
TECHNICAL SPECIFICATION FOR SLURRY PUMPS

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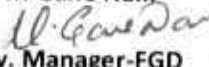
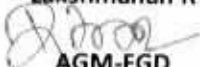
CUSTOMER : NTPC
PROJECT : DADRI 2 x 490MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM



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

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	

TECHNICAL SPECIFICATION FOR SLURRY PUMPS

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NTPC-Dadri (2X490 MW)

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Revision	Date	Status and Description	
01	15.05.2018	Revised Issue	Following changes incorporated Cl. No. 23 (O & M Services for 10 Years Operation) added
00	24.04.2018	Fresh Issue	General technical specifications



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PART –I MAIN SUPPLY

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1.0 PROJECT INFORMATION:

a.	Owner	NTPC
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization

A) SITE CONDITIONS

1.	Ambient Temperature and Relative Humidity		
a.	Average Site Condition (ASC)		
	Ambient Temperature	:	27 deg C
	Ambient Temperature (Design)	:	45 deg C
	Relative Humidity	:	60 %

Note:

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

B) PROJECT LOCATION AND APPROACH

a.	State/Division	Uttar Pradesh
b.	District	Gautam Buddha Nagar

2.0 APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the pump shall follow the latest applicable Indian/International (ASME/EN/Japanese) Standards. In general, pumps shall conform to latest edition of the following standards

- IS:1520 : Horizontal centrifugal pumps for clear cold fresh water
- IS:5120 : Technical requirements of roto dynamic special purpose pumps
- API:610: Centrifugal pumps for general refinery service
- IS:5639: Pumps handling chemicals & corrosion liquids
- IS:5659: Pumps for process water
- HIS: Hydraulic Institute Standards USA
- ASTM-1-165-65: Standard methods for Liquid Penetration Inspection



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3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection & commissioning and performance guarantee testing, 10 years AMC of slurry pumps along with accessories which are provided in the Flue Gas Desulphurization plant of DADRI 2 x 490 MW TPS. The following points may be noted.

- a. There are 2 units of each 490 MW and each unit is envisaged with one FGD system. Slurry pumps are required for various application in the FGD system.
- b. Bidder shall assume full responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- c. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (Annexure-IV)".
- d. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- e. No deviation or exception shall be permitted without the written approval of the purchaser.
- f. 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.
- g. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- h. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

4.0 PROVENNESS CRITERIA:

The Bidder shall offer only proven design which meets the Provenness criteria indicated in the **Annexure-I**. Necessary documentary evidences as per **Annexure-3K for qualification** shall be submitted along with the bid. If the bidder doesn't meet the specified provenness criteria, they are denied to participate in this tender.

Bidders are required to meet the Qualification Requirement (QR) for Slurry Pumps as per **Annexure-I & submit the Annexure-3K to qualification requirement**



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5.0 TECHNICAL INFORMATION

1	Designation	Slurry pumps	
2	Quantity	Please refer Table-A	
3	Location	Outdoor	
4	Operation	Continuous	
8	Design Capacity	Please refer Table-A	
9	Type of Pump	Please refer Table-A	
10	Type of Seal	Mechanical Seal	
11	Pump Driver	Motor (Please refer motor specification)	
12	Voltage level for Motors	Please refer motor specification	
13	Nozzle orientation		
i.	Orientation of Suction	End Suction	
ii.	Orientation of Discharge	Vertical	
14	Material of construction	Horizontal Centrifugal Pump Id No. (1) To (8)	Vertical Sump Pump Id No. (9) To (11)
i.	Casing	Ductile iron (65-45-12, ASTM A-536) with replaceable rubber liner / Hi chrome alloy	Ductile iron (65-45-12, ASTM A-536) with replaceable rubber liner / Hi chrome alloy
ii.	Impeller	Hi Chrome (ASTM 532 Grade IIIA) with minimum hardness of 600-650 BHN or superior material	Hi Chrome (ASTM 532 Grade IIIA) with minimum hardness of 600-650 BHN or superior material
iii.	Shaft	Duplex Stainless steel (S31803, ASTM A-276) or equivalent	Duplex Stainless steel (S31803, ASTM A-276) or equivalent
iv.	Shaft sleeve	CD4M Cu ASTM A-743 or equivalent with a minimum hardness of- 275 BHN	CD4M Cu ASTM A-743 or equivalent with a minimum hardness of- 275 BHN
v.	Base Plate	Carbon steel epoxy coated	Carbon steel epoxy coated



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5.3 FLUSHING WATER ANALYSIS

Process water shall be used for flushing of the Slurry pump. Process water analysis is given below.

S.No	Constituents	Unit	Water quality
1.	Total Dissolved Solids	ppm	~2110
2.	Calcium as CaCO ₃	ppm	721
3.	Magnesium as CaCO ₃	ppm	286
4.	Sodium as CaCO ₃	ppm	358
5.	Potassium as CaCO ₃	ppm	
6.	Iron as Fe	ppm	1.7
7.	Fluoride as F	ppm	0.11
8.	Bicarbonate as CaCO ₃	ppm	688
9.	Chlorides as CaCO ₃	ppm	168
10.	Sulphate as CaCO ₃	ppm	512
11.	Nitrate as NO ₃	ppm	0.55
12.	Silica	ppm	121
13.	pH		7.0 – 8.2
14.	Turbidity	NTU	55



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TABLE-A

SERVICE CONDITION OF SLURRY PUMPS

Pumps should be designed with the following service condition

Sl. No	Description	Limestone Slurry Feed Pump	Gypsum Bleed Pump	Primary Hydro Cyclone Feed Tank Pump	Filtrate Water Tank Pump
1	PUMP ID NO.	(1)	(2)	(3)	(4)
2	Type	Horizontal Centrifugal pump			
3	Capacity of the Pump (in m3/hr)	55	105	210	190
4	Head of the pump (in m)	45	40	60	30
5	Number of pumps	4 nos. (1W +1 S) x 2	4 nos. (1W +1 S) x 2	2 nos. (1W + 1S)	2 nos. (1W + 1S)
6	Mode of operation	Continuous	Continuous	Continuous	Continuous
7	Minimum liquid level in the tank (in m)	1.0	1.5	1.2	1.2
8	Maximum liquid level in the tank (in m)	12.0	6.0	6.1	5.0
9	Maximum operating temperature	65 deg C	65 deg C	65 deg C	65 deg C
10	Minimum operating temperature	10 deg C	10 deg C	10 deg C	10 deg C
11	Maximum operating speed	Vendor to confirm	Vendor to confirm	Vendor to confirm	Vendor to confirm
12	Power loading for bid evaluation	Applicable	Applicable	Applicable	Applicable
13	Pump efficiency	Minimum 65%	Minimum 65%	Minimum 65%	Minimum 65%
14	Type of seal	Mechanical seal	Mechanical seal	Mechanical seal	Mechanical seal

Sl. No.	Description	Secondary Hydro Cyclone Feed Tank Pump	Waste Water Tank Pump	Auxiliary Absorbent Tank Pump	Emergency Transfer Pump
1	PUMP ID NO.	(5)	(6)	(7)	(8)
2	Type	Horizontal Centrifugal pump			
3	Capacity of the Pump (in m3/hr)	125	55	155	570
4	Head of the pump (in m)	50	35	25	30
5	Number of pumps	2 nos. (1W + 1S)	2 nos. (1W + 1S)	1 no. (1W)	2 nos. (1W) x 2
6	Mode of operation	Continuous	Continuous	Intermittent	Intermittent

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7	Minimum liquid level in the tank (in m)	1.0	1.0	1.2	1.5
8	Maximum liquid level in the tank (in m)	5.0	6.8	11.2	6.0
9	Maximum operating temperature	65 deg C	65 deg C	65 deg C	65 deg C
10	Minimum operating temperature	10 deg C	10 deg C	10 deg C	10 deg C
11	Maximum operating speed	Vendor to confirm	Vendor to confirm	Vendor to confirm	Vendor to confirm
12	Power loading for bid evaluation	Applicable	Applicable	Not Applicable	Not Applicable
13	Pump efficiency	Minimum 65%	Minimum 65%	Minimum 65%	Minimum 65%
14	Type of seal	Mechanical seal	Mechanical seal	Mechanical seal	Mechanical seal

Sl. No.	Description	Absorber area drain sump pump	Gypsum area drain sump pump	Limestone area drain sump pump
1	PUMP ID NO.	(9)	(10)	(11)
2	Type	Vertical sump pump		
3	Capacity of the Pump (in m3/hr)	155	50	50
4	Head of the pump (in m)	30	25	25
5	Number of pumps	4 nos. (1W +1 S) x 2	1 no. (1W)	1 no. (1W)
6	Service	Outdoor	Outdoor	Outdoor
7	Mode of operation	Continuous	Continuous	Continuous
8	Process Fluid parameters			
	Liquid	Gypsum Slurry	Gypsum Slurry	Limestone Slurry
	Cl conc:	< 20,000 ppm	< 20,000 ppm	120 ppm
	Temperature	65 °C	65 °C	45 °C
	Specific Gravity	1.215	1.215	1.215
	Viscosity	0.01 Pa.s	0.01 Pa.s	0.1 Pa.s
	Solid conc.	30 wt%	30 wt%	30 wt%
	SiO ₂ content	20.7 g/l	20.7 g/l	18 g/l
	pH	4-8	4-8	5-8
9	Maximum solid particle size	6-7 mm	6-7 mm	6-7 mm
10	Normal solid particle size,d50	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)

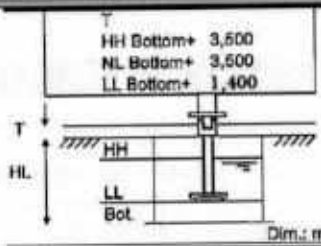
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11	Tank level sketch			
12	Power loading for bid evaluation	Not applicable	Not applicable	Not applicable
13	Maximum operating speed	Vendor to confirm	Vendor to confirm	Vendor to confirm
14	Pump efficiency	Minimum 65%	Minimum 65%	Minimum 65%
15	Type of seal	Mechanical seal	Mechanical seal	Mechanical seal

TABLE-B
SLURRY CONDITION

Sl. No.	Parameter	Limestone Slurry Feed Pumps	Gypsum Bleed Pump / Primary Hydro Cyclone Feed Tank Pump / Emergency Transfer Pump	Filtrate water tank pump	Secondary Hydro Cyclone Feed Tank Pump	Auxiliary Absorbent Tank Pump	Waste Water Tank Pump
1.	Slurry to be handled	Limestone Slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone / Gypsum / mixture of two	Lime stone / Gypsum / mixture of two
2.	Maximum solid particle size	150 mesh (140 micron)	150 mesh (140 micron)	150 mesh (140 micron)	150 mesh (140 micron)	150 mesh (140 micron)	150 mesh (140 micron)
3.	Normal solid particle size, d50	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)
6.	Chloride concentration	20,000 ppm (max)	20,000 ppm (max)	20,000 ppm(max)	20,000 ppm (max)	20,000 ppm (max)	20,000 ppm (max)
7.	Hardness of particle	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)
8.	Slurry concentration	30 wt%	30 wt%	10.8 wt%	16.6 wt%	30 wt%	3 wt%
10.	Sp. Gravity of Slurry	1.215	1.215	1.068	1.111	1.215	1.022
11.	Viscosity at pump	0.03 Pa.S	0.01 Pa.S	0 Pa.S	0 Pa.S	0.01 - 0.03 Pa.S	0 Pa.S
12.	Slurry temperature	65 deg C	65 deg C	65 deg C	65 deg C	65 deg C	65 deg C



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6.0 SCOPE OF SUPPLY

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

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

Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.

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

The scope of supply for Slurry pump shall include but not limited to the following:

Sl. No	Scope
1.	Slurry pump complete with
	i. Casing
	ii. Rotor and Shaft assembly
	iii. Drive motor as per specification
	iv. Coupling
	v. Common base frame and shock pads
	vi. Single Mechanical seal with automatic flushing with a connection for additional manual flushing.
	vii. Flushing and drain system
	viii. Coupling guards with bolts
	ix. Suction filter
	x. Expansion joints at suction and Discharge
	xi. Companion flanges with gaskets and fasteners
	xii. Casing drain terminated at battery limit with flange
	xiii. Cooling water piping for Bearing cooling
	xiv. Lubrication system
	xv. Foundation bolts for supplied items
	xvi. Pedestal
	xvii. Drip tray
	xviii. Lantern Ring
	xix. Mechanical Running and Performance test at shop
	xx. Painting and Rust Prevention during shipment and construction
	xxi. Supervision of Erection & commissioning at site
	xxii. Special tools & tackles as applicable
	xxiii. Pressure & Temperature gauges and service indicator as applicable
	xxiv. Accessory Piping within the skid

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Sl. No	Scope
	xxv. Start-up & Commissioning spares as applicable
	xxvi. Seaworthy Packing & Forwarding (for import supplies) to Project Site office
	xxvii. Installation, operation and maintenance manuals
	xxviii. Any other items required for completeness of the equipment except the items covered in the exclusions.

6.1	TECHNICAL REQUIREMENTS		
1.	All slurry pumps for a particular service shall be identical and interchangeable.		
2.	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, 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.		
3.	In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller.		
4.	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a hi chrome alloy lined pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.		
5.	The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs.		
6.	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft.		
7.	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.		
8.	The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated.		
9.	The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of about 15% more than the design head.		
10.	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.		
11.	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:		
	Speed	Antifriction Bearing	Sleeve Bearing
	1500 rpm and below	75.0 micron	75.0 micron
	3000 rpm	50.0 micron	65.0 micron



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12.	The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Minimum motor margin (as per table below) shall be provided above maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. Continuous Motor rating shall be at 50 deg.C ambient. Motor margin shall be as below <table><tr><th>Pump rated BKW</th><th>Motor rating</th></tr><tr><td><22 kW</td><td>125% of pump rated BKW</td></tr><tr><td>22 kW – 55 kW</td><td>115% of pump rated BKW</td></tr><tr><td>>55 kW</td><td>110% of pump rated BKW</td></tr></table>	Pump rated BKW	Motor rating	<22 kW	125% of pump rated BKW	22 kW – 55 kW	115% of pump rated BKW	>55 kW	110% of pump rated BKW
Pump rated BKW	Motor rating								
<22 kW	125% of pump rated BKW								
22 kW – 55 kW	115% of pump rated BKW								
>55 kW	110% of pump rated BKW								
13.	The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).								
14.	Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.								
15.	The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.								
16.	The pumps shall be designed as impeller centrifugal (non-clog centrifugal) pump. The pumps shall be wear-resistant, be equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance.								
17.	Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be applied.								
18.	Pumps shall have the rated capacity near the best efficiency point								
19.	Impellers shall be single piece casting. Fabricated impellers shall not be accepted.								
20.	The Pumps shall be wear resistant be equipped with flushing devices to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance.								
21.	The slurry pumps shall be equipped with oil level indication, coupling guard and collecting equipment for leakage, made of resistant material.								
22.	Single mechanical seals with automatic flushing with a connection for additional manual flushing shall be applied.								
23.	Pump shall be either belt drive or Gear Box type. If the belt drive is chosen by the vendor, vendor should adhere to the applicable standards for ensuring the performance of the pumps as per the specification. A service factor of 1.5 or better should be considered for Gear Box.								
24.	All pumps shall be designed to withstand a test pressure of 200% of pump rated head or 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions.								
25.	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.								
26.	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least								



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	favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1m to the max NPSH required shall be provided.
27.	The Pump flow/head characteristics shall be such that within the operation range the head will continuously increase with decreasing flow, maximum head (shut off head) being at least 10% higher than the duty point head.
28.	All pumps shall be fitted with suction and discharge pressure gauges
29.	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.
30.	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).
31.	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising it's NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and is at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.
32.	External flushing is required to remove the accumulated particles and all related information should be mentioned in data sheet.
33.	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.
34.	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.
35.	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –Up an overload moment. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
36.	The Antifriction bearing of the pumps shall be designed for minimum useful life (L-10) of 20,000 hours of continuous operation (Under the design condition). The thrust bearing will have dimensions for a minimum of 175 % of the required load.
37.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
38.	The sealing areas shall be designed in such a way so that solids do not precipitate in them affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
39.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
40.	Each rotating equipment shall be first statically balanced and then dynamically balanced



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	according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
6.2	CONSTRUCTIONAL FEATURES
A)	CASING
a.	Pumps shall be of Radial Split Casing, Close/Semi-open, Over-hang, End Suction Type Back Pull-out design, Vertical Discharge type for Horizontal Centrifugal Pump.
b.	The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
c.	Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs.
d.	Pump casing be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.
e.	Lifting provision of pump as a whole and individual casing half should be provided.
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.	Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials.
B)	IMPELLER
a.	Impeller shall be closed, semi-closed or open type and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.
b.	For rubber lined pumps, tip speed of impeller shall not exceed 25 m/sec and for other pumps not over 30 m/sec.
c.	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
d.	Base material for rubber-lined impeller should be capable of handling speed as specified in the respective clause without affecting adhesion of lining. Impeller as rotating assembly along with all elements should be dynamically balanced according to ISO 1940
e.	Maximum size impellers for the pump body shall not be quoted for. By installation of a new impeller a head increase of 5% minimum shall be possible.
C)	IMPELLER/CASING WEARING RINGS

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a.	Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.
D)	SHAFT
b.	The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.
c.	All Pump shafts shall be of ample size to transmit the maximum possible output from the prime mover.
d.	The pump shaft and coupling are to be so dimensioned that the maximum permissible torque of the shaft is higher than the maximum transmissible torque of the coupling and gear.
e.	Pumps shall operate smoothly throughout the speed range up to their operating speeds. The first coupled critical speed must be at least 20% higher than the maximum operating speed. The determination of the shaft diameter and the distance between two consecutive bearings must include a sufficiently large safety margin to satisfy this condition.
f.	Shafts shall be conservatively designed to transmit maximum power required and to assure rigidity. Shafts shall be machined and ground to close tolerances and shall be tapered to permit easy removal of the seals and bearings.
g.	Shaft shall run in high precision heavy duty roller bearings. Lubrication system provided shall be such that visual checking of lubricant level is possible
h.	The shaft shall be finished to close tolerance at the rotor, coupling and bearing diameters. The size of shaft shall be calculated on the basis of maximum combined shear stress. This shear stress shall not exceed 30 percent of the elastic limit in tension or 18 percent of ultimate tensile strength.
i.	No parts of the shaft should come in contact with the liquid medium for horizontal centrifugal pump.
j.	Shaft should have a keyed joint at impeller hub. No thread connection between impeller and shaft is acceptable.
E)	SHAFT SLEEVES
a.	Renewable type fine finished shaft sleeves shall be provided at mechanical seals. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.
F)	BEARINGS
a.	Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

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	Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.
b.	The bearings may be ball, roller or sleeve bearing. If sleeve bearings are used these shall be machined for close running fit. The bearings shall be designed to take the necessary radial load as well as the net axial thrust. Bearings shall be lubricated properly and sized for an operating life of 20,000 hours on the basis of maximum load. Oil level indication shall be provided.
c.	The bearings shall be of automatic oil lubricated type. Vibration sensors and temperature measurements incl. temperature transmitter for continuous monitoring shall be provided.
d.	Bearing housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.
e.	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
f.	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.
G)	MECHANICAL SEALS
a.	Mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.
b.	The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.
c.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.
d.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
e.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
f.	Pump shall be supplied with mechanical seal. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.



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g.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
h.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, pump should have a provision of collecting of any drip leakage and flushing the same to nearby pit is to be providing without corroding the base plate of pump.
i.	Mechanical seals shall be fitted and installed in the pump before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping
j.	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.
k.	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
H)	COUPLING
a.	The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.
b.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings and gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
c.	Coupling shall be of flexible type made of cast steel. The Bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the gearbox and the motor by bidder.
d.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. If weight of the coupling is heavy (>40 kgs), provision of tapped hole should be incorporated in right place of hub to handle the same effortlessly
I)	BASE PLATE
a.	A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.
b.	Suitable holes shall be provided for grouting and these shall be so located that the base plate can be grouted in place without disturbing the pump and motor.
c.	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.



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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.
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.
J)	ASSEMBLY AND DISMANTLING
i.	Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.
K)	ADDITIONAL REQUIREMENT FOR VERTICAL SUMP PUMP
	The pumps shall be designed for continuous operation. The pump 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.
	The pump shall deliver the rated flow at rated head with margins as specified in the respective clauses. The pump shall be capable of pumping of slurry with solid concentration upto 30 wt% & particle lumps of 6-7mm.
	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.
	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.
M)	ACCESSORIES:
1.	Expansion Joints:
i.	Expansion Joints shall be provided at suction and discharge of each pump
2.	Pressure Gauges:
i.	Pressure Gauges shall be furnished for at suction & discharge of each pump. Pressure gauges of class 1.6 or better must be used. Pressure instrument for measurement of steady pressure at varying pressure shall operate in a band centered on 60% of its maximum range. Pressure gauges shall have a dial size of 160 mm.
3.	Pump control:
i.	Each pump shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the pumps can be controlled from the control console in the FGD Control room

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6.3 Motor

6.3.1 General

This specification generally covers the requirement for motors involved in Slurry Pumps system package.

6.3.2 Voltage level:

The voltage level for motors shall be as follows:

S.No	Rating	Voltage	Freq and voltage variation
1	Upto 0.2 kw	Single phase 240V AC / Three phase 415V AC	1. 50 Hz- +3% & -5 % 2. 10% combined variation of voltage & frequency.
2	Above 0.2 and up to 200 kw	Three phase 415V AC	

6.3.3 Starting voltage requirement

Up to 85% of rated voltage for ratings below 110 KW

Up to 80% of rated voltage for ratings from 110 KW to 200 KW

- Voltage rating for special purpose motors viz, VFD shall be as per manufacturer's standard.

6.3.4 Degree of protection:

S.NO	Item	Indoor	Outdoor
1	Motors	IP 54	IP 55
2	Cable box	IP 54	IP 55

6.3.5 Efficiency class:

Premium efficiency IE3 (For Continuous duty motors up to 200 kw) as per IS 12615, IEC:60034-30

6.3.6 General requirements:

S.No	Parameters	To be confirmed by vendor	Vendors confirmation
1	Direction of rotation	Suitable for both directions	
2	Class of Insulation	Thermal class 155 (F) insulation	



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3	Winding Insulation	The winding insulation process shall be Global Vacuum Pressure Impregnated i.e. resin poor method	
4	Starting Current	1. Less than or equal to 600 % full load current subject to tolerance as per IS (Normal motor) 2. Less than or equal to 700 % full load current subject to tolerance as per IS (Normal motor)	
5	Starting Voltage	1. Up to 85% of rated voltage for ratings below 110 KW 2. Up to 80% of rated voltage for ratings from 110 KW to 200 KW	
6	Torque requirement	1. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. 2. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.	
7	Type of enclosure	1. Motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. 2. VFD driven motors to be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor.	
8	Dimensions of Terminal box for LV motors	Motor MCR	Distance between center of stud & gland plate (in mm)
		a. Upto 3 Kw b. Above 3 kw to 7 kw c. Above 7 kw to 13 kw d. Above 13 kw to 24kw e. Above 24 kw to 37kw f. Above 37 kw to 55kw g. Above 55 kw to 90kw	As per manufacturer's practice 85 115 167 196 249 277
9	Cable glands & Lugs	Double compression type Nickel plated brass cable gland & insulated tinned copper crimping lugs to suit the cable sizes	
10	Paint shade	RAL 5012 (Blue)	
11	Space heaters	Suitable single phase space heaters shall be provided on motors rated 30KW and above. Separate terminal box for space heaters shall be provided	

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6.3.7 Locked rotor withstand time

S.No	Starting time at min permissible voltage	Locked rotor withstand time
1	Upto 20 secs	Under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time
2	More than 20 sec & less than 45 sec	Under hot condition at highest voltage limit shall be at least 5 secs. more than starting time
3	More than 45 sec's	under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time

6.3.8 Special Requirement:

Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

6.3.9 Torque Requirements

- 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. It shall be 275% for crane duty motors.

6.4 INSTRUMENTS

6.4.1 General:

This section covers the specification for instruments involved in slurry pumps.

Instruments as per attached list (Section 6.4.3) shall be minimum. Instruments that are required for satisfactory operation of the system though not indicated in the list shall also be supplied.

6.4.2 INSTRUMENTS:

6.4.2.1 General:

All transmitters, sensors, switches and gauges for parameters like pressure, level, flow etc. as required for the safe and efficient operation and maintenance of equipment in the system under the scope of specification shall be provided on as required basis.



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6.4.2.2 Instrumentation valves:

The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis.

6.4.2.3

The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The necessary cables, flexible conduits, junction boxes and accessories for the above purpose shall also be supplied. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

6.4.3 LIST OF INSTRUMENTS:

6.4.3.1 Pressure gauge

To be provided at Pump Suction & Pump Discharge

6.4.3.2 Pressure Transmitter

To be provided at Pump Discharge

6.4.3.3 Specification for Pressure Transmitter:

Microprocessor based 2 wire loop powered electronic transmitter with 4-20 mA DC HART output signal shall be provided. For calibration ranges greater than or equal to 400mmwc, accuracy of transmitter shall be ± 0.060 % of calibrated range(min), stability 0.25 % of calibrated range for 10 years and 50:1 turn down. For calibration ranges less than 400mmwc accuracy shall be ± 0.10 % of calibrated range (min) and 20:1 turndown. Overpressure rating of transmitter shall be 150% of maximum operating pressure. Transmitter shall have weather proof IP-67 metallic housing with durable corrosion resistant coating, integral digital display with self-indicating diagnostics, ,plug and socket type electrical connection, calibration using HART calibrator, 2/3/5 Valve non integral manifold and rack with canopy.



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7.0 GENERAL REQUIREMENTS:

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



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S. No.	Description
15.	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
16.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
17.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
18.	Provide double nuts for anchor bolts
19.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
20.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
21.	Bidder shall provide the mating flanges with the necessary gaskets.
22.	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
23.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
24.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
25.	Quality Plan to be submitted along with the offer.
26.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
27.	Material of construction for all equipment/components shall be subject to NTPC/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
28.	Bidder to provide sub vendor list and Bidder shall strictly adhere to NTPC approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by NTPC/ BHEL before placing order and bidder shall submit relevant documents as per Attachment-VI-Sub-Supplier Questionnaire .
29.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BHEL / NTPC for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of NTPC/ BHEL, the same may be replaced with another NTPC/BHEL approved sub-



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S. No.	Description
	vendor only, without any price implications to BHEL.
30.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the NTPC/ BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the NTPC along with BHEL.
31.	Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
32.	During detail engineering, bidder to strictly adhere to BHEL/NTPC drawing formats, document numbering, quality plan & FQP formats
33.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
34.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/NTPC during detail engineering
35.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
36.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/NTPC should be addressed timely by the bidder.
37.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
38.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer.



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S. No.	Description
	a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"
8.0	PACKING AND FORWARDING
1.	Proper packing to be ensured. Indigenous Supply: Pump & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the pump internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure - VI. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4.	Crates and packing material used for shipping will become the property of owner.(NTPC)
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places



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S. No.	Description
	f. Handling marks and the following delivery marking
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. NTPC NATIONAL CAPITAL THERMAL POWER PROJECTS STAGE – II DADRI, 2 X 490 MW. UTTAR PRADESH INDIA EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, INDIA" In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care", "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15.	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of pump & accessories, BHEL

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S. No.	Description
	item Code, Gross Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
9.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING
1.	The erection of Slurry Pumps will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per boiler for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.
2.	There will be one visit per boiler and totally there will be 2 visits for 2 boilers. The bidder will be informed well in advance for the visit. Bidder shall include 15 working days per visit in the offer with minimum 2 visits.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.
10.0	EXCLUSION
	The following work associated with the slurry pump will be by BHEL: a. Civil foundations b. Walkways, platforms and ladders c. Element handling hoists
11.0	INSPECTION AND TESTING



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
A)	Minimum Testing requirements to be considered are as below:
1.	Hydrostatic test is to be conducted at 200% of pump rated head or at 150% of shut off head, whichever is higher for duration of 30 minutes, taking into consideration of the fact that actual operating temperature is 65 deg Celsius (maximum).
2.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
3.	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
4.	List of Non-Destructive test over and above the material test are as follows: a. Casing: Material test, Magnetic particle (MPI), DP and Hydro test as applicable. b. Impeller- DPT and MPI as applicable. c. Shaft- Ultrasonic (UT), DPT and MPI. d. Sleeve- DP and Hardness test / Manufacturer's recommendation. e. Mechanical Seal- Manufacturer's recommendation. f. Base Plate- Stress relieving of weld. g. Replaceable Rubber liner- Spark test, Shore Hardness, Class and Type certificate
5.	UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.
6.	Once mounting is finished and operation less will be conducted on each pump to determine the characteristic curves. For dynamic pressure and volume output, and to determine the parameters at the design point, mechanical running & performance testing shall be performed & witnessed.
7.	The pump rotating parts shall be subjected to static and dynamic balancing.
8.	NPSH Test, Vibration test and Noise level test shall be witnessed at shop.
9.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
10.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
11.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
12.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	
S. No.	Description
13.	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
B)	General Inspection requirements to be considered are as below:
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BHEL / NTPC prior to manufacture. Inspection of above mentioned tests by BHEL/ NTPC representative at bidder's works is envisaged.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/NTPC.
3.	Slurry Pumps will be inspected at the Bidder's works before dispatch or where the test facilities are available.
4.	The Bidder shall conduct performance test for the remaining pumps and submit the reports.
5.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to NTPC/ BHEL within one (1) week of the successful completion of balancing.
6.	Acceptance tolerance of actual versus guaranteed performance for capacity, head, efficiency and power absorbed shall be as per applicable standard.
7.	Vibration levels shall be measured during shop running/performance tests.
8.	Contract shaft seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition.
9.	Slurry pumps shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
10.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
11.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
12.	Bidder to arrange all calibrated gauges, Instruments during inspection.
13.	Mechanical running and the performance test shall be carried out at factory. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
14.	The performance test may be carried out using water at shop and shall be converted to the design condition.
12.0	PAINTING
1.	Surface Preparation : Power Tool Cleaning to St3 (SSPC-SP3)
2.	PRIMER COAT: 1. Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) – DFT: 60 microns. 2. Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50μ

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	
S. No.	Description
3.	FINISH COAT: One coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Total DFT : 50 micron.
4.	COLOUR CODE (based on DIN 2403:2007-05 & DIN 5381) a. Base: To be informed later b. Lettering: To be informed later.
5.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BHEL / NTPC.
13.0	SPARES,TOOLS & TACKLES
13.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Slurry pumps. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of pump shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipments are energized.
13.3	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
14.0	PERFORMANCE GUARANTEE
	All performance tests for Slurry pumps shall be carried out in accordance with any latest international codes/standards. 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Slurry pump and its accessories 2) Bidder shall guarantee and demonstrate the rated capacity of the pump at the rated head. 3) The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. 4) The material and thickness of the liners shall ensure a minimum service life of 2



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
	years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hrs. 5) Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 6) Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. 7) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ NTPC approval. 8) In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.
15.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION:
1.	POWER GUARANTEE Bidder to specify the guaranteed power consumption at motor input terminal per Pump operating at the duty point in their offer.
2.	BID EVALUATION CRITERIA FOR POWER CONSUMPTION: Power loading shall be applicable for designated slurry pumps as specified in sl. No. 12 of Table A. Guaranteed power consumption at motor input terminal shall be quoted by bidder. Lowest quoted guaranteed power consumption will be taken as base value. Bid prices of other bidders will be loaded @ 197,080 INR for every KW excess over the base value as per the formula given below. Adjustment factor for excess power consumption in INR = $(GPC-BV) \times PL \times \text{No's of Working pumps}$ GPC- Guaranteed Power Consumption quoted by bidder in KW BV- base Value i.e. lowest quoted power consumption in KW PL- Power Loading @ 197,080 INR/KW
16.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
	If actual Power Consumption at motor input terminal during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in INR = $(APC-GPC) \times P \times \text{No's of Working pumps}$



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
	Where • GPC- Guaranteed Power Consumption quoted by bidder in KW • APC- Actual Power Consumption in KW • P- Penalty @ 197,080 INR per KW
17.0	WARRANTY
1.	The warranty period shall begin on the date of taking over by NTPC or date of issuance of the provisional acceptance certificate for the unit (whichever occurs first) and shall end after twenty-four (24) months. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.
2.	In case of failure of the equipment to meet the guarantee, NTPC/BHEL reserves the right to reject the equipment. However, NTPC/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
18.0	FIRST FILL OF CONSUMABLES:
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the NTPC/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
19.0	TRAINING
	Successful bidder shall provide comprehensive training for NTPC/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Slurry pumps - Operation & Maintenance, Troubleshooting etc.
20.0	CONFLICT
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising NTPC in writing of any conflicts between the specifications and Bidder's design, including



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
	performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.
21.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. As a minimum requirement, the following information shall be furnished to fully describe the scope of work and services offered. a. Duly filled-in Technical Data sheets (Annexure II) and guarantee schedule furnished under Annexure-III. b. PID diagram c. Performance curve d. Terminal point details. e. General Arrangement drawings indicating dimensional data with civil loads and pocket details. f. Rotor GD² (kg-m²) g. Torque Vs Speed curve h. Calculation of Motor rating, Bearing capacity and selection of coupling i. Bill of material along with material and code j. Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment. k. Erection, Operation & Maintenance manual with lubrication schedule l. Procedure for shop / site performance tests m. Time schedule for delivery. n. Quality Assurance Plan. o. Make of all bought out items. p. Deviation list q. Spares list. r. Hoist / Crane requirement. s. Reference list of similar projects executed. t. List of proposed makes and vendors u. Training program and schedule for BHEL/NTPC personnel v. Equipment maintenance schedules



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
	The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified here under. However as minimum the following shall be submitted. a. Duly filled technical datasheet. b. Warranted performance curves. c. General arrangement drawings indicating dimension and civil loading details. d. Motor Data e. Recommended repair procedure etc. f. Operation and maintenance manuals g. Any unique installation instructions shall be noted on the submitted drawings or be provided as a separate document prior to the submission of the Operation and Maintenance Manual. h. Erection schedule and component list. i. Successful Bidder shall submit Calculation for Motor power requirement for sizing Motor within 2 weeks from the date of ordering. j. The characteristic curves of Slurry pumps shall be provided along with the documents. These shall be identical and uniform for all the pumps. The pumps shall be designed for optimum power consumption and should not fall under surge point between the operating range k. The following characteristic curves of the pump shall be submitted: i. Flow v/s Head ii. Flow v/s NPSH iii. Flow v/s Efficiency iv. Flow v/s power consumption v. Torque vs. speed curve for Motor selection l. The system-resistance point at different loads shall be indicated in the above performance curves. Drawings that are reviewed by the NTPC/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. NTPC/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

S. No.	Description
	components and necessary set of operation & maintenance manual as asked by NTPC must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDs shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per NTPC requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL.



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

22.0 ANNEXURES

ANNEXURE-I- PROVENNESS CRITERIA

ANNEXURE - I PROVENNESS CRITERIA



CLAUSE NO.	INTENT OF SPECIFICATION										
4.00.00	QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS										
4.01.00	Provenness criteria for critical equipment, auxiliaries, systems and bought out items: The Bidder / Bidder's sub-vendor(s) is required to meet the Provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:										
4.01.01	Slurry Pumps for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder: <u>Type and Rating for Qualification</u> <table border="1" data-bbox="399 1075 1331 1406"> <thead> <tr> <th>Sl. No.</th><th>Name of Equipment</th><th>Type of Equipment</th><th>Application</th><th>Equipment Rating</th></tr> </thead> <tbody> <tr> <td>(e)</td><td>Slurry Pumps</td><td>Centrifugal type</td><td>Wet Limestone based FGD application or ash slurry application in Coal fired power plant</td><td>80% of the flow & 100% of the head of the offered Slurry Pump(s)</td></tr> </tbody> </table>	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating							
(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)							
4.01.03	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified. A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).										



CLAUSE NO.	INTENT OF SPECIFICATION
	Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.
4.01.08	Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.
4.01.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.
4.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. Note to clause 4.01.01 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.

FOR
NCTPP DADRI ST-II (2X490 MW)
BIDDING DOCUMENT NO. CS-6130/0330-109-9

Bidder's Name and Address:

To
Contract Services-II
NTPC Limited
Noida-201301

Summary of Critical Equipment indicated under clause 4.01.00, sub-Section-I, Part-A of Section-VI.

Equipment Name	Sub-Vendor Name	Collaborator's Name, if applicable	Seeking Qualification as per clause... Sub-Section-I, Part-A of Section-VI
Booster Fans			*4.01.01/*4.01.02/*4.01.03
*Slurry Recirculation Pumps			*4.01.01/*4.01.03/*4.01.07
Oxidation Blowers			*4.01.01/*4.01.03/*4.01.04
Wet limestone Grinding mills			*4.01.01/*4.01.03/*4.01.05 (i)/4.01.05 (ii)
Slurry Pumps			*4.01.01/*4.01.03
Agitators			*4.01.01/*4.01.03/*4.01.06
Vacuum Belt filters			*4.01.01/*4.01.03

Note : *Strike-off whichever is not applicable.

1. If qualification sought as per clause 4.01.01, sub-Section-I-A, Part-A of Section-VI then the details of the sub vendor (manufacturer) shall be filled by the bidder in the format A to G.

2. If the qualification sought as per the clause 4.01.02, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e. manufacturer of such equipments for at least 490 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be furnished.
3. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipments in India shall be furnished individually for each equipment by the bidder such as,
 - i) Copy of document of incorporation of JV/Subsidiary company in India
 - ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI.
 - iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

Further, the details of collaborator or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall be filled by the Bidder in the format A to G (format given at 1.00.00). In addition to that, the sub vendor along with the Indian JV company/subsidiary company, qualified equipment manufacturer and its holding company/subsidiary company as applicable shall furnish the DJU.

*** strike out whichever is not applicable.**

1.00.00

(Applicable for Bidder/his sub vendors seeking qualification as per clause no. 4.01.01, Sub section-I, Part-A of Section-VI. Bidder shall furnish the required data only for those equipments / auxiliaries which are proposed to be sourced under this route.)

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems and Bought Out Items such as Slurry Pumps which have been designed (either by self manufacturer or under valid ongoing collaboration and technology transfer agreement), *manufactured/ *got manufactured and supplied by us /Manufacturer (or manufactured/ got manufactured & supplied by our proposed sub-vendors) and these are in successful operation in at least one (1) plant for a period not less than one year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder. The details of type and minimum equipment rating of such equipment are given below :

E. Slurry Pumps: We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement), *manufactured/*got manufactured and supplied at least one (1) number of Slurry Pump of minimum 80% of the flow & 100% of the head of the offered Slurry Pump(s), Centrifugal type working in Wet Limestone based FGD application or ash slurry application in coal fired power plant and which has been in successful operation for minimum one (1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether operating in a Wet Limestone based FGD application or similar process/duty application	-*Yes/*No
5.	Whether operating in a similar process/duty application	-*Yes/*No...(indicate industry type)
6.	Name of equipment manufacturer & address:	
7.	Date of commission of the equipments:	
8.	Model no. of the equipment:	
9.	Brief Technical particulars of the equipments:	
10.	Flow-	m ³ /h

Sl. No.	Description	Reference Work
11.	Head-	 meters of liquid column
12.	Whether the equipment(s) are in successful operation in atleast one(01) plant for a period not less than one(01) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder	-*Yes/*No
13.	Flue gas Desulphurization system details:	*Technical extract/ *paper letter/ *email/ *Drawing from user or *contract document or *scheme or *any document in public domain enclosed at annexure....to Attachment-3K
14.	Scope of Work:	*Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K
15.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K

* Strike off whichever is not applicable.

***Bidder to strike off whichever is not applicable.**

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

2.02.00

We further confirm that details in respect of collaboration / valid licensing agreement for the aforesaid equipment as per 2.01.00 above who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI are enclosed at **Annexure-.....** to this Attachment. The data in respect of Provenness criteria for these equipment which are in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below. We further confirm that we/ our sub vendor(s) have created manufacturing and testing facilities at our/ their works as per collaborator's/ Licensor's design, manufacturing & quality control system for these equipment(s)/ Auxiliary(ies).

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

***3.00.00**

Applicable for JV Company/Subsidiary Company meeting provenness criteria as per clause no. 4.01.01, Sub section-IA, Part-A of Section-VI.

3.01.00

We, hereby confirm that JV company/ Subsidiary company (Strike off whichever is not applicable) formed for manufacturing and supply of equipment(s) (Slurry Pumps) has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 of sub-section-I, Part-A, Section VI of bidding documents (or the technology provider of the qualified equipment manufacturer).

Further, in such a case, such qualified equipment manufacturers is having, directly or indirectly through its holding company/subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture / Subsidiary or up to the end of defect liability period of the contract, whichever is later. Before taking up the manufacturing of such equipment(s) (Slurry Pumps), we/our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licensor's design, manufacturing and quality control system.

We further confirm that details in respect of collaboration / valid licensing agreement for the aforesaid equipment(s) (Slurry Pumps,) who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment.



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

ANNEXURE – II- TECHNICAL DATA SHEET (to be repeated and filled by bidder for each type of pump)

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: DADRI (2x 490MW)
	c. Ultimate Customer	: NTPC
	d. Location	: Gautam Budh Nagar, UP, India
	e. Service	: Continuous
	f. Installation	: Outdoor
	g. Pump name	: Bidder to fill
	h. No. of working pumps	: Bidder to fill
	i. No. of standby pumps	: Bidder to fill
2.0	MANUFACTURER DETAILS	
	a. Model	: Bidder to provide
	b. Type	: Centrifugal (non- Clogging)
	c. Type of Driver	: Bidder to provide
3.0	OPERATING CONDITION	
	Medium to be handled	: Bidder to fill
	Maximum solid particle size	: Bidder to fill
	Normal solid particle size, d 50	: Bidder to fill
	Concentration of chloride	: Bidder to fill
	Viscosity of slurry	: Bidder to fill
	Concentration of slurry	: Bidder to fill
	Specific gravity of slurry	: Bidder to fill
	pH of slurry	: Bidder to fill
4.0	PERFORMANCE DATA	
	a. Capacity	m ³ /hr : Bidder to Provide
	b. Head	M : Bidder to Provide
	c. Pump efficiency	% : Bidder to Provide
	d. BkW Normal / Maximum	KW : Bidder to Provide
	e. Motor rating	KW : Bidder to Provide
	f. Motor Speed	Rpm : Bidder to Provide
	g. Differential pressure (inclusive of losses)	Kg/cm ² : Bidder to Provide
	h. Speed Maximum/ Normal/Minimum	rpm : Bidder to Provide
	i. Noise level	dB(A) : Bidder to Provide
	j. Performance curve	: Bidder to Provide
4.0	CONSTRUCTION DATA	
	a. Manufacturer	: Bidder to Provide
	b. Model No.	: Bidder to Provide
	c. Suction Rating / Size	: Bidder to Provide
	d. Discharge Rating / Size	: Bidder to Provide
	e. Type of rotor	: Bidder to Provide
	f. Size of rotor Dia	mm : Bidder to Provide
	g. Journal bearing: Type / Size:	: Bidder to Provide



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

	h. Thrust bearing: Type / Size:	:	Bidder to Provide
	i. Bearing cooling required	:	Yes / No - Bidder to confirm
	j. Cooling water required	:	Bidder to confirm the quantity
	k. Type of drive	:	Direct Drive
	l. Shaft seal	:	Mechanical
	m. Size / Code	:	Bidder to Provide
	n. Type of coupling	:	Bidder to Provide
	o. Service factor	:	Bidder to Provide
	p. GD ² at drive shaft end	:	Bidder to Provide
	q. Rotation viewed from coupling end	:	Clock wise / Counter clock wise
	r. Coupling type	:	Yes / No - Bidder to confirm
	s. Coupling make	:	Bidder to Provide
	t. Base plate common to pump, bearing housing, coupling	:	Yes / No - Bidder to confirm
	u. Total weight kg	:	Bidder to Provide
	v. Maximum Erection weight kg	:	Bidder to Provide
5.0	MATERIALS		
	a. Casing	:	Bidder to Provide
	b. Impeller	:	Bidder to Provide
	c. Shaft	:	Bidder to Provide
	d. Shaft Seal	:	Bidder to Provide
	e. Base frame	:	Bidder to Provide
6.0	INSPECTION AND TESTING		
	a. Material Test certificates required for : Casing, Impeller, shaft, shaft sleeve	:	[R] [O]
	b. DPT & MPI Test for impeller, if applicable	:	[R] [O]
	c. Ultrasonic & Liquid penetrant test for shaft	:	[R] [O]
	d. Dimensional & visual inspection	:	[R] [W]
	e. Mechanical running test for 4 hrs.	:	[R] [W]
	f. Vibration test at rated speed	:	[R] [W]
	g. Performance test	:	[R] [W]
	h. Balancing test of Rotor Assembly	:	[R] [O]
	i. Noise level test	:	[R] [W]
	j. NPSH Test	:	[R] [W]
	k. Hydrostatic Test	:	[R] [W]
	[R]: Required, [W]: Witnessed by BHEL/ NTPC representative, [O]: Observed		

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)

DADRI:FGD:SLP:R01

ANNEXURE III- SCHEDULE OF GUARANTEES (to be repeated and filled by bidder for each type of pump)

Sl. No	Description	Data
1.	Pump name	: Bidder to provide
2.	Rated capacity of pump m ³ /hr	: Bidder to provide
3.	Total head at rated capacity MLC	: Bidder to provide
4.	Guaranteed power consumption at motor input terminal per pump at rated capacity & head kW	: Bidder to provide
5.	Noise level at a distance of 1.0 meter horizontally from the equipment at site and 1.5 m above operating floor dB(A)	: Bidder to provide
6.	Maximum vibration (peak to peak amplitude at site) microns	: Bidder to provide
7.	Equipment Availability (%) Equipment availability for 120 days % Equipment availability for 1 year %	: Bidder to provide : Bidder to provide
8.	Pump Efficiency %	: Bidder to provide
9.	Guaranteed life of all pump wear parts including casing liners, bearing, etc. Hours	: Bidder to provide

SIGNATURE OF BIDDER

NAME

DESIGNATION

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	

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

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)

DADRI:FGD:SLP:R01

ANNEXURE -V

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

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

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
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B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	No of copies After award of contract	Delivery Time
1.	Utility Consumption	1	2 weeks after contract
2.	Foundation Data including Anchor plan	1	2 weeks after contract
3.	Performance curve	2	2 weeks after contract
4.	Assembly drawings of each equipment	1	1 month after contract
5.	Cross section detail drawing	1	1 month after contract
6.	Data Sheet	1	2 weeks after contract
7.	Annexure to qualification requirement- Annexure 3K.	1	2 weeks after contract
8.	Lubricating oil list	1	2 months after contract
9.	Special tools list	1	2 months after contract
10.	Installation and assembly procedure	1	4 months after contract
11.	Inspection and Test Procedure	1	1 month after contract
12.	Inspection & Test record	1	In 2 weeks after test
13.	Inspection Certificate	1	In 2 weeks after test
14.	Sub vendors List	1	2 weeks after contract
15.	Manufacturing Schedule	1	2 weeks after contract
16.	Progress report	1	Every month
17.	Proforma Packing List	1	2 months prior to shipping
18.	Approximate weight of each skid	1	2 months after contract
19.	Required Electric power	2	2 weeks after contract
20.	Pump and Motor Sizing Calculation	1	2 weeks after contract
21.	Material Test Certificates	2	In 2 weeks after test
22.	Pre Commissioning Check List	2	4 months after contract
23.	Scope of Supply	2	2 weeks after contract
24.	Quality Plan	4	1 month after contract

		TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)	
DADRI:FGD:SLP:R01			
Sl. No.	Description	No of copies After award of contract	Delivery Time
25.	Operation and Maintenance Manual	• 10 hardcopies and 5 electronic copies in English • 1 hardcopy and 1 electronic copy in "Bangla"	4 months after contract
26.	Spare List (Mandatory, Recommended)	1	1 month after contract
27.	Start-up & Commissioning Spares	2	1 month after contract
28.	List of Special Tools	1	1 month after contract
29.	Delivery Schedule	1	2 weeks after contract
30.	Test Arrangement & Test procedure	2	1 month after contract
31.	T-S curve	2	2 weeks after contract
32.	P & I Diagram	2	2 weeks after contract
33.	Catalogue	2	2 weeks after contract

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



**TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)**

DADRI:FGD:SLP:R01

ANNEXURE-VI

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING

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

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	

ANNEXURE-VII

INSPECTION & TESTING

Refer to all clauses for Inspection & testing requirements.

SIGNATURE OF BIDDER

NAME

DESIGNATION

	TECHNICAL SPECIFICATION OF SLURRY PUMPS NTPC-Dadri (2X490 MW)
DADRI:FGD:SLP:R01	

ANNEXURE-VIII

HEALTH & SAFETY MANAGEMENT MANUAL

Refer to all clauses for Health & Safety requirements.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____



TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)

DADRI:FGD:SLP:R01

ANNEXURE – I(a) - LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED:

The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip.
5. Temperature rise test.
6. Momentary excess torque test.
7. High voltage test.
8. Test for vibration severity of motor.
9. Test for noise levels of motor:
 - Noise level for all the motors shall be limited to 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
10. Test for degree of protection
11. Over speed test.
12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1
 - 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.
 - The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.



PART –II

O&M Spares and O&M Services For 10 years



TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)

DADRI:FGD:SLP:R01

23	O & M Services for 10 Years Operation – Annual Maintenance Contract (AMC).										
	O & M Services of Slurry Pumps & its accessories to be taken up by Bidder at DADRI Site. The O & M services will be for a period of 10 years. SCOPE OF O & M Services: A) Annual Maintenance Contract (AMC): 1. The Bidder to carry out maintenance of slurry pumps & accessories supplied for a period of 10 years. The contract shall cover both preventive maintenance & Minor / Major Overhauls. 2. All services call shall be attended at the earliest. 3. All spare parts required for the upkeep of the equipment's (Slurry Pumps & it's accessories) to be stocked in advance or arranged within 2 - 3 days' time to ensure trouble free operation & to meet the 95 % availability as per specification. 4. The Bidder has to take necessary approval from site In-charge for carrying out necessary maintenance operation. 5. The bidder shall provide qualified technicians for carrying out the AMC at site. Necessary site support will be provided by BHEL. TA/DA, boarding and lodging of such technicians attending to AMC requirements shall be borne by the bidder and shall be included in AMC scope. B) O & M Spares: 1. All spares required for the upkeep of the equipments for 10 years operation is in the scope of the bidder. 2. The bidder will submit a separate list of spares required for AMC from a) 3- 4 years operation. b) 5-7 years operation. c) 8- 10 years operation Note: 0 -2 years covered in warranty clause. 3. The following is the minimum spare parts along with their break up price to be stocked by the bidder, if applicable.<table><tr><td>a) Impeller Assembly</td><td>4 no. of each type</td></tr><tr><td>b) Casing Liners</td><td>1 no. of each type</td></tr><tr><td>c) Seals</td><td>4 no of each type</td></tr><tr><td>d) Bearings</td><td>1 no. of each type</td></tr><tr><td>e) Motor</td><td>1 no. of each type</td></tr></table>	a) Impeller Assembly	4 no. of each type	b) Casing Liners	1 no. of each type	c) Seals	4 no of each type	d) Bearings	1 no. of each type	e) Motor	1 no. of each type
a) Impeller Assembly	4 no. of each type										
b) Casing Liners	1 no. of each type										
c) Seals	4 no of each type										
d) Bearings	1 no. of each type										
e) Motor	1 no. of each type										



TECHNICAL SPECIFICATION OF SLURRY PUMPS
NTPC-Dadri (2X490 MW)

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- f) Motor-Pump Coupling 1 no. of each type

C) GENERAL

1. The AMC (A) & O & M Spares (B) are part of the scope for 10 years up keep of the equipments.
2. Maintenance charges – AMC (A) & O&M Spares (B) together will be paid yearly on a pro-rata basis for 10 years.
3. The AMC (A) & O&M Spares (B) rate to be quoted separately with the main offer.
4. The Price offer for supply of Slurry Pumps & 10 years AMC (A) & O&M Spares (B) of Slurry Pumps & its accessories will be considered for Evaluation.

All spares to be used during AMC under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements.