**


- a) All motors shall be **Air cooled type**, and the maximum temperature rise shall be 70⁰ C by resistance method for both class B & F insulation.
- b) For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 3 secs more than the starting time. For motors with starting time more than 20secs and up to 45secs at minimum voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5secs more than starting time. For motors with starting time more than 45secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at high voltage limit shall be more than starting time by at least 10% of the starting time. Speed switch mounted on the motor shall be provided in cases where above requirements are not met.
- c) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205%of full load torque.
- d) Starting voltage requirement will be 85% of rated voltage up to 1500 kW rating motor.

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- e) Single phase space heaters suitable for 240V AC shall be provided on motors rated 30kw and above to maintain winding in dry condition when motor is standstill. Separate terminal box for space heater and RTDs shall be provided.
- f) All motors shall be either Totally Enclosed Fan Cooled (TEFC), for Motors below 30 kw, winding shall be suitable for heating at 24V, 1 phase AC. All motor should be treated as located in Hazardous Area and shall have Flame proof enclosure of Group-IIC as per IS 4691.
- g) Winding and Insulation shall be of type Non-hygroscopic Oil and Flame resistant. It shall be capable three hot starts in succession with initially at normal running temperature. The insulation shall be Class B or better.
- h) Noise level of all motor shall be limited to 85 dB (A). Vibration shall be limited within the limit prescribed by IS12075, Part-14. Motor shall withstand the vibration produced by driven equipment. Combined vibration of the equipment at site shall only be accepted as per the **Schedule of Guarantee Clause**, as mentioned in the data sheet.
- i) Motor body shall have two earthing points on opposite side.
- j) inside the terminal box to suit the conductor size
 - Motors up to 1 kw - 8 swg wire
 - 1kw - 30 kw - 25x3 mm GI flat
 - 30 kw - 60 kw - 25x6 mm GI flat
 - 60 kw & above - 30x 6 mm GI flat
- k) **Sizing calculation for motor to be submitted by vendor.**

5.6.0 Testing of LT Motors

- a) LT Motors shall be of type tested quality. For each type and rating of LT Motors, rated above 50KW, the vendor shall submit for Owner's approval the report of all type tests as per relevant standards and carried out within last five (5) years from the date of Purchase Order(PO). These reports should be for the test conducted on the equipments similar to those proposed to be supplied under this contract, and the tests should have been either conducted at an independent laboratory or should have been witnessed by client.
- b) In case vendor is not able to submit the report of the type tests, conducted within last five (5) years from the date of PO or in case the type tests report are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the ultimate purchaser (NTPC in this case) and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

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- d) All Motors shall be so designed that maximum inrush currents and locked rotors and pull-out torque developed at extreme voltage and frequency variation do not endanger the motor and driven equipments.
- e) The motor shall be suitable for bus transfer scheme provided on 6.6KV/415V system without any injurious effect on its life.
- f) Terminal boxes of breaker operated LT Motors above 160kw shall be capable of withstanding system fault level 31MVA for 0.12 second.
- g) The size and number of cables to be intimated to successful bidder during detail engineering and the contractor shall provide terminal box suitable for the same.

6.0.0 BIDDER'S DATA AND DOCUMENTATION

6.1.0 CONTRACT DATA

Documentation: Following items are required to be duly filled and submitted along with the proposals minimum requirement;

- a. Compliance of the specification, duly signed and stamped by the designating authority of manufacturer, duly indicating the deviation that are taken.
- b. General arrangement drawing, indicating showing direction of rotation, size, battery limit, indicating scope of supply, connection detail , overall dimensions, maintenance clearance, overall weight and maximum weight to be handled. Final drawings, after post order stage, are to be in scale.
- c. Cross-sectional drawing of pump (Type) after placement of PO.
- d. Data sheet of pump, clearly indicating exhaustive data of pump, Gear Head etc along with material of construction.
- e. Pump characteristics curve indicating Head, Capacity, Power, Efficiency and NPSHR that consists of following curves –
 - i) Flow Vs Head
 - ii) Flow Vs Efficiency
 - iii) Flow Vs Power
 - iv) Flow Vs NPSH
 - v) Speed Vs Torque
- f. It should be mentioned clearly that submitted curve is for “Clear Water”, when followed for testing only at manufacturer works. It also should be indicated the Specific gravity of the liquid and the corresponding Head, Capacity and Power and efficiency of actual fluid that is expected to be attained at site.
- g. Quality Plan.
- h. Delivery schedule, from the day of order and inclusive of documentation.
- i. Performance test procedure.
- j. List of commissioning spare, Mandatory spare and recommended spare for 3 Years of

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operation. (Annexure III)


- k. Experience Record Performa. (Annexure IV)
- l. List of Deviations/Exceptions to the Enquiry Documents. (Annexure VI)
- m. List of scope of supply (Annexure V)

Following additional items are required to be submitted at post-order stage as minimum requirement;

- a. Test arrangement set-up, clearly indicating the upstream, downstream straight length distance, as per ISO-3555/ISO-9906, Pt-1 or other acceptable standard along with all measurement instruments detail/requirement.
- b. Erection drawing along with Operation and Erection manuals, containing all details of reference drawing and, technical data.

7.0.0 PAINTING PROCEDURE

Primer coat		Intermediate Coat		Finish Coat			Total DFT µm (min)
Paint	No. of Coats/ DFT	Paint	No. of Coats/ DFT	Paint	No. of Coats	Shade	
Zinc phosphate primer	2 coat DFT = 30 µm per coat	---	---	2 K Epoxy paint or equivalent DFT= 20 µm per coat	2	RAL 5015	100 Microns


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8.0.0 ANNEXURES


ANNEXURE I

DATA SHEET FOR DRAIN PIT PUMPS


Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. Total No of Pumps	: 5
2.0	Manufacturer Details	:
	a. Model	:
	b. Type	: Vertical Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-6004, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	:
	a. Specific gravity of Slurry	: 1.12
	b. Max. slurry concentration % w/w	: 30 %
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 20
	▪ Head m LC	: 20
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & %	:

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Sl. No	Description	Data
	head (Slurry)	
	▪ Power required by pump at rated condition (Slurry) kW :	
	▪ Maximum pump input power KW :	
	▪ Gear Box loss KW :	
	▪ Power output at motor at rated duty condition KW :	
	▪ Motor rating (Recommended based on Clause 4.1) KW :	
	▪ Rated speed rpm :	
	▪ Motor details Volts/HZ :	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed rpm :	
	e. Critical speeds rpm :	
	f. Margins	
	▪ Flow %	5 %
	▪ Head %	10 %
	g. Direction of rotation viewed from driver :	
	h. slurry temperature for operating range without cavitation °C :	60
	i. Minimum submergence required, if applicable M :	
	j. Recommended min. Flow through pump and corresponding speed in RPM m ³ / hr :	
	k. Recommended max. Flow through pump and corresponding speed in RPM m ³ / hr :	
	l. Time the pump can run under shut-off condition Min. :	
	m. Impeller	
	▪ Type :	
	▪ Diameter of impeller mm :	
	▪ Shaft material :	
	▪ Material /thickness of impeller mm :	
	▪ Lining material/thickness mm :	
	▪ Max particle size that can be handled mm :	
	▪ Width/Diameter ratio of impeller :	
	n. Shut-off head mIC :	
4.0	CONSTRUCTION FEATURES	

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Sl. No	Description	Data
4.1	a. Impeller	
	▪ Type	: Semi close
	▪ Diameter of impeller mm	:
	▪ Shaft material	:
	▪ Material /thickness of impeller mm	:
	▪ Lining material/thickness mm	:
	▪ Max particle size that can be handled mm	:
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge) kg/cm ²	:
	c. Casing material	
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	e. Nozzle size DN	:
	f. Details of flange	
	▪ PN Rating PN	: PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ISO 2084
4.4	Suction Side	
	g. Diameter DN	:
	h. Details of flange	
	▪ PN Rating PN	: PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ISO 2084
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	: Anti friction
	b. Make	: SKF/FAG/TIM
	c. Type of lubrication	: Oil bath
	d. Sight gauge	: Required
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point Hr	: 25000
	i. Rating, L ₁₀ at minimum continuous Flow Hr	: 25000
5.2	Guide Bearing Housing	
	a. Type	: Anti friction Ball/Roller/spherical

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Sl. No	Description	Data
	b. Make	: SKF / FAG /Timken
	c. Arrangement of Cooling	: Natural
	d. Rating ,L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	e. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.5	Coupling between pump & drive	
	a. Type	: Flexible, Jaw with spacer type
	b. Make & Model No.	:
	c. Rating	kW/rpm : Motor rating with service factor of 1.2
	d. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate	Cc/hr : 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	:
	b. Casing wear plate	:
	c. Casing liner	:
	d. Impeller	:
	e. Impeller liner	:
	f. Impeller shaft	:
	g. Shaft sleeve	:
	h. Shaft coupling	:
	i. Base plate	:
	j. Coupling guard	:
	k. Fasteners in pump assembly (Wet region)	:
	l. Fasteners in pump assembly (Dry region)	:
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight	Kgs :
	b. Base plate	Kgs :
	c. Coupling weight	Kgs :
	d. Motor weight	Kgs :
	e. Total weight (a+b+c+d)	Kgs :
	f. Heaviest single piece component of pump to be handled.	Kgs :

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Sl. No	Description	Data
10.0	Reference Drawings	
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:

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ANNEXURE II

SCHEDULE OF GUARANTEED DATA


Sl. No	Description	Data
1.	Rated capacity of pump at rated head m ³ /hr	: 20
2.	Total head at design capacity mIC	: 20
3.	Guaranteed power consumption at motor terminal at rated capacity & head kW	:
4.	Noise level at a distance of 1.0 meter from the equipment at site dB(A)	:
5.	Maximum vibration (peak to peak amplitude at site) microns	:
6.	Life of Slurry Pump wear parts, from the date of commissioning	
	a. Casing Hrs	: 16000
	b. Impeller Hrs	: 16000
	c. Shaft Hrs	: 16000
	d. Bearing Hrs	: 25000
	e. Sleeve Hrs	: 16000
	f. Mechanical seal Hrs	: 16000
	g. Casing liner, if any hrs	: 16000

Note: Guaranteed power will be the power at Duty Point rated head with permissible (+) variation on Power and capacity as per the testing standard at 50 Hz frequency. No (-) negative tolerance on efficiency is admissible.

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE-III

LIST OF MANDATORY, RECOMMENDED & COMMISSIONING SPARE

(TO BE FILLED INDEPENDENTLY FOR SIX DIFFERENT PUMPS)

Qty will be Number or Set as applicable

Sl No	Item	Unit	Mandatory	Recommended	Commissioning
1.	Impeller assembly	No	1 no of each type		
2.	Casing liner	No	1 no of each type		
3.	Mechanical Seals	No	1 set of each type		
4.	Bearings	No	1 no of each type		
5.	Motor	No	1 no of each type		
6.	Motor pump coupling	No	1 no of each type		
7.	Sleeve	No			
8.	Wear Ring(Impeller)	No			
9.	Gasket	Set			
10.	"O"-ring	Set			
11.	Flexible Coupling Pad	Set			
12.	Flexible Coupling	No			


Note:

- Bidder to identify each and every item from the submitted cross-sectional drawing which will be considered as wear parts. Each and every parts, rotating and wearable are to be guaranteed for 16000 hrs operation life
- Rubber items which are having a self-life will also be considered as wear items
- Bidder to suggest and add to the list of spare the item which are not covered by above list but is considered to be incorporated. This will be decided as per cross-sectional drawing of pump.
- Non rotating part with rubber line, should be treated as static component and it should have minimum life of 4 yrs. (Eg. Bell mouth at suction.)

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ANNEXURE - IV


EXPERIENCE RECORD PERFORMA (ERP)

Sl no	Customer	Project	Model	Capacity Cub /hr	Head mWC	Speed rpm	Year of Commg	Purpose	Qty
1.								Limestone slurry	
2.								Limestone slurry	
3.								Limestone slurry	

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ANNEXURE -V

SCOPE OF SUPPLY

A--Materials:


Sl No	Item	Unit of Quantity	Quantity
1.	Pump	Set	
2.	Motor	Set	
3.	Gear box	Set	
4.	Flexible Coupling (Motor-Gear Box)	Set	
5.	Flexible Coupling (Pump-Gear Box)	set	
6.	Base Plate	Set	
7.	Companion Flange ,Bolt, Nut & Gasket	Set	
8.	Foundation Bolt + Taper Wedge for leveling	Set	
9.	RTD		

Note: Enlarge the table to incorporate items

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B--Testing and Inspection


Sl No	Item	Category	Unit	Quantity	Component
1.	Material Test	Shop Inspection	Set		
2.	Dp Test	Shop Inspection	Set		
3.	Radiographic	Shop Inspection	Set		
4.	Magnetic Particle Test	Shop Inspection	Set		
5.	Ultrasonic	Shop Inspection	Set		
6.	Hydro test	Shop Inspection	Set		
7.	Inter Granular Corrosion Test	Shop Inspection	Set		
8.	Dynamic Balancing Test	Shop Inspection Testing	Set		
9.	Performance Test (Internal)	Shop Testing			
10.	Performance Test (Witness)	Shop Testing			
11.	NPSHR Test (Internal)	Shop Testing			
12.	NPSHR Test (Witness)	Shop Testing			
13.	Vibration Test	Shop Testing			
14.	Vibration Test	Site Testing			

Note: Enlarge the table to incorporate items

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ANNEXURE - VI

LIST OF DEVIATIONS


Sl No	Clause No	Page No	Description of deviation

Note: Enlarge the table to incorporate items

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NAME -----

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Annexure -VII

DOCUMENTATION

Sl. no.	Description	With proposal	After award of contract
1.	Compliance of specification	1	
2.	Deviation List	1	
3.	Performance Curve	1	4
4.	General Assembly Drawing	1	4
5.	Motor Sizing Calculation	1	
6.	Cross-sectional Drawing	1	4
7.	Data Sheet	1	4
8.	Sub-Vendor List	1	4
9.	Material Test Certificates		4
10.	Pre Commissioning Check List		4
11.	Scope of Supply	1	4
12.	Quality Plan	1	4
13.	Operation and Maintenance Manual		4
14.	Spare List (Mandatory., Recommended)	1	4
15.	Start-up & Commissioning Spare	1	4
16.	List of Special Tools	1	4
17.	Delivery Schedule	1	4
18.	Test Arrangement	1	4
19.	T-N curve of Pump-	1	4
20.	Motor Drawing	1	4
21.	Curve of Motor (T-N, Efficiency, time etc.)	1	4
22.	P & I Diagram	1	4
23.	Catalogue	1	4

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

**BONGAIGAON– 3X250 MW
FLUE GAS DESULFURIZATION SYSTEM**


**TECHNICAL SPECIFICATION
FOR
LIME STONE SLURRY PUMPS**

CUSTOMER : NATIONAL THERMAL POWER CORPORATION LIMITED




NTPC: BONG: FGD: LPUMPS-SPEC-004: REV-01

Flue Gas Desulphurization Group
Air Quality Control Systems
BAP:: BHEL :: Ranipet

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LIME STONE SLURRY PUMPS		


Technical specification for Limestone Slurry Pump

Prepared	Checked	Approved
Sashi Kumar Sr Engineer - FGD	Sashi Kumar Sr Engineer - FGD	Shaktikanta Dash Manager - FGD
R00 dated 16 09 2010	----	
R01 dated 04 06 2013	Specification revised <ul style="list-style-type: none"> • Painting procedure included • Bearing life revised from 40000 hrs. to 25000 hrs. as per std API-610 	


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LIME STONE SLURRY PUMPS		

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3.0.0	BASIC DESIGN
4.0.0	ACCESSORIES
5.0.0	INSPECTION AND TESTS
6.0.0	BIDDER'S DATA & DOCUMENTATION
7.0.0	PAINTING PROCEDURE
8.0.0	ANNEXURE
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	ANNEXURE II - SCHEDULE OF GUARANTEED DATA
	ANNEXURE III - LIST OF MANDATORY, RECOMMENDED AND COMMG SPARES
	ANNEXURE IV - REFERENCE LIST
	ANNEXURE V - LIST OF DEVIATIONS
	ANNEXURE VI- SCOPE OF SUPPLY
	ANNEXURE VII- DOCUMENTATION

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LIME STONE SLURRY PUMPS		

1.0.0	PROJECT INFORMATION	
	▪ Owner	NTPC
	▪ Buyer	BHEL, Ranipet
	▪ Process / application	Wet Lime Stone FGD system
1.1.0	SITE CONDITIONS	
	▪ Ambient temperature (Guarantee)	27 Deg C
	▪ Ambient temperature (Design)	50 Deg C
	▪ Relative Humidity	60 %
1.2.0	LOCATION AND APPROACH	
	▪ Project location	
	▪ Place	Kumkuri near Salakati, Bongaigaon
	▪ District	Kokrajhar
	▪ State	Assam
	▪ Height above sea level	47 m

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2.0.0 INTENT OF SPECIFICATION

The Bidder shall offer only proven design in successful operation.

This specification together with the attendant Technical Data Sheet and other specifications/attachments to inquiry / order defines the minimum requirements for horizontal centrifugal pumps including pumps and their accessories /auxiliaries for use in the process of Flue gas Desulphurization (FGD), involving Limestone (Calcite) slurry. The scope details the requirement for design and manufacturing of Horizontal Centrifugal pumps that are to be used for slurry, containing particles of hardness (Moh scale 6 and below) for concentration of 30% by weight and particle size d98 of 200 mesh (Tyler scale) and lower used for FGD and similar mineral application.

Bidder shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.


In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), these shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (Annexure-V)". Deviation shall be listed separately for each document with cross reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable. No deviation or exception shall be permitted without the written approval of the purchaser.

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.

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, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.

2.2.0 CODES AND STANDARDS

The design, manufacture, inspection and testing of horizontal centrifugal pumps shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Other Internationally acceptable standards, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the Contractor of the

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required statutory responsibility. In particular the pumps shall conform to the latest edition of the following standards:

IS:1520	Horizontal centrifugal pumps for clear, cold fresh water.
IS:5120	Technical requirements for Roto-Dynamic special purpose pumps
IS:5639	Pumps handling chemicals & corrosive liquids
IS:5659	Pumps for process water.
IS:6536	Pumps for handling volatile liquids.
API:610	Centrifugal pumps for general refinery service.
	Standards of Hydraulic Institute of U.S.A.

2.3.0 SCOPE OF SUPPLY

a. **Pump Quantity :**

Refer Annexure I for number of pumps along with Motor Assembly with Base Plate, coupling and Foundation Bolt.

b. **Service Engineer Visit :**

Bidder's Service Engineer shall visit the site for supervision of commissioning the pumps. It is the bidder's responsibility to commission all the pumps to the satisfaction of end user/BHEL. Duration of visit of engineer may be planned and agreed mutually as per site condition

c. **Erection and commissioning supports:**

Inspection for Erection, Testing, commissioning, operation and maintenance.

d. **Operation & Erection Manuals :**

Containing all details of reference drawings and technical data shall be furnished by the Bidder.

e. **First Fill of Consumables, Oil & Lubricants.**


3.0.0 BASIC DESIGN

3.1.0 GENERAL

This section covers the manufacturing and performance requirement of the pump and its accessories.

3.2.0 PUMP TYPE AND OPERATION

- a. Pumps shall be Radial Split Casing, Close/Semi-open, Over-hang, End Suction type Back Pull-out design, Vertical Discharge type for Horizontal Centrifugal Pump.
- b. Pump shall be either belt drive or Gear Box type and the stand-by pump should be the same. If the belt drive is chosen by the vendor, vendor should

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adhere to the applicable standards for ensuring the performance of the pumps as per the specification. Necessary spares for the belt filter (Mandatory/ Recommended/ Commissioning spares) required also to be specified by vendor.

- c. The wearable parts of the pump which are in contact with slurry shall be provided with replaceable with rubber or Elastomer liners suitable for the slurry. The vendor can also offer alloy line pump if he has previous experience for the same for similar applications. The material used shall be proven in previous installations.
- d. The pumps shall be designed for continuous operation.

3.3.0 SERVICE CONDITION


Pump should be designed with the following service condition within the limit

- a. Maximum discharge pressure of slurry = 58 mlc per pump
- b. Capacity of the Pump = 70 m³/hr
- c. Maximum operating temperature = 60 deg Celsius
- d. Minimum operating temperature = 10 deg Celsius
- e. Maximum operating speed = 2500 rpm

3.4.0 PROCESS PARAMETERS

- a. Solid to be handled = Limestone
- b. Medium = Limestone slurry
- c. Maximum solid particle size = 150 mesh (140 micron)
- d. Normal solid particle size, d 50 = 325 mesh (43 micron) and fine particles
- e. Concentration of chlorine = 20,000 ppm (max)
- f. Viscosity of slurry = 10 cp
- g. Concentration of slurry = 30 (% by weight)
- h. Specific gravity of slurry = 1.225
- i. pH of slurry (Alkaline) = >9
- j. PPM of heavier particle (Silica, Aluminum Oxide, Ferric Oxide and Columbium) = 23290 ppm
- k. Total PPM of all suspended particle, including heavier particles as above in the slurry = 281300 ppm

Note: Bidder to indicate clearly in the offer what “De-ration Factor” has been taken into account for “Slurry Head to Water Head” and efficiency. This factor is to be indicated in data sheet.


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3.5.0 DUTY PARAMETERS AND REQUIREMENT

3.5.1 Refer Annexure I for Duty Parameters. Vendor to submit duly filled Annexure I along with the offer

3.5.2 REQUIREMENTS


- a. Design criterion of pump and auxiliaries shall be consistent with a minimum service life of 10 years (excluding normal wear of parts as indicated in Annexure-1) and 16000 hrs (minimum) for all rotating and wearable parts.
- b. Pump shall be capable of operating up to at least 115% of the rated speed because of frequency variation and shall be capable of operating briefly, under emergency conditions up to the driver trip speed
- c. 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).
- d. Pump casing shall be designed to remove of the rotor or inner elements without disconnecting the suction and discharge piping or moving the driver.
- e. Pump should have a clear operating range. Master characteristics curve of the pump must indicate the same and to be submitted.
- f. Selection of Duty point should preferably at BEP 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 its 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. Minimum and Maximum water level in the tank are as follows;
 - Minimum slurry level : 1.12 m
 - Maximum slurry level : 11.5 m
- g. Selection of point should not be at full diameter of impeller. Selected diameter should be such that extra 10% head increase is possible. Similarly, duty point should not be at minimum diameter of impeller. Margin in head may be 10 % of the rated head.
- h. 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".

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- i. Motor, Electrical components and electrical installations shall be suitable for area classification (Class, Group, Division/Zone) as per the specification and shall meet the requirements of NFPA as well as local codes and furnished by end user
- j. Pumps and its driver shall perform on the test stand at shop and on the pump's permanent foundation at site within vibration limit as specified in Clause-3.17.0. After installation at site, the vibration of combined unit will be the joint responsibility of pump and motor manufacturer. Site performance of vibration is one of the "Acceptance Criteria" of accepting the equipment. Please note vibration at test stand can only be taken as for information. Pump should be supplied with mechanical seal.
- k. If external flushing is required to satisfy "**Zero Leakage**", it should be provided. If it is required, manufacturer to indicate the plan and necessary piping shall be supplied by pump manufacturer. If flushing is required occasionally to remove the accumulated particles, all related information should be mentioned in data sheet.
- l. Pump manufacturer has to submit NPSHR test result of one pump for a particular model. If models are different, test result of one pump from each model will be selected. If agreed otherwise, final quantity for which NPSHR test result shall be required will be mutually agreed upon. However, in any case, testing of one pump for NPSHR is required if the manufacturer is having previous test record of sufficient quantity of same pump.
- m. Pump should have a 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.

3.6.0 CASING

- a. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
- b. Service condition shall apply to all parts referred to in the definition of pressure casing.
- c. Casing and flanges shall be designed to withstand the maximum discharge pressure at the pumping temperatures
- d. Pressure casing shall be designed with a corrosion allowance to meet the requirement of section 3.5.2 and taking into account the "Process Parameters" in the section 3.4.0.
- e. Connection for suction and discharge pressure gauge shall be provided as standard feature.
- f. Lifting provision of pump as a whole and individual casing half should be provided.
- g. For all pumps, the casing material shall be Ductile iron (65-45-12, ASTM A-536) or any other superior material with replaceable rubber liner.

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- h. 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).
- i. Casing with non-replaceable rubber lining can also be offered, provided a guarantee is given of rubber quality which gives guarantee of equipment as per 3.5.2.
- j. The vendor can also offer an alloy lined casing if he has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.

3.7.0 NOZZLES & MISCELLANEOUS CONNECTIONS


- a. Casing connection should be as per standard nominal pipe (NPS) or DN. However, non- standard sizes (viz. 550,650,750 NS etc.) should be avoided.
- b. For rubber-lined pump the same provisions (Flushing, Venting, Draining and Pressure gauge connection) should be provided as per requirement.
- c. Suction and Discharge flange should be of same rating and raised- face, suitable for through bolting.
- d. All connections shall be suitable for hydrostatic test pressure of that region of the casing to which they are attached.
- e. Companion flange along with necessary Bolt, Nut and Gasket shall be taken as pump manufacturer's scope of supply. Material of the companion flange should be Mild steel.

3.8.0 EXTERNAL NOZZLES FORCES & MOMENTS

Allowable nozzle load and a figure that defines the co-ordinate system in which the load are applied, shall be supplied with tender. Permissible load and moment from pipe line should be as per HI 12.2-12.6-2005 or ISO standard.

3.9.0 IMPELLER

- Impeller material shall be either Hi Chrome (ASTM 532 Grade IIIA) with minimum hardness of 600-650 BHN or superior material, guided by 3.4.0 taking into account the corrosion and erosion effect as per slurry parameters.
- 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.
- Base material for rubber-lined impeller should be capable of handling speed as specified in clause 3.3.0 service condition without affecting adhesion of lining.
- Impeller as rotating assembly along with all elements should be dynamically balanced to meet the standard Gr G 6.3: ISO-1940.

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3.10.0 WEAR RINGS or CASING LINER

All the Pump wear parts in contact with the slurry shall be provided with replaceable rubber / Elastomer liners suitable for the fluid handled. The contractor can also offer an alloy line pump if he has previous experience of the same for similar applications. The material used by the Bidder shall be proven in previous installations.

The material thickness of the liners shall ensure a minimum service life of 2 years before replacement.

3.11.0 SEAL

- a. Pump shall be supplied with mechanical seal as per Clause 3.5.2. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not used.
- b. Cartridge seal shall be removable without disturbing the drive. Design and material of mechanical seal shall be suitable for the specified service condition. MAWP shall apply to all parts referred to, in the definition of pressure casing. If pressure rating of seals does not meet this requirement, it shall be stated, and purchaser shall be advised.
- c. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
- d. Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, will be guided by ISO: 21049. Hence, 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.
- e. Mechanical seal and glands shall be fitted and installed in the pump before shipment and shall be clean. As indicated in Clause 3.5.2, adjustment provision of axial clearance in pump is to be taken care of.
- f. 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.
- g. Seal life has to be guaranteed, taking into consideration all its components, as mentioned in 3.4.0. If seal manufacturer cannot give guarantee of 16000 hr, cost of one or two seal to the pump cost will be arrived to, depending on the seal life, guaranteed by seal manufacturer. If seal fails within guaranteed period, quoted by seal manufacturer, cost will be recovered from pump manufacturer.
- h. List of spare that is required is to be identified and listed in spare list (Annexure III)

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3.12.0 SHAFT AND SHAFT SLEEVE

- The design of the shaft and sleeve shall ensure that the critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- Shaft should be of Duplex Stainless steel (S31803, ASTM A-276) or equivalent. No parts of the shaft should come in contact with the liquid medium.
- Shaft sleeve should be CD4M Cu ASTM A-743 or equivalent with a minimum hardness of-275 BHN. 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 below which sleeve should not be replaced without jeopardizing pump efficiency. This is in line the Clause 3.5.2.
- No parts of the shaft should come in contact with the liquid medium.
- Shaft should have a keyed joint at impeller hub. No thread connection between impeller and shaft is acceptable.

3.13.0 OTHER COMPONENTS

All internal fasteners, coming in contact with liquid medium should be Type A4, ISO-3506. Other fasteners should be of Class 6.6 or higher, galvanized as per ISO-898. All other components, not mentioned anywhere in the specification but required for assembly of equipment are as per manufacturer's own practice.

3.14.0 ASSEMBLY AND DISMANTLING


Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

3.15.0 FLUSHING LINES AND VALVES

Flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.

3.16.0 DYNAMICS

- a. Critical speed: Operation at both sides is permissible but with 25% margin, with twice the normal wear and inter bushing clearance.
- b. Additional to the requirement of the critical speed of pump, as specified above. Pump manufacturer is to analyze the combined critical speed of Pump, Gear Box and Motor to establish that 1st critical speed is 20% above the operating speed.
- c. Torsional critical speed is to be indicated in Data Sheet.

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3.17.0 VIBRATION


Pumps shall run smoothly without undue vibration and noise. Peak to peak vibration limits shall be restricted to the following values during operation.

Speed	Antifriction bearing	Sleeve bearing
▪ 1500 Rpm and below	75 micron	75 micron
▪ 3000 RPM	50 micron	65 micron

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 m from the equipment surface

3.18.0 BEARINGS & BEARING HOUSINGS

- a. Bearing shall be of rolling type radial and thrust (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition. No thrust load should get transmitted by coupling.
- b. Thrust bearing shall provide full load capability if the pump's normal direction of rotation is reversed.
- c. It is to be noted that 80% of the rated head of the pump is static. Hence, in due course of tripping, pump may run in reverse direction. Pump should be suitable to sustain this reverse speed.
- d. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L_{10} of 25000 hr (minimum as per API-610 standard). It should not be interpreted that only bearing housing as total, is guaranteed for 25000 hr minimum, irrespective of the number of bearings it contains. Every bearing in bearing housing will come under "Guaranteed requirement" individually.
- e. Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100 cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) number G1/2" thread (ISO-228, Prt-1) port is required for remote control of temperature of bearing housing oil bath RTD.
- f. If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
- 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.

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- ii) Above 0.2KW and : 3 phase 415V AC upto 200 KW
- iii) Above 200KW : 6.6 kV

- d. Fault level shall be limited to 40kA RMS for 1 second for 6.6kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC systems shall be isolated type.


4.0.0 ACCESSORIES

4.1.0 DRIVERS

- a. Driver shall be sized to meet all specified operating conditions including bearing housing , mechanical seal, external gear box and coupling loss,(if any).
- b. Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in “Site Power Supply Condition” as in Section 3.20.0
- c. Motor should be selected based on the maximum power over the entire range of characteristics curve
- d. Motor rating should have a clear margin of 15% over the maximum power required over the “Operating Range”, except at run-off where 10% minimum margin is to be guaranteed. This is based on specific gravity of liquid as specified in “Process Parameter” Section 3.4.0
- e. Gear Box: Rating of Gear Box will be at least 10% higher than the rating of the motor. Gear Box also will be guided by same 3.4.0. as it is applicable for pump. This applicability is equally for life of the equipment as a whole as well for wear-out component.
- f. A service factor of 1.5 or better should be constituent of Gear Box.

4.2.0 COUPLING & COUPLING GUARD

- a. Coupling and coupling guard should be supplied between driver and driven equipment. Coupling should be designed taking into consideration adequate service factor
- b. Design rating of the coupling (excluding service factor) should be indicated in data sheet.
- c. 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.
- d. Coupling should be Spacer-type flexible coupling, made of cast steel. Spacer length shall be sufficient to remove the rotating assembly without disturbing the driver and pump casing connection.
- e. It is desirable that for servicing of mechanical seal, coupling half should not be removed.

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- f. Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.

4.3.0 BASE PLATE AND FOUNDATION BOLTS


- a. Base plate should be fabricated with mild steel of structural quality (UTS = 42 N/sq mm minimum). Base plate should preferably be one piece item. However, if transportation and shipment is a problem, it can be split into two. Base plate should be supplied along with “Taper Wedge” or “Mounting Plate” to be placed in between base frame and floor for leveling.
- b. 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.
- c. 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.
- d. 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.
- e. Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.

4.4.0 SPECIAL TOOLS

Pumps shall be designed to be assembled, disassembled, and maintained with standard hand tools. However, if at all the Vendor desires special tools are required; the same has to be supplied along with pump. List of the special tool is to be indicated in Annexure VI (Scope of supply). This special tool is equally applicable for Gear head also, if offered with pump.

5.0.0 INSPECTION AND TESTS

- a. Material test: All material inspection and testing will be as per submitted QAP, Purchaser’s representative shall have access to review the supplier’s quality assurance program.
- a. Maximum severity level of defects in casting for the Linear Discontinuities, Shrinkage, Inclusions, Chill and Chaplets, Porosity and Welds must be indicated in QAP.
- b. The customer hold points can be altered at the discretion of ultimate customer (NTPC). The same will be intimated when approving the final quality plan.
- c. Performance test: Performance testing of pump with Clear water pump at manufacturer’s shop shall be conducted along with the NPSHR testing of the pump.

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Performance tolerance of “Acceptance Level” will be “A” at Rated head at rated speed as per HI-1.6: Centrifugal pump testing.

- d. Pump shall be tested with minimum 5(Five) points, including Shut-off, BEP and Run-off. 1 point will be at the left of BEP at near 75% of BEP and other 1 point shall be at 110 % right of BEP, covering full range of curve.
- e. For shut-off condition, the permissible tolerance is (+) 10% to (-) 10%. Negative tolerance is acceptable only if test curve shows that pump is having rising characteristics curve, and shut-off head shall be no way below 125 % of BEP Head.
- f. Atleast one number of Pump for each unit will be tested for NPSHR or shall be mutually agreed.
- g. Pump manufacture has to give Performance guarantee of pump for all aspects viz. Hydraulic, Vibration, Power consumption etc. Guaranteed Data as indicated in Annexure II of Data Sheet shall be the final acceptance norm of equipment.

5.1.0 Non-Destructive Test

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
- b. Impeller- MPI
- c. Shaft- Ultrasonic (UT), DP and IGC
- d. Sleeve- DP and Hardness test
- e. Mechanical Seal- Manufacture’s recommendation.
- f. Base Plate- Stress relieving of weld.
- g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate

These are the components which shall be having “ASTM Full Compliance Material” as specified in Clause 3.19.0 and sub clauses.

QAP of Gear Box is to be submitted along with all necessary applicable standards.

Acceptance level of UT, DP and MPI testing must be indicated as per ASTM for Welding, casting and Shaft in QAP


5.2.0 HYDROSTATIC TEST:

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).

5.3.0 PREPARATION FOR SHIPMENT

Flanged openings shall be provided with metal closure of 4.8 mm (3/16 inch) minimum thickness with rubber gaskets and at least four full diameter bolts.

The equipment shall be protected for storage of 12 months at site, if any extra precaution is to be taken by the Purchaser for storage beyond 12 months the

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same shall be explicitly indicated in the operation and maintenance manuals.

For multistage pumps, in case spare rotor is ordered, the spare rotor shall be crafted in a metal container for transportation and storage. The crating method shall be suitable for at least 4 years storage in vertical position. The container shall be equipped for blanketing.

5.4.0 SPECIFICATION OF MOTOR

- **Degree of Protection**

- a) Indoor motors : IP 54
- b) Outdoor motors : IP 55
- c) CW motors (in case of Screen protected, Drip proof) : IP 23
- d) Cable box-Indoor area : IP 54
- e) Cable box-Outdoor area : IP 55

- **Codes and Standards**

- a) Three phase induction motors : IS325; IEC : 60034
- b) Single phase AC : IS: 996; IEC 60034


- **Rating**

- a) Up to 0.2kw : Single Ph 240V AC/ 3Ph 415V AC
- b) Above 0,2 kw and up to 200kw : 3Ph 415V AC
- c) Above 200kw : 6.6 KV

5.5.0 AC Motors Type

AC Motors: All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. **Rating of motor must be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.**

- a) All motors shall be **Air cooled type**, and the maximum temperature rise shall be 70⁰ C by resistance method for both class B & F insulation.
- b) For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 3 secs more than the starting time. For motors with starting time more than 20secs and up to 45secs at minimum voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5secs more than starting time. For motors with starting time more than 45secs at minimum permissible voltage during starting, the locked rotor withstand time under hot


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condition at high voltage limit shall be more than starting time by at least 10% of the starting time. Speed switch mounted on the motor shall be provided in cases where above requirements are not met.

- c) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205% of full load torque.
- d) Starting voltage requirement will be 85% of rated voltage up to 1500 kw rating motor.
- e) Single phase space heaters suitable for 240 v AC shall be provided on motors rated 30kw and above to maintain winding in dry condition when motor is standstill. Separate terminal box for space heater and RTDs shall be provided.
- f) All motors shall be either Totally Enclosed Fan Cooled (TEFC), for Motors below 30 kw, winding shall be suitable for heating at 24v, 1 phase AC. All motor should be treated as located in Hazardous Area and shall have Flame proof enclosure of Group-IIC as per IS 4691.
- g) Winding and Insulation shall be of type Non-hygroscopic Oil and Flame resistant. It shall be capable Three hot start in succession with initially at normal running temperature. The insulation shall be Class B or better.
- h) Noise level of all motor shall be limited to 85 dB (A). Vibration shall be limited within the limit prescribed by IS12075, Part-14. Motor shall withstand the vibration produced by driven equipment. Combined vibration of the equipment at site shall only be accepted as per the **Schedule of Guarantee Clause**, as mentioned in the data sheet.
- i) Motor body shall have two earthing points on opposite side.
- j) inside the terminal box to suit the conductor size
 - Motors up to 1 kw - 8 swg wire
 - 1kw - 30 kw - 25x3 mm GI flat
 - 30 kw - 60 kw - 25x6 mm GI flat
 - 60 kw & above - 30x 6 mm GI flat

5.6.0 Testing of LT Motors

- a) LT Motors shall be of type tested quality. For each type and rating of LT Motors, rated above 50KW, the vendor shall submit for Owner's approval the report of all type tests as per relevant standards and carried out within last five (5) years from the date of Purchase Order(PO). These reports should be for the test conducted on the

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LIME STONE SLURRY PUMPS		

equipments similar to those proposed to be supplied under this contract, and the tests should have been either conducted at an independent laboratory or should have been witnessed by client.


- b) In case vendor is not able to submit the report of the type tests, conducted within last five (5) years from the date of PO or in case the type tests report are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the ultimate purchaser (NTPC in this case) and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- d) All Motors shall be so designed that maximum inrush currents and locked rotors and pull-out torque developed at extreme voltage and frequency variation do not endanger the motor and driven equipments.
- e) The motor shall be suitable for bus transfer scheme provided on 6.6KV/415V system without any injurious effect on its life.
- f) Terminal boxes of breaker operated LT Motors above 160kw shall be capable of withstanding system fault level 31MVA for 0.12 second.
- g) The size and number of cables to be intimated to successful bidder during detail engineering and the contractor shall provide terminal box suitable for the same.

6.0.0 BIDDER'S DATA AND DOCUMENTATION

6.1.0 CONTRACT DATA

Documentation: Following items are required to be duly filled and submitted along with the proposals minimum requirement;

- a. Compliance of the specification, duly signed and stamped by the designating authority of manufacturer, duly indicating the deviation that are taken.
- b. General arrangement drawing, indicating showing direction of rotation, size, battery limit ,indicating scope of supply, connection detail , overall dimensions, maintenance clearance , overall weight and maximum weight to be handled. Final drawing ,after post order stage, has to be in scale.
- c. Cross-sectional drawing of pump (Type).
- d. Data sheet of pump, clearly indicating exhaustive data of pump, Gear Head etc along with material of construction.
- e. Pump characteristics curve indicating Head, Capacity, Power, Efficiency and NPSHR.
Pump characteristics curve indicating Head, Capacity, Power, Efficiency and NPSHR that consists of following curves –
 - i) Flow Vs Head

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- ii) Flow Vs Efficiency
- iii) Flow Vs Power
- iv) Flow Vs NPSH
- v) Speed Vs Torque
- f. It should be mentioned clearly that submitted curve is for “Clear Water”, when followed for testing only at manufacturer works. It also should be indicated the Specific gravity of the liquid and the corresponding Head, Capacity and Power and efficiency of actual fluid that is expected to be attained at site
- g. Quality Plan
- h. Delivery schedule, from the day of order and inclusive of documentation.
- i. List of commissioning spare, Mandatory spare and recommended spare for 3 Years of operation. (Annexure III)
- j. Experience Record Performa. (Annexure IV)
- k. List of Deviations/Exceptions to the Enquiry Documents. (Annexure V)
- l. List of scope of supply (Annexure VI)

Following additional items are required to be submitted at post-order stage as minimum requirement;

- a. Test arrangement set-up, clearly indicating the upstream, downstream straight length distance, as per ISO-3555/ISO-9906, Pt-1 or other acceptable standard along with all measurement instruments detail/requirement.
- b. Erection drawing along with Operation and Erection manuals, containing all details of reference drawing and, technical data.

7.0.0 PAINTING PROCEDURE

Primer coat		Intermediate Coat		Finish Coat			Total DFT µm (min)
Paint	No. of Coats/ DFT	Paint	No. of Coats/ DFT	Paint	No. of Coats	Shade	
Zinc phosphate primer	2 coat DFT = 30 µm per coat	---	---	2 K Epoxy paint or equivalent DFT= 20 µm per coat	2	RAL 5015	100 Microns

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8.0 ANNEXURES

ANNEXURE - I

TECHNICAL DATA SHEET (Vendor to fill the datasheet and submit)

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for each unit	: 1
	h. No of stand-by Pumps for each unit	: 1
	i. Total number of pumps	: 6 (2 Nos for Unit1, 2 Nos for Unit 2 and 2 Nos for Unit3)
2.0	Manufacturer Details	
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	
	a. Specific gravity of Slurry	: 1.225
	b. Max. slurry concentration % w/w	: 30 %
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 70
	▪ Head m WC	: <ul style="list-style-type: none"> ▪ 38 for unit 1 ▪ 48 for unit 2 ▪ 58 for unit 3
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:



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Sl. No	Description	Data
	▪ Power required by pump at rated condition (Slurry) kW :	
	▪ Maximum pump input power KW :	
	▪ Gear Box loss KW :	
	▪ Power output at motor at rated duty condition KW :	
	▪ Motor rating (Recommended based on Clause 4.1) KW :	
	▪ Rated speed rpm :	
	▪ Motor details Volts/HZ :	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed rpm :	
	e. Critical speeds rpm :	
	f. Margins	
	▪ Flow %	5 %
	▪ Head %	10 %
	g. Direction of rotation viewed from driver :	
	h. slurry temperature for operating range without cavitation °C :	60
	i. Minimum submergence required, if applicable M :	
	j. Recommended min. Flow through pump and corresponding speed in RPM m ³ / hr :	
	k. Recommended max. Flow through pump and corresponding speed in RPM m ³ / hr :	
	l. Time the pump can run under shut-off condition Min.	
	m. Impeller	
	▪ Type :	
	▪ Diameter of impeller mm :	
	▪ Shaft material :	
	▪ Material /thickness of impeller mm :	
	▪ Lining material/thickness mm :	
	▪ Max particle size that can be handled mm :	
	▪ Width/Diameter ratio of impeller :	
	n. Shut-off head mIC :	
4.0	CONSTRUCTION FEATURES	
4.1	a. Impeller	
	▪ Type :	
	▪ Diameter of impeller mm :	


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Sl. No	Description	Data
	▪ Shaft material :	
	▪ Material /thickness of impeller mm :	
	▪ Lining material/thickness mm :	
	▪ Max particle size that can be handled mm :	
	▪ Width/Diameter ratio of impeller :	
4.2	Casing	
	a. Design Pressure (gauge) kg/cm ² :	
	b. Casing material	
	c. Casing Liner material/thickness	
4.3	Discharge Side:	
	a. Nozzle size DN :	
	b. Details of flange	
	▪ PN Rating PN :	PN-10
	▪ Type of flange	Flat face
	▪ Drilling Standard	ANSI B 16.5 150 class
4.4	Suction Side	
	c. Diameter DN :	
	d. Details of flange	
	▪ PN Rating PN :	PN-10
	▪ Type of flange)	Flat face
	▪ Drilling Standard	ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type :	Anti friction
	b. Make :	SKF/FAG/TIM
	c. Type of lubrication	Oil bath
	d. Sight gauge	Yes
	e. Grade of Lubricant	
	f. Quantity of Lubricant	
	g. Arrangement of Cooling	
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point 4Hr :	25000
	i. Rating, L ₁₀ at minimum continuous Flow Hr :	25000
5.2	Guide Bearing Housing	
	a. Type :	Anti friction Ball / Roller / spherical
	b. Make :	SKF / FAG /Timken
	c. Arrangement of Cooling	Natural
	d. Rating ,L ₁₀ in terms of hours of continuous operation at duty Hr :	25000

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Sl. No	Description	Data
	point	
	e. Rating, L ₁₀ at minimum continuous Flow Hr	: 25000
5.5	Coupling between pump & drive	
	a. Type	: Flexible, Jaw with spacer type
	b. Make & Model No.	:
	c. Rating kW/rpm	: Motor rating with service factor of 1.2
	d. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate Cc/hr	: 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	: Ductile Iron (65-45-12) ASTM A 536
	b. Casing wear plate	: Not applicable
	c. Casing liner	: 30 % Acrylonitrile NBR with shore Hardness 60 ± 5 ShA
	d. Impeller	:
	e. Impeller liner	: Rubber lining
	f. Impeller shaft	: SS-31803, ASTM A-276
	g. Shaft sleeve	: CD4MCu
	h. Shaft coupling	: Cast Iron
	i. Base plate	: Structural Steel, ASTM A--36
	j. Coupling guard	: Galvanized Steel
	k. Fasteners in pump assembly (Wet region)	: SS 316
	l. Fasteners in pump assembly (Dry region)	: SS 316
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight Kgs	:
	b. Base plate Kgs	:
	c. Coupling weight Kgs	:
	d. Motor weight Kgs	:
	e. Total weight (a+b+c+d) Kgs	:
	f. Heaviest single piece component of pump to be handled. Kgs	:
10.0	Reference Drawings	

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LIME STONE SLURRY PUMPS

Sl. No	Description	Data
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:

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ANNEXURE-III

LIST OF MANDATORY, RECOMMENDED & COMMISSIONING SPARES

Qty will be Number or Set as applicable

Sl No	Item	Unit	Mandatory	Recommended	Commissioning
1.	Impeller assembly	No	1 no of each type		
2.	Casing liner	No	1 no of each type		
3.	Mechanical Seals	No	1 set of each type		
4.	Bearings	No	1 no of each type		
5.	Motor	No	1 no of each type		
6.	Motor pump coupling	No	1 no of each type		
7.	Sleeve	No			
8.	Wear Ring(Impeller)	No			
9.	Gasket	Set			
10.	"O"-ring	Set			
11.	Flexible Coupling Pad	Set			
12.	Flexible Coupling	No			


Note:

- Bidder to identify each and every item from the submitted cross-sectional drawing which will be considered as wear parts. Each and every parts, rotating and wearable are to be guaranteed for 16000 hrs operation
- Rubber items which are having a self life will also be considered as wear items
- Bidder to suggest and add to the list of spare the item which are not covered by above list but is considered to be incorporated. This will be decided as per cross-sectional drawing of pump.
- Non rotating part with rubber line, should be treated as static component and it should have minimum life of 4 yrs. (Eg. Bell mouth at suction.)

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE - IV


EXPERIENCE RECORD PERFORMA (ERP)

Sl no	Customer	Project	Model	Capacity Cub /hr	Head mWC	Speed rpm	Year of Commg	Purpose	Qty
1.								Limestone slurry	
2.								Limestone slurry	
3.								Limestone slurry	

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE - V

LIST OF DEVIATIONS


Sl No	Clause No	Page No	Description of deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE -VI

SCOPE OF SUPPLY

A--Materials:


Sl No	Item	Unit of Quantity	Quantity
1.	Pump	Set	
2.	Motor	Set	
3.	Gear box	Set	
4.	Flexible Coupling (Motor-Gear Box)	Set	
5.	Flexible Coupling (Pump-Gear Box)	set	
6.	Base Plate	Set	
7.	Companion Flange ,Bolt, Nut & Gasket	Set	
8.	Foundation Bolt + Taper Wedge for leveling	Set	
9.	RTD		

Note: Enlarge the table to incorporate items

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B--Testing and Inspection


Sl No	Item	Category	Unit	Quantity	Component
1.	Material Test	Shop Inspection	Set		
2.	Dp Test	Shop Inspection	Set		
3.	Radiographic	Shop Inspection	Set		
4.	Magnetic Particle Test	Shop Inspection	Set		
5.	Ultrasonic	Shop Inspection	Set		
6.	Hydro test	Shop Inspection	Set		
7.	Inter Granular Corrosion Test	Shop Inspection	Set		
8.	Dynamic Balancing Test	Shop Inspection Testing	Set		
9.	Performance Test (Internal)	Shop Testing			
10.	Performance Test (Witness)	Shop Testing			
11.	NPSHR Test (Internal)	Shop Testing			
12.	NPSHR Test (Witness)	Shop Testing			
13.	Vibration Test	Shop Testing			
14.	Vibration Test	Site Testing			

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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Annexure -VII

DOCUMENTATION

Sl. no.	Description	With proposal	After award of contract
1.	Compliance of specification	1	
2.	Deviation List	1	
3.	Performance Curve	1	4
4.	General Assembly Drawing	1	4
5.	Motor Sizing Calculation	1	
6.	Cross-sectional Drawing	1	4
7.	Data Sheet	1	4
8.	Sub-Vendor List	1	4
9.	Material Test Certificates		4
10.	Pre Commissioning Check List		4
11.	Scope of Supply	1	4
12.	Quality Plan	1	4
13.	Operation and Maintenance Manual		4
14.	Spare List (Mandatory., Recommended)	1	4
15.	Start-up & Commissioning Spare	1	4
16.	List of Special Tools	1	4
17.	Delivery Schedule	1	4
18.	Test Arrangement	1	4
19.	T-N curve of Pump-	1	4
20.	Motor Drawing	1	4
21.	Curve of Motor (T-N, Efficiency, time etc.)	1	4
22.	P & I Diagram	1	4
23.	Catalogue	1	4

SIGNATURE OF BIDDER

NAME

DESIGNATION

**BONGAIGAON– 3X250 MW
FLUE GAS DESULFURIZATION SYSTEM**


**TECHNICAL SPECIFICATION
FOR
SLURRY PUMPS**

CUSTOMER : NATIONAL THERMAL POWER CORPORATION LIMITED




NTPC: BONG: FGD: SPUMPS-SPEC-005: REV-01

Flue Gas Desulphurization Group
Air Quality Control Systems
BAP:: BHEL :: Ranipet

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Technical specification for Slurry Pumps

Prepared	Checked	Approved
Sashi Kumar Sr Engineer - FGD	Sashi Kumar Sr Engineer - FGD	Shaktikanta Dash Manager - FGD
R00 dated 16 09 2010		----
R01 dated 04 06 2013		Specification revised <ul style="list-style-type: none"> • Painting procedure included • Bearing life revised from 40000 hrs. to 25000 hrs. as per standard API-610

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9.0.0 DATA SHEETS

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DATA SHEET FOR FILTRATE WATER PUMPS

DATA SHEET FOR AUXILIARY ABSORBENT PUMP


DATA SHEET FOR SECONDARY HYDROCYCLONE PUMPS

DATA SHEET FOR PRIMARY OVERFLOW TRANSFER PUMPS

DATA SHEET FOR PRIMARY OVERFLOW TRANSFER PUMPS

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1.0.0	PROJECT INFORMATION	
	▪ Owner	NTPC
	▪ Buyer	BHEL, Ranipet
	▪ Process / application	Wet Lime Stone FGD system
1.1.0	SITE CONDITIONS	
	▪ Ambient temperature (Guarantee)	27 Deg C
	▪ Ambient temperature (Design)	50 Deg C
	▪ Relative Humidity	60 %
1.2.0	LOCATION AND APPROACH	
	▪ Project location	
	▪ Place	Kumkuri near Salakati, Bongaigaon
	▪ District	Kokrajhar
	▪ State	Assam
	▪ Height above sea level	47 m

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2.0.0 INTENT OF SPECIFICATION

The Bidder shall offer only proven design in successful operation.

This specification together with the attendant Technical Data Sheet and other specifications/attachments to inquiry / order defines the minimum requirements for horizontal centrifugal pumps including pumps and their accessories /auxiliaries for use in the process of Flue gas Desulphurization (FGD), involving Limestone (Calcite) slurry. The scope details the requirement for design and manufacturing of Horizontal Centrifugal pumps that are to be used for slurry, containing particles of hardness (Moh scale 7 and below).

Bidder shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.


In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), these shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (Annexure-V)". Deviation shall be listed separately for each document with cross reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable. No deviation or exception shall be permitted without the written approval of the purchaser.

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.

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, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.

2.1.0 CODES AND STANDARDS

The design, manufacture, inspection and testing of horizontal centrifugal pumps shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Other Internationally acceptable standards, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the Contractor of the required statutory responsibility. In particular the pumps shall conform to the latest edition of the following standards:

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IS:1520	Horizontal centrifugal pumps for clear, cold fresh water.	
IS:5120	Technical requirements for Roto -Dynamic special purpose pumps	
IS:5639	Pumps handling chemicals & corrosive liquids	
IS:5659	Pumps for process water.	
IS:6536	Pumps for handling volatile liquids.	
API:610	Centrifugal pumps for general refinery service.	
	Standards of Hydraulic Institute of U.S.A.	

2.2.0 SCOPE OF SUPPLY

a. Pump Quantity :

There are 3 FGD units for this project. There are pumps that are specific to each unit and few common pumps for all three units. Refer Table A for details on the number of pumps along with Motor Assembly with Base Plate, coupling and Foundation Bolt.

b. Service Engineer Visit :

Bidder's Service Engineer shall visit the site for supervision of commissioning the pumps. It is the bidder's responsibility to commission all the pumps to the satisfaction of end user/BHEL. Duration of visit of engineer may be planned and agreed mutually as per site condition.

c. Erection and commissioning supports:

Inspection for Erection, Testing, commissioning, operation and maintenance.

d. Operation & Erection Manuals :

Containing all details of reference drawings and technical data shall be furnished by the Bidder.

e. First Fill of Consumables, Oil & Lubricants.


3.0.0 BASIC DESIGN

3.1.0 GENERAL

This section covers the manufacturing and performance requirement of the pump and its accessories.

3.2.0 PUMP TYPE AND OPERATION


- a. Pumps shall be Radial Split Casing, Close/Semi-open, Over-hang, End Suction type Back Pull-out design, Vertical Discharge type for Horizontal Centrifugal Pump.
- b. Pump shall be either belt drive or Gear Box type and the stand-by pump shall be the same type. If the belt drive is chosen by the vendor, vendor should

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along with the offer.

3.5.2 REQUIREMENTS

- a. Design criterion of pump and auxiliaries shall be consistent with a minimum service life of 10 years (excluding normal wear of parts as indicated in datasheets) and 16000 hrs (minimum) for all rotating and wearable parts.
- b. Pump shall be capable of operating up to at least 115% of the rated speed because of frequency variation and shall be capable of operating briefly, under emergency conditions up to the driver trip speed
- c. 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).
- d. Pump casing shall be designed to remove of the rotor or inner elements without disconnecting the suction and discharge piping or moving the driver.
- e. Pump should have a clear operating range. Master characteristics curve of the pump must indicate the same and to be submitted.
- f. Selection of Duty point should preferably at BEP 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 its 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.
- g. Selection of point should not be at full diameter of impeller. Selected diameter should be such that extra 10% head increase is possible. Similarly, duty point should not be at minimum diameter of impeller. Margin in head may be 10 % of the rated head.
- h. 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".
- i. Motor, Electrical components and electrical installations shall be suitable for area classification (Class, Group, Division/Zone) as per the specification and shall meet the requirements of NFPA as well as local codes and furnished by end user
- j. Pumps and its driver shall perform on the test stand at shop and on the pump's permanent foundation at site within vibration limit as specified in Clause-3.17.0. After installation at site, the vibration of combined unit will be the joint responsibility of pump and motor manufacturer. Site performance of vibration is one of the

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“Acceptance Criteria” of accepting the equipment. Please note vibration at test stand can only be taken as for information. Pump should be supplied with mechanical seal.


- k. If external flushing is required to satisfy “**Zero Leakage**”, it should be provided. If it is required, manufacturer to indicate the plan and necessary piping shall be supplied by pump manufacturer. If flushing is required occasionally to remove the accumulated particles, all related information should be mentioned in data sheet.
- l. Pump should have an 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.

3.6.0 CASING

- a. Pump casing shall have radially spilt type construction as specified.
- b. The casing 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 of section 3.5.2 and taking into account the “Process Parameters” in the Table B.
- d. For waste water pump, casing materials shall be rubber lined Cast Iron (IS:210 Gr FG260).
- e. For all pumps, the casing material shall be Ductile iron (65-45-12, ASTM A-536) or any other superior material with replaceable rubber liner. The material provided by the vendor to meet the guarantee of casing life in line with Annexure I.
- f. 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).
- g. Casing with non-replaceable rubber lining can also be offered, provided the guarantee is given of rubber quality which gives guarantee of equipment as per 3.5.2.
- h. The vendor can also offer an alloy lined casing if he has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.
- i. 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.
- j. Connection for suction and discharge pressure gauge shall be provided as standard feature.
- k. Lifting provision of pump as a whole and individual casing half should be provided.

3.7.0 NOZZLES & MISCELLANEOUS CONNECTIONS

- a. Casing connection should be as per standard nominal pipe (NPS) or DN. However, non- standard sizes (viz. 550,650,750 NS etc.) should be avoided.

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- b. For rubber-lined pump the same provisions (Flushing, Venting, Draining and Pressure gauge connection) should be provided as per requirement.
- c. Suction and Discharge flange should be of same rating and raised- face, suitable for through bolting.
- d. All connections shall be suitable for hydrostatic test pressure of that region of the casing to which they are attached.
- e. Companion flange along with necessary Bolt, Nut and Gasket shall be taken as pump manufacturer's scope of supply. Material of the companion flange should be Mild steel.

3.8.0 EXTERNAL NOZZLES FORCES & MOMENTS

Allowable nozzle load and a figure that defines the co-ordinate system, in which the load are applied, shall be supplied with tender. Permissible load and moment from pipe line should be as per HI 12.2-12.6-2005 or ISO standard.

3.9.0 IMPELLER


- Impeller material shall be either Hi Chrome (ASTM 532 Grade IIIA) with minimum hardness of 600-650 BHN or superior material, guided by 3.4.0 taking into account the corrosion and erosion effect as per slurry parameters.
- However, for waste water pumps, the impeller material shall be rubber lined Cast Iron (IS:210 Gr FG260).
- 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.
- Base material for rubber-lined impeller should be capable of handling speed as specified in clause 3.3.0 service condition without affecting adhesion of lining.
- Impeller as rotating assembly along with all elements should be dynamically balanced to meet the standard Gr G 6.3: ISO-1940.

3.10.0 WEAR RINGS or CASING LINER

All the Pump wear parts in contact with the slurry shall be provided with replaceable rubber / Elastomer liners suitable for the fluid handled. The contractor can also offer an alloy line pump if he has previous experience of the same for similar applications. The material used by the Bidder shall be proven in previous installations. For the waste water pumps, the wear parts are to be provided with rubber lining. The material thickness of the liners shall ensure a minimum service life of 2 years before replacement.

3.11.0 SEAL


- a. Pump shall be supplied with mechanical seal as per Clause 3.5.2. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not used.

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- b. Cartridge seal shall be removable without disturbing the drive. Design and material of mechanical seal shall be suitable for the specified service condition. All parts referred to, in the definition of pressure casing shall withstand the maximum shut off pressure developed at the discharge end. If pressure rating of seals does not meet this requirement, it shall be stated, and purchaser shall be advised.
- c. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
- d. Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, will be guided by ISO: 21049. Hence, 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.
- e. Mechanical seal and glands shall be fitted and installed in the pump before shipment and shall be clean. As indicated in Clause 3.5.2, adjustment provision of axial clearance in pump is to be taken care of.
- f. 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.
- g. Seal life has to be guaranteed, taking into consideration all its components, as mentioned in Table B (Process parameters). If seal manufacturer cannot give guarantee of 16000 hrs, cost of one or two seal to the pump cost will be arrived to, depending on the seal life, guaranteed by seal manufacturer. If seal fails within guaranteed period, quoted by seal manufacturer, cost will be recovered from pump manufacturer.
- h. List of spare that is required is to be identified and listed in spare list (Annexure II)

3.12.0 SHAFT AND SHAFT SLEEVE

- The design of the shaft and sleeve shall ensure that the critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- Shaft should be of Duplex Stainless steel (S31803, ASTM A-276) or equivalent. No parts of the shaft should come in contact with the liquid medium.
- Shaft sleeve should be CD4M Cu ASTM A-743 or equivalent with a minimum hardness of-275 BHN. 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 below which sleeve should not be replaced without jeopardizing pump efficiency. This is in line the Clause 3.5.2.
- Shaft and sleeve material for waste water pumps shall be of Stainless Steel-410.
- No parts of the shaft should come in contact with the liquid medium.

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- Shaft should have a keyed joint at impeller hub. No thread connection between impeller and shaft is acceptable.

3.13.0 OTHER COMPONENTS

All internal fasteners, coming in contact with liquid medium should be Type A4, ISO-3506. Other fasteners should be of Class 6.6 or higher, galvanized as per ISO-898. All other components, not mentioned anywhere in the specification but required for assembly of equipment are as per manufacturer's own practice.

3.14.0 ASSEMBLY AND DISMANTLING

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

3.15.0 FLUSHING LINES AND VALVES

Flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.

3.16.0 DYNAMICS


- a. Critical speed: Operation at both sides is permissible but with 25% margin, with twice the normal wear and inter bushing clearance.
- b. Additional to the requirement of the critical speed of pump, as specified above. Pump manufacturer is to analyze the combined critical speed of Pump, Gear Box and Motor to establish that 1st critical speed is 20% above the operating speed.
- c. Torsional critical speed is to be indicated in Data Sheet.

3.17.0 VIBRATION

Pumps shall run smoothly without undue vibration and noise. Peak to peak vibration limits shall be restricted to the following values during operation.

Speed	Antifriction bearing	Sleeve bearing
▪ 1500 Rpm and below	75 micron	75 micron
▪ 3000 RPM	50 micron	65 micron

The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 m from the equipment surface.


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3.18.0 BEARINGS & BEARING HOUSINGS

- a. Bearing shall be of rolling type radial and thrust (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition. No thrust load should get transmitted by coupling.
- b. Thrust bearing shall provide full load capability if the pump's normal direction of rotation is reversed.
- c. It is to be noted that 80% of the rated head of the pump is static. Hence, in due course of tripping, pump may run in reverse direction. Pump should be suitable to sustain this reverse speed.
- d. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L_{10} of 25000 hr (minimum as per API-610 standard). It should not be interpreted that only bearing housing as total, is guaranteed for 25000 hr minimum, irrespective of the number of bearings it contains. Every bearing in bearing housing will come under "Guaranteed requirement" individually.
- e. Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100 cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one (1) number G1/2" thread (ISO-228, Prt-1) port is required for remote control of temperature of bearing housing oil bath RTD.
- f. If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
- 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.

3.19.0 MATERIALS

- a. Pump components designated as "Full Compliance Material" shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.
- b. Pump components not designated as "Full Compliance Material" shall meet the requirements of chemical composition but need not meet other requirement of listed industry specification.
- c. Material shall be clearly identified in the proposal with their applicable industry standard number (along with equivalent ASTM, if different standard is followed) and grade.
- d. If no such designation is available, the supplier material specification, giving physical properties, chemical composition, and test requirements, shall be included in the proposal.

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- e. Materials casting factors and the quality of any welding shall be equal to those required by Section VIII, Division-1 of ASME Code or equivalent.
- f. A detail quality plan is to be submitted along with offer for all items marked “ASTM Full Compliance Material”.
- g. Final acceptance of the quality plan will be approved by ultimate user (hereafter called NTPC). Hence, it is expected that manufacturer to submit quality plan (QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest
- h. Scope of supply incorporates the material, testing/inspection, painting, packing forwarding, installing at site and commissioning at site of the equipment.
- i. Certain activities may be excluded from Bidder’s scope as per “Annexure V - Scope of Supply” which shall be mutually agreed upon as per the sheet.


4.0.0 ACCESSORIES

4.1.0 DRIVERS

- a. Driver shall be sized to meet all specified operating conditions including bearing housing , mechanical seal, external gear box and coupling loss (if any).
- b. Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in “Site Power Supply Condition” as per clause 3.3.1
- c. Continuous Motor rating (at 50 Deg C ambient) shall be at least 10 % above the maximum load demand of the Pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.
- d. The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified.
- e. Gear Box: Rating of Gear Box will be at least 10% higher than the rating of the motor. Gear Box also will be guided by same Annexure B as it is applicable for pump. This applicability is equally for life of the equipment as a whole as well for wear-out component.
- f. A service factor of 1.5 or better should be constituent of Gear Box.

4.2.0 COUPLING & COUPLING GUARD

- a. Coupling and coupling guard should be supplied between driver and driven equipment. Coupling should be designed taking into consideration adequate service factor
- b. Design rating of the coupling (excluding service factor) should be indicated in data sheet.
- c. 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.

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- d. Coupling should be Spacer-type flexible coupling, made of cast steel. Spacer length shall be sufficient to remove the rotating assembly without disturbing the driver and pump casing connection.
- e. It is desirable that for servicing of mechanical seal, coupling half should not be removed.
- f. Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.

4.3.0 BASE PLATE AND FOUNDATION BOLTS


- a. Base plate should be fabricated with mild steel of structural quality (UTS = 42 N/sq mm minimum). Base plate should preferably be one piece item. However, if transportation and shipment is a problem, it can be split into two.
- b. 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.
- c. 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.
- d. 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.
- e. Base plate must be stress-relieved for any residual welding stress and certificate to that effect is to be submitted as per inspection requirement.

4.4.0 SPECIAL TOOLS

Pumps shall be designed to be assembled, disassembled, and maintained with standard hand tools. However, if at all the Vendor desires special tools are required, the same has to be supplied along with pump. List of the special tool is to be indicated in Annexure V (Scope of supply). This special tool is equally applicable for Gear head also, if offered with pump.

5.0.0 INSPECTION AND TESTS

- a. Material test: All material inspection and testing will be as per submitted QAP, Purchaser’s representative shall have access to review the supplier’s quality assurance program.
- b. Maximum severity level of defects in casting for the Linear Discontinuities, Shrinkage, Inclusions, Chill and Chaplets, Porosity and Welds must be indicated in QAP.
- c. The customer hold points can be altered at the discretion of ultimate customer (NTPC). The same will be intimated when approving the final quality plan.

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- d. Pump shall be tested with minimum 5(Five) points, including Shut-off, BEP and Run-off. 1 point will be at the left of BEP at near 75% of BEP and other 1 point shall be at 110 % right of BEP, covering full range of curve.
- e. For shut-off condition, the permissible tolerance is (+) 10% to (-) 10%. Negative tolerance is acceptable only if test curve shows that pump is having rising characteristics curve, and shut-off head shall be no way below 125 % of BEP Head.
- f. Pump manufacture has to give Performance guarantee of pump for all aspects viz. Hydraulic, Vibration, Power consumption etc. Guaranteed Data as indicated in Annexure II of Data Sheet shall be the final acceptance norm of equipment.
- g. All pumps will be tested or the number of pumps to be tested will be mutually agreed.

5.1.0 Non-Destructive Test

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
- b. Impeller- DPT and MPI
- c. Shaft- Ultrasonic (UT), DPT and MPI
- d. Sleeve- DP and Hardness test
- e. Mechanical Seal- Manufacture's recommendation.
- f. Base Plate- Stress relieving of weld.
- g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate

These are the components which shall be having "ASTM Full Compliance Material" as specified in Clause 3.19.0 and sub clauses.

QAP of Gear Box is to be submitted along with all necessary applicable standards.

Acceptance level of UT, DP and MPI testing must be indicated as per ASTM for Welding, casting and Shaft in QAP

5.2.0 HYDROSTATIC TEST:


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).

5.3.0 PREPARATION FOR SHIPMENT

Flanged openings shall be provided with metal closure of 4.8 mm (3/16 inch) minimum thickness with rubber gaskets and at least four full diameter bolts.

The equipment shall be protected for storage of 12 months at site, if any extra precaution is to be taken by the Purchaser for storage beyond 12 months the same shall be explicitly indicated in the operation and maintenance manuals.

For multistage pumps, in case spare rotor is ordered, the spare rotor shall be crafted in a metal container for transportation and storage. The crating method shall be suitable for at least 4 years storage in vertical position. The container shall

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be equipped for blanketing.


5.4.0 SPECIFICATION OF MOTOR

- **Degree of Protection**
 - a) Indoor motors : IP 54
 - b) Outdoor motors : IP 55
 - c) CW motors (in case of Screen protected, Drip proof : IP 23
 - d) Cable box-Indoor area : IP 54
 - e) Cable box-Outdoor area : IP 55
- **Codes and Standards**
 - a) Three phase induction motors : IS325; IEC : 60034
 - b) Single phase AC : IS: 996; IEC 60034
- **Rating**
 - a) Up to 0.2kw : Single Ph 240V AC/ 3Ph 415V AC
 - b) Above 0,2 kw and up to 200kw : 3Ph 415V AC
 - c) Above 200kw : 6.6 KV

5.5.0 AC Motors Type

AC Motors: All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. **Rating of motor must be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.**


- a) All motors shall be **Air cooled type**, and the maximum temperature rise shall be 70⁰ C by resistance method for both class B & F insulation.
- b) For motors with starting time up to 20 secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 3 secs more than the starting time. For motors with starting time more than 20secs and up to 45secs at minimum voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5secs more than starting time. For motors with starting time more than 45secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at high voltage limit shall be more than starting time by at least 10% of the starting time. Speed switch mounted on the motor shall be provided in cases where above requirements are not met.
- c) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205%of full load torque.
- d) Starting voltage requirement will be 85% of rated voltage up to 1500 kW rating motor.

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- e) Single phase space heaters suitable for 240V AC shall be provided on motors rated 30kw and above to maintain winding in dry condition when motor is standstill. Separate terminal box for space heater and RTDs shall be provided.
- f) All motors shall be either Totally Enclosed Fan Cooled (TEFC), for Motors below 30 kw, winding shall be suitable for heating at 24V, 1 phase AC. All motor should be treated as located in Hazardous Area and shall have Flame proof enclosure of Group-IIC as per IS 4691.
- g) Winding and Insulation shall be of type Non-hygroscopic Oil and Flame resistant. It shall be capable three hot starts in succession with initially at normal running temperature. The insulation shall be Class B or better.
- h) Noise level of all motor shall be limited to 85 dB (A). Vibration shall be limited within the limit prescribed by IS12075, Part-14. Motor shall withstand the vibration produced by driven equipment. Combined vibration of the equipment at site shall only be accepted as per the **Schedule of Guarantee Clause**, as mentioned in the data sheet.
- i) Motor body shall have two earthing points on opposite side.
- j) inside the terminal box to suit the conductor size
 - Motors up to 1 kw - 8 swg wire
 - 1kw - 30 kw - 25x3 mm GI flat
 - 30 kw - 60 kw - 25x6 mm GI flat
 - 60 kw & above - 30x 6 mm GI flat
- k) **Sizing calculation for motor to be submitted by vendor.**

5.6.0 Testing of LT Motors

- a) LT Motors shall be of type tested quality. For each type and rating of LT Motors, rated above 50KW, the vendor shall submit for Owner's approval the report of all type tests as per relevant standards and carried out within last five (5) years from the date of Purchase Order(PO). These reports should be for the test conducted on the equipments similar to those proposed to be supplied under this contract, and the tests should have been either conducted at an independent laboratory or should have been witnessed by client.
- b) In case vendor is not able to submit the report of the type tests, conducted within last five (5) years from the date of PO or in case the type tests report are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the ultimate purchaser (NTPC in this case) and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

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- d) All Motors shall be so designed that maximum inrush currents and locked rotors and pull-out torque developed at extreme voltage and frequency variation do not endanger the motor and driven equipments.
- e) The motor shall be suitable for bus transfer scheme provided on 6.6KV/415V system without any injurious effect on its life.
- f) Terminal boxes of breaker operated LT Motors above 160kw shall be capable of withstanding system fault level 31MVA for 0.12 second.
- g) The size and number of cables to be intimated to successful bidder during detail engineering and the contractor shall provide terminal box suitable for the same.

6.0.0 BIDDER'S DATA AND DOCUMENTATION

6.1.0 CONTRACT DATA

Documentation: Following items are required to be duly filled and submitted along with the proposals minimum requirement;

- a. Compliance of the specification, duly signed and stamped by the designating authority of manufacturer, duly indicating the deviation that are taken.
- b. General arrangement drawing, indicating showing direction of rotation, size, battery limit, indicating scope of supply, connection detail , overall dimensions, maintenance clearance, overall weight and maximum weight to be handled. Final drawings, after post order stage, are to be in scale.
- c. Cross-sectional drawing of pump (Type) after placement of PO.
- d. Data sheet of pump, clearly indicating exhaustive data of pump, Gear Head etc along with material of construction.
- e. Pump characteristics curve indicating Head, Capacity, Power, Efficiency and NPSHR that consists of following curves –
 - i) Flow Vs Head
 - ii) Flow Vs Efficiency
 - iii) Flow Vs Power
 - iv) Flow Vs NPSH
 - v) Speed Vs Torque
- f. It should be mentioned clearly that submitted curve is for “Clear Water”, when followed for testing only at manufacturer works. It also should be indicated the Specific gravity of the liquid and the corresponding Head, Capacity and Power and efficiency of actual fluid that is expected to be attained at site.
- g. Quality Plan.
- h. Delivery schedule, from the day of order and inclusive of documentation.
- i. Performance test procedure.
- j. List of commissioning spare, Mandatory spare and recommended spare for 3 Years of operation. (Annexure II)

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- k. Experience Record Performa. (Annexure III)
- l. List of Deviations/Exceptions to the Enquiry Documents. (Annexure V)
- m. List of scope of supply (Annexure IV)

Following additional items are required to be submitted at post-order stage as minimum requirement;

- a. Test arrangement set-up, clearly indicating the upstream, downstream straight length distance, as per ISO-3555/ISO-9906, Pt-1 or other acceptable standard along with all measurement instruments detail/requirement.
- b. Erection drawing along with Operation and Erection manuals, containing all details of reference drawing and, technical data.

7.0.0 PAINTING PROCEDURE

Primer coat		Intermediate Coat		Finish Coat			Total DFT µm (min)
Paint	No. of Coats/ DFT	Paint	No. of Coats/ DFT	Paint	No. of Coats	Shade	
Zinc phosphate primer	2 coat DFT = 30 µm per coat	---	---	2 K Epoxy paint or equivalent DFT= 20 µm per coat	2	RAL 5015	100 Microns


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TABLE-A

SERVICE CONDITION OF SLURRY PUMPS

Pumps should be designed with the following service condition within the limit

Sl. No	Description	Gypsum Bleed pumps	Filtrate water pump	Secondary Hydro cyclone Pump
1	Head of the pump (in m)	64	15	37
2	Capacity of the Pump (in m ³ /hr)	265	500	115
3	Number of pumps	6 pumps (2 per unit - 1W +1 S)	2 Pumps for all 3 units (1W+1S)	2 Pumps for all 3 units (1W+1S)
4	Mode of operation	Continuous	Continuous	Continuous
5	Minimum water level in the tank (in m)	1.90	1.40	1.64
6	Maximum water level in the tank (in m)	8.87	8.05	11.50
7	Normal water level in the tank (in m)	8.87	3.05	3.50
8	Maximum operating temperature	60 deg C	60 deg C	60 deg C
9	Minimum operating temperature	10 deg C	10 deg C	10 deg C
10	Maximum operating speed	Vendor to confirm	Vendor to confirm	Vendor to confirm


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TABLE-A

SERVICE CONDITION OF SLURRY PUMPS

Sl. No	Description	Auxiliary Absorbent Pump	Primary Overflow transfer pumps	Waste Water Pumps
1	Head of the pump (in m)	25	15	14
2	Capacity of the Pump (in m ³ /hr)	205	265	100
3	Number of pumps	1 pump (for all 3 units)	2 Pumps for all 3 units (1W+1S)	2 Pumps for all 3 units (1W+1S)
4	Mode of operation	Intermittent	Continuous	Continuous
5	Minimum water level in the tank (in m)	1.26	3.50	0.78
6	Maximum water level in the tank (in m)	9.75	11.50	9.5
7	Normal water level in the tank (in m)	1.26	3.5	2.0
8	Maximum operating temperature	60 deg C	60 deg C	60 deg C
9	Minimum operating temperature	10 deg C	10 deg C	10 deg C
10	Maximum operating speed	Vendor to confirm	Vendor to confirm	Vendor to confirm



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TABLE - B

PROCESS PARAMETERS FOR SLURRY PUMPS

Sl. No	Parameter	Gypsum Bleed pumps	Filtrate water pump Secondary Hydro cyclone & Primary Overflow transfer pumps	Auxiliary Absorbent Pump	Waste water Pumps
1.	Maximum solid particle size	200 mesh (75micron)	325mesh (43micron)	200mesh (75micron)	200 mesh (75micron)
2.	Normal solid particle size,d50	325 mesh (43 micron)	500mesh(25micron) to 1250(10 micron)	325mesh (43micron)	325 mesh (43 micron) and fine particles
3.	Solid to be handled	Gypsum	Gypsum	Gypsum along Lime Stone and other impurities	Lime stone /Gypsum/mixture of two
4.	PPM of heavier particle (Silica, Aluminum Oxide, Ferric Oxide and Columbium)	23290	3200-3500	11800	255
5.	Total PPM of all suspended particle, including heavier particles as above	281300	48000-50000	193800	4200
6.	Concentration of Chlorine	20,000ppm (max)	20,000ppm (max)	20,000ppm (max)	20,000ppm (max)
7.	Hardness of particle	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)
8.	Concentration of slurry	30% by weight	4% by weight	15% by weight	4 % by weight
9.	pH of slurry	>9	>9	>9	>9
10.	Sp Gravity of Slurry	1.23	1.025	1.1	1.025
11.	Viscosity of Slurry	10cp	2-5cp	10-15cp	10cp
12.	Maximum operating temperature of Slurry	60 deg C	60 deg C	60 deg C	60 deg C

Note: Bidder to indicate clearly in the offer what “De-ration Factor” has been taken into account for “Slurry Head to Water Head” and efficiency. This factor is to be indicated in data sheet

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8.0.0 ANNEXURES

ANNEXURE I

SCHEDULE OF GUARANTEED DATA (TO BE FILLED INDEPENDENTLY FOR SIX DIFFERENT PUMPS)


Sl. No	Description	Data
1.	Rated capacity of pump at rated head m ³ /hr :	
2.	Total head at design capacity mLC :	
3.	Guaranteed power consumption at motor terminal at rated capacity & head kW :	
4.	Noise level at a distance of 1.0 meter from the equipment at site dB(A) :	
5.	Maximum vibration (peak to peak amplitude at site) microns :	
6.	Life of Slurry Pump wear parts, from the date of commissioning	
	a. Casing Hrs :	16000
	b. Impeller Hrs :	16000
	c. Shaft Hrs :	16000
	d. Bearing Hrs :	25000
	e. Sleeve Hrs :	16000
	f. Mechanical seal Hrs :	16000
	g. Casing liner, if any hrs :	16000

Note: Guaranteed power will be the power at Duty Point rated head with permissible (+) variation on Power and capacity as per the testing standard at 50 Hz frequency. No (-) negative tolerance on efficiency is admissible.

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE-II

LIST OF MANDATORY, RECOMMENDED & COMMISSIONING SPARE

(TO BE FILLED INDEPENDENTLY FOR SIX DIFFERENT PUMPS)

Qty will be Number or Set as applicable

Sl No	Item	Unit	Mandatory	Recommended	Commissioning
1.	Impeller assembly	No	1 no of each type		
2.	Casing liner	No	1 no of each type		
3.	Mechanical Seals	No	1 set of each type		
4.	Bearings	No	1 no of each type		
5.	Motor	No	1 no of each type		
6.	Motor pump coupling	No	1 no of each type		
7.	Sleeve	No			
8.	Wear Ring(Impeller)	No			
9.	Gasket	Set			
10.	"O"-ring	Set			
11.	Flexible Coupling Pad	Set			
12.	Flexible Coupling	No			


Note:

- Bidder to identify each and every item from the submitted cross-sectional drawing which will be considered as wear parts. Each and every parts, rotating and wearable are to be guaranteed for 16000 hrs operation life
- Rubber items which are having a self life will also be considered as wear items
- Bidder to suggest and add to the list of spare the item which are not covered by above list but is considered to be incorporated. This will be decided as per cross-sectional drawing of pump.
- Non rotating part with rubber line, should be treated as static component and it should have minimum life of 4 yrs. (Eg. Bell mouth at suction.)

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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ANNEXURE - III


EXPERIENCE RECORD PERFORMA (ERP)

Sl no	Customer	Project	Model	Capacity Cub /hr	Head mWC	Speed rpm	Year of Commg	Purpose	Qty
1.								Limestone slurry	
2.								Limestone slurry	
3.								Limestone slurry	

SIGNATURE OF BIDDER

NAME

DESIGNATION

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ANNEXURE -IV

SCOPE OF SUPPLY

A--Materials:


Sl No	Item	Unit of Quantity	Quantity
1.	Pump	Set	
2.	Motor	Set	
3.	Gear box	Set	
4.	Flexible Coupling (Motor-Gear Box)	Set	
5.	Flexible Coupling (Pump-Gear Box)	set	
6.	Base Plate	Set	
7.	Companion Flange ,Bolt, Nut & Gasket	Set	
8.	Foundation Bolt + Taper Wedge for leveling	Set	
9.	RTD		

Note: Enlarge the table to incorporate items

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NAME -----

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B--Testing and Inspection


Sl No	Item	Category	Unit	Quantity	Component
1.	Material Test	Shop Inspection	Set		
2.	Dp Test	Shop Inspection	Set		
3.	Radiographic	Shop Inspection	Set		
4.	Magnetic Particle Test	Shop Inspection	Set		
5.	Ultrasonic	Shop Inspection	Set		
6.	Hydro test	Shop Inspection	Set		
7.	Inter Granular Corrosion Test	Shop Inspection	Set		
8.	Dynamic Balancing Test	Shop Inspection Testing	Set		
9.	Performance Test(Internal)	Shop Testing			
10.	Performance Test (Witness)	Shop Testing			
11.	NPSHR Test (Internal)	Shop Testing			
12.	NPSHR Test (Witness)	Shop Testing			
13.	Vibration Test	Shop Testing			
14.	Vibration Test	Site Testing			

Note: Enlarge the table to incorporate items

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ANNEXURE - V

LIST OF DEVIATIONS


Sl No	Clause No	Page No	Description of deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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Annexure -VI


DOCUMENTATION

Sl. no.	Description	With proposal	After award of contract
1.	Compliance of specification	1	
2.	Deviation List	1	
3.	Performance Curve	1	4
4.	General Assembly Drawing	1	4
5.	Motor Sizing Calculation	1	
6.	Cross-sectional Drawing	1	4
7.	Data Sheet	1	4
8.	Sub-Vendor List	1	4
9.	Material Test Certificates		4
10.	Pre Commissioning Check List		4
11.	Scope of Supply	1	4
12.	Quality Plan	1	4
13.	Operation and Maintenance Manual		4
14.	Spare List (Mandatory., Recommended)	1	4
15.	Start-up & Commissioning Spare	1	4
16.	List of Special Tools	1	4
17.	Delivery Schedule	1	4
18.	Test Arrangement	1	4
19.	T-N curve of Pump-	1	4
20.	Motor Drawing	1	4
21.	Curve of Motor (T-N, Efficiency, time etc.)	1	4
22.	P & I Diagram	1	4
23.	Catalogue	1	4

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----


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9.0.0 Data Sheets


TECHNICAL DATA SHEET-I


DATA SHEET FOR GYPSUM BLEED PUMPS

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for each unit	: 1
	h. No of stand-by Pumps for each unit	: 1
	i. Total number of pumps	: 6 (2 Nos for Unit1, 2 Nos for Unit 2 and 2 Nos for Unit 3)
2.0	Manufacturer Details	:
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-6004, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	:
	a. Specific gravity of Slurry	: 1.23
	b. Max. slurry concentration % w/w	: 30 %
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 265
	▪ Head m WC	: 64

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SLURRY PUMPS				
	▪ Pump input power at rated capacity & head (Slurry)	kW	:	
	▪ Pump efficiency at rated capacity & head (Slurry)	%	:	
	▪ Power required by pump at rated condition (Slurry)	kW	:	
	▪ Maximum pump input power	KW	:	
	▪ Gear Box loss	KW	:	
	▪ Power output at motor at rated duty condition	KW	:	
	▪ Motor rating (Recommended based on Clause 4.1)	KW	:	
	▪ Rated speed	rpm	:	
	▪ Motor details	Volts/HZ	:	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm	:	
	e. Critical speeds	rpm	:	
	f. Margins			
	▪ Flow	%		5 %
	▪ Head	%		10 %
	g. Direction of rotation viewed from driver		:	
	h. slurry temperature for operating range without cavitation	⁰ C	:	60
	i. Minimum submergence required, if applicable	M	:	
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	l. Time the pump can run under shut-off condition	Min.	:	
	m. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	
	▪ Max particle size that can be handled	mm	:	
	▪ Width/Diameter ratio of impeller		:	
	n. Shut-off head	mIC	:	
4.0	CONSTRUCTION FEATURES			

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SLURRY PUMPS		
4.1	a. Impeller	
	▪ Type	:
	▪ Diameter of impeller mm	:
	▪ Shaft material	:
	▪ Material /thickness of impeller mm	:
	▪ Lining material/thickness mm	:
	▪ Max particle size that can be handled mm	:
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge) kg/cm ²	:
	c. Casing material	
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	e. Nozzle size DN	:
	f. Details of flange	
	▪ PN Rating PN	:
	▪ Type of flange	:
	▪ Drilling Standard	:
4.4	Suction Side	
	g. Diameter DN	:
	h. Details of flange	
	▪ PN Rating PN	:
	▪ Type of flange)	:
	▪ Drilling Standard	:
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	:
	b. Make	:
	c. Type of lubrication	:
	d. Sight gauge	:
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point Hr	:
	i. Rating, L ₁₀ at minimum continuous Flow Hr	:
5.2	Guide Bearing Housing	
	a. Type	:
	b. Make	:
	c. Arrangement of Cooling	:
	d. Rating ,L ₁₀ in terms of hours of continuous Hr	:


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SLURRY PUMPS		
	operation at duty point	
	e. Rating, L ₁₀ at minimum continuous Flow Hr	: 25000
5.5	Coupling between pump & drive	
	a. Type	: Flexible, Jaw with spacer type
	b. Make & Model No.	:
	c. Rating kW/rpm	: Motor rating with service factor of 1.2
	d. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate Cc/hr	: 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	:
	b. Casing wear plate	:
	c. Casing liner	:
	d. Impeller	:
	e. Impeller liner	:
	f. Impeller shaft	:
	g. Shaft sleeve	:
	h. Shaft coupling	:
	i. Base plate	:
	j. Coupling guard	:
	k. Fasteners in pump assembly (Wet region)	:
	l. Fasteners in pump assembly (Dry region)	:
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight Kgs	:
	b. Base plate Kgs	:
	c. Coupling weight Kgs	:
	d. Motor weight Kgs	:
	e. Total weight (a+b+c+d) Kgs	:
	f. Heaviest single piece component of pump to be handled. Kgs	:
10.0	Reference Drawings	
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:


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SLURRY PUMPS		


TECHNICAL DATA SHEET-II


DATA SHEET FOR FILTRATE WATER PUMPS

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for 3 units	: 1
	h. No of stand-by Pumps for 3 units	: 1
	i. Total number of pumps	: 2 Pumps for all 3 units
2.0	Manufacturer Details	
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	
	a. Specific gravity of Slurry	: 1.025
	b. Max. slurry concentration % w/w	: 4 %
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 500
	▪ Head m WC	: 15
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:
	▪ Power required by pump at rated condition (Slurry) kW	:

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SLURRY PUMPS				
	▪ Maximum pump input power	KW	:	
	▪ Gear Box loss	KW	:	
	▪ Power output at motor at rated duty condition	KW	:	
	▪ Motor rating (Recommended based on Clause 4.1)	KW	:	
	▪ Rated speed	rpm	:	
	▪ Motor details	Volts/HZ	:	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm	:	
	e. Critical speeds	rpm	:	
	f. Margins			
	▪ Flow	%	:	5 %
	▪ Head	%	:	10 %
	g. Direction of rotation viewed from driver		:	
	h. slurry temperature for operating range without cavitation	⁰ C	:	60
	i. Minimum submergence required, if applicable	M	:	
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	l. Time the pump can run under shut-off condition	Min.	:	
	m. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	
	▪ Max particle size that can be handled	mm	:	
	▪ Width/Diameter ratio of impeller		:	
	n. Shut-off head	mLC	:	
4.0	CONSTRUCTION FEATURES			
4.1	a. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	

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SLURRY PUMPS		
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge)	kg/cm ² :
	c. Casing material	:
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	i. Nozzle size	DN :
	j. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
4.4	Suction Side	
	k. Diameter	DN :
	l. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	: Anti friction
	b. Make	: SKF/FAG/TIM
	c. Type of lubrication	: Oil bath
	d. Sight gauge	: Yes
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	i. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.2	Guide Bearing Housing	
	j. Type	: Anti friction Ball/Roller/spherical
	k. Make	: SKF / FAG
	l. Arrangement of Cooling	: Natural
	m. Rating ,L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	n. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.3	Coupling between pump & drive	
	o. Type	: Flexible, Jaw with spacer type
	p. Make & Model No.	:
	q. Rating	kW/rpm : Motor rating with service factor of 1.2


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SLURRY PUMPS		
	r. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate Cc/hr	: 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	:
	b. Casing wear plate	:
	c. Casing liner	:
	d. Impeller	:
	e. Impeller liner	:
	f. Impeller shaft	:
	g. Shaft sleeve	:
	h. Shaft coupling	:
	i. Base plate	:
	j. Coupling guard	:
	k. Fasteners in pump assembly (Wet region)	:
	l. Fasteners in pump assembly (Dry region)	:
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight Kgs	:
	b. Base plate Kgs	:
	c. Coupling weight Kgs	:
	d. Motor weight Kgs	:
	e. Total weight (a+b+c+d) Kgs	:
	f. Heaviest single piece component of pump to be handled. Kgs	:
10.0	Reference Drawings	
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:


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SLURRY PUMPS		


TECHNICAL DATA SHEET-III


DATA SHEET FOR SECONDARY HYDROCYCLONE FEED PUMPS

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for 3 units	: 1
	h. No of stand-by Pumps for 3 units	: 1
	i. Total number of pumps	: 2 Pumps for all 3 units
2.0	Manufacturer Details	:
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	:
	a. Specific gravity of Slurry	: 1.025
	b. Max. slurry concentration % w/w	: 4 %
	c. Rated Capacity	
	▪ Flow m^3 / Hr	: 115
	▪ Head m WC	: 37
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:

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SLURRY PUMPS		
	▪ Power required by pump at rated condition (Slurry)	kW :
	▪ Maximum pump input power	KW :
	▪ Gear Box loss	KW :
	▪ Power output at motor at rated duty condition	KW :
	▪ Motor rating (Recommended based on Clause 4.1)	KW :
	▪ Rated speed	rpm :
	▪ Motor details	Volts/HZ : 415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm :
	e. Critical speeds	rpm :
	f. Margins	
	▪ Flow	% : 5 %
	▪ Head	% : 10 %
	g. Direction of rotation viewed from driver	:
	h. slurry temperature for operating range without cavitation	⁰ C : 60
	i. Minimum submergence required, if applicable	M :
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr :
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr :
	l. Time the pump can run under shut-off condition	Min. :
	m. Impeller	
	▪ Type	:
	▪ Diameter of impeller	mm :
	▪ Shaft material	:
	▪ Material /thickness of impeller	mm :
	▪ Lining material/thickness	mm :
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
	n. Shut-off head	mIC :
4.0	CONSTRUCTION FEATURES	
4.1	a. Impeller	
	▪ Type	:
	▪ Diameter of impeller	mm :
	▪ Shaft material	:


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SLURRY PUMPS		
	▪ Material /thickness of impeller	mm :
	▪ Lining material/thickness	mm :
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge)	kg/cm ² :
	c. Casing material	
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	m. Nozzle size	DN :
	n. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
4.4	Suction Side	
	o. Diameter	DN :
	p. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	q. Type	: Anti friction
	r. Make	: SKF/FAG/TIM
	s. Type of lubrication	: Oil bath
	t. Sight gauge	: Yes
	u. Grade of Lubricant	:
	v. Quantity of Lubricant	:
	w. Arrangement of Cooling	:
	x. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	y. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.2	Guide Bearing Housing	
	r. Type	: Anti friction Ball / Roller / spherical
	s. Make	: SKF / FAG
	t. Arrangement of Cooling	: Natural
	u. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	v. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.3	Coupling between pump & drive	
	w. Type	: Flexible, Jaw with spacer


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SLURRY PUMPS		
		type
	x. Make & Model No.	:
	y. Rating	kW/rp m
	z. Coupling Guard	:
6.0	Sealing System	:
	a. Type	:
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate	Cc/hr
7.0	Material of Construction	:
	a. Suction bell /Casing	:
	b. Casing wear plate	:
	c. Casing liner	:
	d. Impeller	:
	e. Impeller liner	:
	f. Impeller shaft	:
	g. Shaft sleeve	:
	h. Shaft coupling	:
	i. Base plate	:
	j. Coupling guard	:
	k. Fasteners in pump assembly (Wet region)	:
	l. Fasteners in pump assembly (Dry region)	:
8.0	Allowable force on pump flanges	:
	Standard for permissible nozzle load	:
9.0	Weight	:
	a. Bare pump weight	Kgs
	b. Base plate	Kgs
	c. Coupling weight	Kgs
	d. Motor weight	Kgs
	e. Total weight (a+b+c+d)	Kgs
	f. Heaviest single piece component of pump to be handled.	Kgs
10.0	Reference Drawings	:
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:


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SLURRY PUMPS		


**TECHNICAL DATA SHEET-IV
DATA SHEET FOR AUXILIARY ABSORBENT PUMP**

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for all units	: 1
	h. No of stand-by Pumps for all units	: -
	i. Total number of pumps	: 1 pump for all units
2.0	Manufacturer Details	
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	
	a. Specific gravity of Slurry	: 1.1
	b. Max. slurry concentration % w/w	: 15
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 205
	▪ Head m WC	: 25
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:
	▪ Power required by pump at rated condition (Slurry) kW	:

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SLURRY PUMPS				
	▪ Maximum pump input power	KW	:	
	▪ Gear Box loss	KW	:	
	▪ Power output at motor at rated duty condition	KW	:	
	▪ Motor rating (Recommended based on Clause 4.1)	KW	:	
	▪ Rated speed	rpm	:	
	▪ Motor details	Volts/HZ	:	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm	:	
	e. Critical speeds	rpm	:	
	f. Margins			
	▪ Flow	%	:	5 %
	▪ Head	%	:	10 %
	g. Direction of rotation viewed from driver		:	
	h. slurry temperature for operating range without cavitation	⁰ C	:	60
	i. Minimum submergence required, if applicable	M	:	
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	l. Time the pump can run under shut-off condition	Min.	:	
	m. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	
	▪ Max particle size that can be handled	mm	:	
	▪ Width/Diameter ratio of impeller		:	
	n. Shut-off head	mIC	:	
4.0	CONSTRUCTION FEATURES			
4.1	a. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	


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SLURRY PUMPS		
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge)	kg/cm ² :
	c. Casing material	:
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	e. Nozzle size	DN :
	f. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
4.4	Suction Side	
	g. Diameter	DN :
	h. Details of flange	
	▪ PN Rating	PN : PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	: Anti friction
	b. Make	: SKF/FAG/TIM
	c. Type of lubrication	: Oil bath
	d. Sight gauge	: Yes
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	i. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.2	Guide Bearing Housing	
	j. Type	: Anti friction Ball / Roller / spherical
	k. Make	: SKF / FAG
	l. Arrangement of Cooling	: Natural
	m. Rating ,L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	n. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.5	Coupling between pump & drive	
	o. Type	: Flexible, Jaw with spacer type
	p. Make & Model No.	:
	q. Rating	kW/rp : Motor rating with service


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SLURRY PUMPS		
	m	factor of 1.2
	r. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate	Cc/hr
		: 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	:
	b. Casing wear plate	:
	c. Casing liner	:
	d. Impeller	:
	e. Impeller liner	:
	f. Impeller shaft	:
	g. Shaft sleeve	:
	h. Shaft coupling	:
	i. Base plate	:
	j. Coupling guard	:
	k. Fasteners in pump assembly (Wet region)	:
	l. Fasteners in pump assembly (Dry region)	:
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight	Kgs
	b. Base plate	Kgs
	c. Coupling weight	Kgs
	d. Motor weight	Kgs
	e. Total weight (a+b+c+d)	Kgs
	f. Heaviest single piece component of pump to be handled.	Kgs
10.0	Reference Drawings	
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	:


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SLURRY PUMPS		

TECHNICAL DATA SHEET- V
DATA SHEET FOR PRIMARY OVERFLOW TRANSFER PUMPS

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for each unit	: 1
	h. No of stand-by Pumps for each unit	: 1
	i. Total number of pumps	: 2
2.0	Manufacturer Details	:
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	:
	a. Specific gravity of Slurry	: 1.025
	b. Max. slurry concentration % w/w	: 4%
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 265
	▪ Head m WC	: 15
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:


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SLURRY PUMPS				
	▪ Power required by pump at rated condition (Slurry)	kW	:	
	▪ Maximum pump input power	KW	:	
	▪ Gear Box loss	KW	:	
	▪ Power output at motor at rated duty condition	KW	:	
	▪ Motor rating (Recommended based on Clause 4.1)	KW	:	
	▪ Rated speed	rpm	:	
	▪ Motor details	Volts/HZ	:	415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm	:	
	e. Critical speeds	rpm	:	
	f. Margins			
	▪ Flow	%		5 %
	▪ Head	%		10 %
	g. Direction of rotation viewed from driver		:	
	h. slurry temperature for operating range without cavitation	^o C	:	60
	i. Minimum submergence required, if applicable	M	:	
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr	:	
	l. Time the pump can run under shut-off condition	Min.		
	m. Impeller			
	▪ Type		:	
	▪ Diameter of impeller	mm	:	
	▪ Shaft material		:	
	▪ Material /thickness of impeller	mm	:	
	▪ Lining material/thickness	mm	:	
	▪ Max particle size that can be handled	mm	:	
	▪ Width/Diameter ratio of impeller		:	
	n. Shut-off head	mIC	:	
4.0	CONSTRUCTION FEATURES			
4.1	a. Impeller			
	▪ Type		:	

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SLURRY PUMPS		
	▪ Diameter of impeller	mm :
	▪ Shaft material	:
	▪ Material /thickness of impeller	mm :
	▪ Lining material/thickness	mm :
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge)	kg/cm ² :
	c. Casing material	:
	d. Casing Liner material/thickness	:
4.3	Discharge Side:	
	e. Nozzle size	DN :
	f. Details of flange	:
	▪ PN Rating	PN : PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
4.4	Suction Side	
	g. Diameter	DN :
	h. Details of flange	:
	▪ PN Rating	PN : PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	: Anti friction
	b. Make	: SKF/FAG/TIM
	c. Type of lubrication	: Oil bath
	d. Sight gauge	: Yes
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	i. Rating, L ₁₀ at minimum continuous Flow	Hr : 25000
5.2	Guide Bearing Housing	
	j. Type	: Anti friction Ball / Roller / spherical
	k. Make	: SKF / FAG
	l. Arrangement of Cooling	: Natural
	m. Rating, L ₁₀ in terms of hours of continuous operation at duty point	Hr : 25000
	n. Rating, L ₁₀ at minimum continuous	Hr : 25000

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SLURRY PUMPS


	Flow		
5.3	Coupling between pump & drive		
	o. Type	:	Flexible, Jaw with spacer type
	p. Make & Model No.	:	
	q. Rating	kW/rp m	Motor rating with service factor of 1.2
	r. Coupling Guard	:	Yes
6.0	Sealing System		
	a. Type	:	Mechanical seal
	b. Cooling water quantity and pressure required.	:	
	c. Leakage Rate	Cc/hr	3 (max)
7.0	Material of Construction		
	a. Suction bell /Casing	:	
	b. Casing wear plate	:	
	c. Casing liner	:	
	d. Impeller	:	
	e. Impeller liner	:	
	f. Impeller shaft	:	
	g. Shaft sleeve	:	
	h. Shaft coupling	:	
	i. Base plate	:	
	j. Coupling guard	:	
	k. Fasteners in pump assembly (Wet region)	:	
	l. Fasteners in pump assembly (Dry region)	:	
8.0	Allowable force on pump flanges		
	Standard for permissible nozzle load	:	
9.0	Weight		
	a. Bare pump weight	Kgs	:
	b. Base plate	Kgs	:
	c. Coupling weight	Kgs	:
	d. Motor weight	Kgs	:
	e. Total weight (a+b+c+d)	Kgs	:
	f. Heaviest single piece component of pump to be handled.	Kgs	:
10.0	Reference Drawings		
	a. General arrangements Drawing No.	:	
	b. Cross-sectional Drawing No	:	
	c. Quality Plan	:	
	d. Characteristics Curve No	:	


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SLURRY PUMPS		


TECHNICAL DATA SHEET- VI

DATA SHEET FOR WASTE WATER PUMPS

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Bongaigaon-TPS (3X250 MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Flue Gas Desulphurization (FGD)
	e. Service	: Continuous
	f. Installation	: Out-door
	g. No of Pumps for each unit	: 1
	h. No of stand-by Pumps for each unit	: 1
	i. Total number of pumps	: 2
2.0	Manufacturer Details	:
	a. Model	:
	b. Type	: Horizontal Centrifugal Pump
	c. Type of Driver	: Motor
	d. Area classification	: Non-Hazardous
	e. Driver Duty	: Type S1, IEC-60034, Part-1
	f. No of Stage	: Single(1)
	g. Orientation of Suction	: End Suction
	h. Orientation of Discharge	: Vertical
	i. Pull-out	: Back-Pull-out
	j. Clogging/Non-Clogging	: Non-clogging
3.0	PERFORMANCE DETAILS	:
	a. Specific gravity of Slurry	: 1.025
	b. Max. slurry concentration % w/w	: 4 %
	c. Rated Capacity	
	▪ Flow m ³ / Hr	: 100
	▪ Head m WC	: 14
	▪ Pump input power at rated capacity & head (Slurry) kW	:
	▪ Pump efficiency at rated capacity & head (Slurry) %	:
	▪ Power required by pump at rated kW	:

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SLURRY PUMPS		
	condition (Slurry)	
	▪ Maximum pump input power	KW :
	▪ Gear Box loss	KW :
	▪ Power output at motor at rated duty condition	KW :
	▪ Motor rating (Recommended based on Clause 4.1)	KW :
	▪ Rated speed	rpm :
	▪ Motor details	Volts/HZ : 415 volts, 50 hz, 3 phase
	d. Synchronous Motor speed	rpm :
	e. Critical speeds	rpm :
	f. Margins	
	▪ Flow	% 5 %
	▪ Head	% 10 %
	g. Direction of rotation viewed from driver	:
	h. slurry temperature for operating range without cavitation	^o C : 60
	i. Minimum submergence required, if applicable	M :
	j. Recommended min. Flow through pump and corresponding speed in RPM	m ³ / hr :
	k. Recommended max. Flow through pump and corresponding speed in RPM	m ³ / hr :
	l. Time the pump can run under shut-off condition	Min. :
	m. Impeller	
	▪ Type	:
	▪ Diameter of impeller	mm :
	▪ Shaft material	: SS-410
	▪ Material /thickness of impeller	mm :
	▪ Lining material/thickness	mm :
	▪ Max particle size that can be handled	mm :
	▪ Width/Diameter ratio of impeller	:
	n. Shut-off head	mIC :
4.0	CONSTRUCTION FEATURES	
4.1	a. Impeller	
	▪ Type	:
	▪ Diameter of impeller	mm :

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SLURRY PUMPS		
	▪ Shaft material	: SS-410
	▪ Material /thickness of impeller mm	: Cast Iron
	▪ Lining material/thickness mm	: Rubber lining
	▪ Max particle size that can be handled mm	:
	▪ Width/Diameter ratio of impeller	:
4.2	Casing	
	b. Design Pressure (gauge) kg/cm ²	:
	c. Casing material	: Cast Iron
	d. Casing Liner material/thickness	: Rubber lining
4.3	Discharge Side:	
	e. Nozzle size DN	:
	f. Details of flange	
	▪ PN Rating PN	: PN-10
	▪ Type of flange	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
4.4	Suction Side	
	g. Diameter DN	:
	h. Details of flange	
	▪ PN Rating PN	: PN-10
	▪ Type of flange)	: Flat face
	▪ Drilling Standard	: ANSI B 16.5 150 class
5.0	Bearings	
5.1	Thrust bearings Housing	
	a. Type	: Anti friction
	b. Make	: SKF/FAG/TIM
	c. Type of lubrication	: Oil bath
	d. Sight gauge	: Yes
	e. Grade of Lubricant	:
	f. Quantity of Lubricant	:
	g. Arrangement of Cooling	:
	h. Rating, L ₁₀ in terms of hours of continuous operation at duty point Hr	: 25000
	i. Rating, L ₁₀ at minimum continuous Flow Hr	: 25000
5.2	Guide Bearing Housing	
	j. Type	: Anti friction Ball / Roller / spherical
	k. Make	: SKF / FAG
	l. Arrangement of Cooling	: Natural
	m. Rating ,L ₁₀ in terms of hours of continuous operation at duty point Hr	: 25000
	n. Rating, L ₁₀ at minimum continuous Flow Hr	: 25000

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SLURRY PUMPS		
5.3	Coupling between pump & drive	
	o. Type	: Flexible, Jaw with spacer type
	p. Make & Model No.	:
	q. Rating	kW/rp m : Motor rating with service factor of 1.2
	r. Coupling Guard	: Yes
6.0	Sealing System	
	a. Type	: Mechanical seal
	b. Cooling water quantity and pressure required.	:
	c. Leakage Rate	Cc/hr : 3 (max)
7.0	Material of Construction	
	a. Suction bell /Casing	: Cast iron (IS:210 Gr FG260)
	b. Casing wear plate	: Not applicable
	c. Casing liner	: Rubber lining
	d. Impeller	: Cast iron
	e. Impeller liner	: Rubber lining
	f. Impeller shaft	: SS-410
	g. Shaft sleeve	: SS-410
	h. Shaft coupling	: Cast Iron
	i. Base plate	: Structural Steel, ASTM A--36
	j. Coupling guard	: Galvanized Steel
	k. Fasteners in pump assembly (Wet region)	: SS 316
	l. Fasteners in pump assembly (Dry region)	: SS 316
8.0	Allowable force on pump flanges	
	Standard for permissible nozzle load	:
9.0	Weight	
	a. Bare pump weight	Kgs :
	b. Base plate	Kgs :
	c. Coupling weight	Kgs :
	d. Motor weight	Kgs :
	e. Total weight (a+b+c+d)	Kgs :
	f. Heaviest single piece component of pump to be handled.	Kgs :
10.0	Reference Drawings	
	a. General arrangements Drawing No.	:
	b. Cross-sectional Drawing No	:
	c. Quality Plan	:
	d. Characteristics Curve No	: