	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Water Systems Group- WEG & WS Boiler Auxiliary Plant (BAP), Ranipet

TECHNICAL SPECIFICATION FOR SLURRY PUMPS

SPECIFICATION NUMBER : ROS: 9081
BUYER (EPC) : BHEL, BAP Ranipet
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM

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1.0 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 for the Flue Gas Desulphurization plant. For project specific technical parameters, refer to **Annexure-A**. The following points may be noted:

a. Bidder shall assume full responsibility for the entire equipment assembly and shall comply to the requirements of this specification and referred specifications/attachments to enquiry/order.

b. 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- II**)".

c. Any deviation, not listed in Annexure - II, though reflected in any other part of the offer, shall not be considered.

d. BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – II. Only written approval by BHEL is valid means of acceptance of deviation / exception.

e. 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.

f. 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.

g. 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.

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 confirm 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
- ANSI HI 12.1 to 12.6 & ISO 9906 2012 grade 2B standard (Pump Testing)

3.0 PROVENNESS CRITERIA: IF APPLICABLE

Bidders shall meet the Qualification Requirement (QR) for Slurry Pumps as per **Annexure-B and submit the Annexure to qualification requirement (Attachment-3K).** Necessary documentary evidences shall be submitted along with the bid. **Offers of Bidders not meeting Qualification Criteria shall not be considered for evaluation.**

4.0 MATERIAL OF CONSTRUCTION

	Material of construction	Horizontal Centrifugal Pumps	Vertical Sump Pumps
i.	Casing	1. Ductile Iron (65-45-12, ASTM A536) with replaceable rubber liner- 14000hrs to be guaranteed. **OR** 2. Ductile Iron with Hi Chrome liner - 14000hrs to be guaranteed. **OR** 3. In case of Hi chrome casing pump the Guaranteed wear life of casing shall not be less than 24000 hrs.	1. Ductile Iron (65-45-12, ASTM A536) with replaceable rubber liner- 14000hrs to be guaranteed. **OR** 2. Ductile Iron with Hi Chrome liner - 14000hrs to be guaranteed. **OR** 3. In case of Hi chrome casing pump the Guaranteed wear life of casing shall not be less than 24000 hrs.
ii.	Impeller	Hi Chrome or superior material with 14000 hrs guarantee.	Hi Chrome or Natural Rubber+ High chrome or superior material with 14000 hrs. Guarantee.
iii.	Solid Shaft	Duplex SS 2205 /EN8D /EN9 or any other superior material suitable for slurry application.	Duplex SS 2205 / EN8+Rubber Lined or any other superior material suitable for slurry application.
iv.	Shaft sleeve at mechanical seal (If Applicable)	CD4MCU ASTM A 743/ Duplex 2205	CD4MCU ASTM A 743/ Duplex 2205
v.	Base Plate	Carbon steel with Epoxy Coating	Carbon steel with Epoxy Coating

Note: The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement.
The time period for warranty/ guarantee of the wear life /service life will be considered whichever is later for the above MOC details.

5.0 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 CUSTOMER.

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 or Pulley & V-belt (As applicable)
	v. Common base frame for pump & motor and shock pads

Sl. No	Scope	
	vi.	Single/ Double Mechanical seal as applicable with applicable Quenching/ Flushing plan
	vii.	Flushing/Quenching and drain system Provision to be provided in mechanical seal in case of with Flushing/Quenching mechanical seal along with applicable API Plans. Water flow and pressure requirement to be duly mentioned while bid submission.
	viii.	Coupling guards with bolts or V-belt guard (As applicable)
	ix.	Discharge pressure guage(to be supplied as loose)
	x.	Temporary Strainers required for commissioning
	xi.	Expansion joints (Bellows) at suction and Discharge
	xii.	Casing drain terminated at battery limit with flange(if applicable)
	xiii.	Cooling water piping for Bearing cooling(as applicable)
	xiv.	Lubrication system (as applicable)
	xv.	Foundation bolts for supplied items
	xvi.	Pedestal for Pump(as applicable)
	xvii.	Drip tray for drainage collection from pump (if applicable). However bidder to provide the same in case end customer requests for the same.
	xviii.	Lantern Ring (if applicable)
	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.	Accessory (Internal) Piping within the skid(if applicable)
	xxiv.	First fill of consumables like lubricants, etc.,
	xxv.	Start-up & Commissioning & Mandatory spares.
	xxvi.	Seaworthy Packing & Forwarding (for import supplies) to Project Site office
	xxvii.	Installation, operation and maintenance manuals
	xxviii.	In case of series pumps, common individual base frame to be provided by vendor with interconnecting piping (MOC: MSRL/ any other material suitable for handling slurry application), interconnecting expansion joints, interconnecting fasteners.
	xxix.	Any other items required for completeness of the equipment except the items covered in the exclusions.

6.0	**DESIGN & CONSTRUCTION**
6.1	**DESIGN REQUIREMENTS**
1.	The pump shall be **single stage centrifugal type** capable of delivering the rated flow at rated head with margins as specified below.
2.	All slurry pumps for a particular service shall be identical and interchangeable. The composition of Limestone slurry is provided in the Annexure for reference. Bidder shall consider the Slurry pumps accordingly with reference to construction and speed as follows. Tip speed of impeller :(a) for rubber lined pumps should not exceed 25m/sec, (b) for other pumps should not exceed 30m/sec- vendor to furnish the same in its offer. However, if the discharge head exceeds 6.0 bar bidder may consider higher tip speed subject with BHEL approval. The slurry velocity shall be in the range of 1.2 m/s to 2.3 m/s to prevent bed of solids in the

	pipe. Notwithstanding the above parameters, it shall be the bidders endeavor and responsibility to ensure that there shall be no settling of solids in the pipelines. Necessary calculations shall be submitted to BHEL for review.
3.	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.
4.	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(FAG/SKF/TIMKEN/ or equivalent subjected to BHEL approval)
5.	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. Bidder to confirm the pump operating range from 40% to 110% with respect to BEP of the quoted pump. Bidder to quote higher efficiency pumps based on the rated duty condition mentioned in the specifications.
6.	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. Bidder can propose the pump with lower shut off condition also based on their past experience in similar project which will be subjected to BHEL approval.
7.	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.
8.	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation. Pump RPM shall be designed with respect to allowable pump tip speed and selected material of construction for pump impeller in Clause 6.1(2) above. Speed | Antifriction Bearing | Sleeve Bearing 1500 rpm and below | 75.0 micron | 75.0 micron 3000 rpm | 50.0 micron | 65.0 micron
9.	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. Continuous Motor rating (at 50 deg.C ambient) shall be at least ten percent (10%) above the 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.
10.	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).
11.	Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.
12.	The Contractor under this specification shall take full responsibility in the operation of pump and motor as a unit.
13.	The pumps shall be designed as impeller centrifugal pump. The pumps shall be wear-resistant, be equipped with flushing devices/provision to prevent sedimentation and shall be designed and installed in a manner to allow easy replacements, repair and maintenance.
14.	Impellers shall be single piece casting. Fabricated impellers shall not be accepted.

15.	The slurry pumps shall be equipped with oil level indication (if applicable), coupling guard/V-belt guard & other accessories for collecting leakage, made of corrosion resistant material.
16.	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1m to the max NPSH required shall be provided.
17.	All pumps shall be fitted with pressure gauges on discharge end. (To be supplied loose). The technical detail for the Pressure Gauge is specified elsewhere in the BHEL specification.
18.	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. (If Applicable)
19.	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off.
20.	Selection of Duty point should preferably be at BEP (Best Efficiency Point). 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 at normal water level, pump will operate at the right of BEP. Pump's operating zone shall be considered accordingly.
21.	External flushing is required to remove the accumulated particles within the pump & provision for the same should be provided in order to remove the accumulated particles within the pump, all related information shall be mentioned in data sheet. Bidder to supply quenching plan system mounted on the pump base frame as per API plan and water requirement to be defined while submitting the bid.
22.	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency in the event of wear between impeller and casing.
23.	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. Bidder can also quote pumps with V-belt & Pulley arrangement.
24.	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.
25.	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.
26.	The sealing areas shall be designed in such a way so that solids do not precipitate, affect the cooling, or affect adjustment and mechanical functioning of the seals. Seals requiring jet cleaning shall be avoided. Bidder to furnish the water requirement for Plan 62 so that BHEL can arrange the same suitably.
27.	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
28.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 Gr 6.3 (As applicable.).Moreover Bidder to ensure balancing of the impellers after mounting on the shaft as per relevant balancing standards. In case during operation deflection in the shaft or any other operation issues occur, the same needs to be rectified by the bidder without any price implication to BHEL.
6.2	**CONSTRUCTIONAL FEATURES**

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A)	**CASING**
a.	Pumps shall be of Radial Split Casing (if twin casing pump), 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 (As Applicable).
d.	Pump casing to be provided with a connection for discharge pressure gauge as standard feature. (Pressure Gauge shall be supplied loose) 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.	For single casing pumps, bidder to confirm that in case casing wears out by 50% during operation, pump allowable maximum pressure will not reduce. This shall be confirmed strictly for equipment and plant safety. A basis of calculation proving the same shall be submitted for review.
f.	Lifting provision of pump as a whole and individual casing half should be provided.
g.	Renewable wear rings (As applicable) shall be provided at points of running clearance and shall be made from appropriate materials indicated in the referred standards.
B)	**IMPELLER**
a.	Impeller shall be semi-closed, 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. Bidder may also propose threaded connection between impeller and shaft. Bidder shall provide evidence of zero contact between the slurry being processed and the Threaded region.
b.	Tip speed of impeller: Please refer Clause 6.1(2)
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.	Impeller as rotating assembly along with all elements should meet balancing standard of ISO 1940 Gr 6.3
e.	Maximum size impellers for the pump body shall not be quoted. By installation of a new impeller a head increase of 5% minimum shall be possible. Maximum size impeller to be quoted or as appropriate technically by the bidder. In case there is variation required in the system then same can be done thru by changing the pump RPM with change in pulley ratio.
C)	**IMPELLER/CASING WEARING RINGS**
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 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.	No parts of the shaft should come in contact with the liquid medium for horizontal centrifugal pump.
i.	Shaft should have a keyed joint at impeller hub or thread connection between impeller and shaft is acceptable however in no circumstances Slurry shall come in contact with the threaded part.
E)	**SHAFT SLEEVES**
a.	Replaceable 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. 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.	Bearing housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.
d.	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
e.	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.

f.	Make of Bearings : SKF, FAG & TIMKEN or any other reputed make subjected to BHEL approval.
G)	**MECHANICAL SEALS**
a.	Mechanical seals shall be of single/double 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. Bidder to supply quenching plan system mounted on the pump base frame as per API plan and water requirement to be defined while submitting the bid.
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.
g.	Requirement of flushing/quenching water, its quantity, and pressure to be indicated in data sheet.
h.	Slurry Pumps should have Zero leakage. 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.	Seal life shall be guaranteed for 14000 hrs. In the event seals fail before guarantee period, the bidder shall replace the same without any cost implication. Make of Mechanical Seals: Eagle Burgmann/ Flowserve/ John crane / any other make subjected to BHEL approval.
k.	All the mechanical seal shall have a lubrication arrangement i.e. Quenching (Plan 62) only. Bidder shall guarantee the seal life with quenching itself.
l.	For Quenching integrated piping along with their respective instruments, fittings will be in the scope of the bidder. The Quenching plans should meet the respective API Standards. Bidder to provide the quantity of water requirement for such arrangement so that BHEL can arrange the same suitably.
m.	BHEL will provide maximum pressure of 1 bar for Quenching requirement.
n.	Bidder may kindly note the ports for Quenching & Flushing (if available) should be separate & same should be tightly sealed in case of non-usage.
H)	**COUPLING (if applicable)**
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. The HT motors are in BHEL's scope. However, bidder should design the base frame in order to accommodate both the HT motor & pump on the same base frame. (HT motor overall dimensions & weight will be provided by BHEL after placement of PO).
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.
d.	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, "Taper wedge (if applicable)" 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**
a.	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**
a.	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.
b.	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.
c.	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.
d.	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.
e.	Typical GA Drawing for the vertical pump sumps is attached (Annexure J). The bidder to design the pumps accordingly meeting the minimum & maximum water levels as provided.

M)	ACCESSORIES:
1.	**Suction Strainers**
i.	Temporary conical strainer to be provided so as to avoid entry of any particle into the pump at the time of commissioning/starting up. **Note:** Pipe sizes / Flange sizes will be informed during detail engineering with respect to strainer size & its mounting holes.
ii.	Quantity of Temporary Conical Strainers : 1 no. at the suction of each horizontal pump. For the vertical pumps the same is not required.
iii.	MOC & Size of the temporary conical strainers: As per the attached sizing sheet (Annexure K)

6.3 Motor

Please refer to the motor specification attached TECI: LT MOTOR: REV 05(**Annexure-F**). The motor make is subject to end customer approval. The motor painting schedule is subject to customer approval.

Note: 1) All **HT Motors are in BHEL Scope.**

2) HT Motor Range: Above 200kW.

3) For HT motor pumps, provision for Vibration sensor and Key Phase Marker Sensor should be provided.

a) Vibration Sensor: 4 provisions on the pump. Thread size of M6x1 (M6x1 threaded provision 12mm deep) for each vibration sensor.
b) Key Phase Marker Sensor: 1 Provision. Notch (of size 30mmL x 15mmW x 3mmD) for phase marker probes are to be provided.

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^2G. For instance the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, 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 dBA 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 /HIS 9.6.4.11 for casing vibrations.
7.	Suitable drain connections shall be provided (as applicable).
8.	The equipment shall be suitable for stable operation continuously.

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S. No.	Description
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.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.
11.	Flanges shall be in accordance with ANSI B16.5 Class 150, However if Vendor Proposes any other drilling standard, prior approval from BHEL to be taken & Vendor to provide one no. extra pipe fittings such as expansion bellow, concentric reducer/expander etc. for each pump with fasteners suitable for handling slurry application shall be provided by the bidder.
12.	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.
13.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
14.	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.
15.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
16.	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.
17.	Provide double nuts for Foundation bolts.
18.	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
19.	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.
20.	Bidder shall provide the mating flanges with the necessary gaskets. Gasket Material shall be of EPDM/Neoprene Rubber or any other material suited for slurry application.
21.	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.
22.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
23.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
24.	Quality Plan to be submitted along with the offer.
25.	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.

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26.	All the fasteners which are in contact with slurry should be of High chrome/ Duplex material only. All other fastener shall be as per manufacturer's standard practice and proven experience. Bidder should ensure that the fasteners should not get corroded/damaged in case of spillage of slurry or due to any environmental condition. In case of corrosion or damaged the same needs to be replaced by the bidder without any cost implication to BHEL.
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 specification no. **PE-TS-888-100-A001 (Annexure-H)** .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 (CUSTOMER).
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 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 with project details as per enquiry.

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	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 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.

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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. **Note:** Vendor to Provide photos of Packing boxes along with Packing box dimensions before dispatch.
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 visits 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.	Total number of visits shall be 6 and number of days per visit shall be 5 working days. Total number of working days= 6 x 5 = 30 days. Travel duration shall be additional.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.
4.	Per day Charges for supervision shall be quoted by the bidder.
5.	Price comparison for evaluating the lowest bid will be considered all main supply, supervision of E&C charges and mandatory spares price all together.
10.0	**EXCLUSIONS**
	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**
A)	Minimum Testing requirements to be considered are as below: The typical quality plan is enclosed with this specification(**ANNEXURE-G**).
1.	Bidder shall submit the quality plan during the Post ordering stage subject to BHEL / end customer approval.
2.	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.
3.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
4.	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.
5.	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.

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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 / CUSTOMER prior to manufacture. Inspection of above mentioned tests by BHEL/ CUSTOMER 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/CUSTOMER.
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 evidencing that the rotating assembly has been balanced dynamically shall be sent to CUSTOMER/ 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 – As per enclosed document Annexure-E**
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.
13.2	**MANDATORY SPARES**
	The mandatory spares list is provided in the enclosed **Annexure-D.** The Mandatory spares price will be considered for bid evaluation.

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	Mandatory spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of main equipment's. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan. Supply of spares shall be subjected to the approval of BHEL
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. Bidder to submit the PG test procedure for approval & Conductance of PG test shall be subjected to the final approval of end customer. 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) Noise level ≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 4) 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. 5) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ CUSTOMER approval. 6) 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 the offer.
2.	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:** **Refer Annexure C**
16.0	**LIQUIDATED DAMAGES FOR POWER CONSUMPTION**
	Refer Annexure C

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S. No.	Description
17.0	**WARRANTY**
1.	Warrantee Shall be 24 months from the date of taking over by customer site / Operational acceptance or 36 months from the date of last supply of equipment whichever is earlier. Please note that overall warranty on Goods whether repaired / replaced in total shall not exceed 24 months from the date of such repair / replacement or 36 months from the date of last supply of equipment whichever is earlier. However, the warranty. Period shall not be extended beyond 24 months from the date when the Goods are first placed in commercial operation / Operational acceptance or 36 months from the date of last supply of main equipment whichever is earlier. Warrantee Shall be 24 months from the date of taking over by customer site / Operational acceptance or 36 months from the date of last supply of equipment whichever is earlier. Please note that overall warranty on Goods whether repaired / replaced in total shall not exceed 24 months from the date of such repair / replacement or 36 months from the date of last supply of equipment(including mandatory spares) whichever is earlier
2.	In case of failure of the equipment to meet the guarantee, CUSTOMER/BHEL reserves the right to reject the equipment. However, CUSTOMER/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 CUSTOMER/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 CUSTOMER/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Slurry pumps - Operation & Maintenance, Troubleshooting etc. (for minimum 2 days).
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 CUSTOMER in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.

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S. No.	Description
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. The documents mentioned as **to be submitted along with the offer** 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 all documents, mentioned **as to be submitted after award of contract,** for review, approval. Drawings that are reviewed by the CUSTOMER/ 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. CUSTOMER/ 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 components and necessary set of operation & maintenance manual as asked by CUSTOMER 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 CUSTOMER 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.

I. DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	Require For Part	Purpose
1.	**Annexure to qualification requirements : Attachment -3K**	I	Qualification Requirement (QR)
2.	Reference plant details of similar or higher capacity Slurry Pumps supplied (**ANNEXURE-I**)	I	QR
3.	Seal & Sign of bidder on all pages of specification	I	Technical Evaluation of Bid(TEB)
4.	Deviation List (if any)	I	TEB
5.	Slurry Pump & Motor Sizing Calculation	I	TEB
6.	GA drawing all offered pumps with foundation details	I	TEB
7.	Filled Data Sheets of Slurry Pumps & All accessories	I	TEB

8.	Performance curves i. Flow v/s Head ii. Flow v/s NPSH iii. Flow v/s Efficiency iv. Flow v/s Power Consumption v. Torque v/s Speed curve for motor selection	I	TEB
9.	Required Electric power & other Utility List	I	TEB
10.	Make of all bought out items & sub vendor list	I	TEB
11.	Quality Plan	I	TEB
12.	List of Start-up & Commissioning Spares	I	TEB
13.	List of Special Tools	I	TEB
14.	Delivery Schedule	I	TEB
15.	Catalogue	I	TEB

II. DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	Handing over of Documents after Contract (in weeks)	Purpose
1.	Utility Consumption & Lubricating Oil List	2	Customer Approval
2.	Foundation Drawing, Foundation Bolts, static & dynamic details	2	Customer Approval
3.	GA drawing including cross sectional view of Slurry Pumps & Accessories with bill of material (in PDF & AutoCAD format)	2	Customer Approval
4.	GA drawings for Pumps in series arrangement with interconnecting piping & expansion joints drawings	2	Customer Approval
5.	P&ID drawing of Slurry Pumps & Lube Oil System in PDF & AUTOCAD format	3	Customer Approval
6.	GA drawings of mechanical seal and coupling for offered slurry pumps	3	Customer Approval
7.	Filled Data Sheets of Slurry Pumps & All accessories	3	Customer Approval
8.	Quality Plan with Inspection & Performance Test Procedure at site	3	Customer Approval
9.	Pump & Motor Sizing Calculation	4	Customer Approval
10.	Performance curves i. Flow v/s Total Pressure ii. Flow v/s Efficiency iii. Flow v/s Power consumption iv. Torque v/s Speed curve for motor selection	4	Customer Approval
11.	Motor Rating in KW	4	Customer Approval
12.	Sub vendors List	4	Customer Approval
13.	Manufacturing Schedule	4	Customer Approval
14.	Approximate weight of each skid	5	To arrange lifting

Sl. No.	Description	Handing over of Documents after Contract (in weeks)	Purpose
15.	List of Special Tools	8	E&C
16.	List of Start-up & Commissioning Spares	9	E&C
17.	Required Electric power	10	E&C
18.	Pre- Commissioning Check List	10	E&C
19.	Installation & assembly procedure	10	E&C
20.	Erection & Commissioning Schedule	10	E&C
21.	Recommended Repair Procedure	10	E&C
22.	Operation and Maintenance Manual (10 hardcopies and 5 electronic copies in English)	10	E&C
23.	Electrical Load List with Single Line Diagram	10	BHEL Review
24.	Control Logic of Slurry Pumps	10	BHEL Review
25.	Catalogue	10	BHEL Review
26.	Proforma Packing List	12	Dispatch

22.0 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. Motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads (If applicable), if not Bidder to ensure & Vibration shall be within the limit prescribed in IS/IEC 60034-14 & HIS Standard. If Vibration limits exceeds Bidder to provide required support to rectify the issue with no cost implication to BHEL.
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 CUSTOMER, 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.

ANNEXURE I : REFERENCE LIST FOR SLURRY PUMPS

Sl. No.	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD Yes/No	Type of Slurry Pump	Model	Capacity	Head in meter of slurry column	Speed	Year of Commissioning	Qty
						m^3/hr.	meter	rpm		

ANNEXURE II : LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT

Enquiry No :_____; Project :_____

Sl No	Clause No	Page No	Description of Deviation

PROJECT:NTPL TUTICORIN 2x500 MW										ANNEXURE: G515:A	
SLURRY PUMP DATA SHEET											
S.NO	Description	LIMESTONE SLURRY FEED PUMP	GYPSUM BLEED PUMP	PRIMARY HYDROCYCLONE FEED TANK PUMP	FILTRATE WATER TANK PUMP	SECONDARY HYDROCYCLONE FEED TANK PUMP	AUXILIARY ABSORBENT TANK PUMP	EMERGENCY TRANSFER PUMP	ABSORBER AREA DRAIN SUMP PUMP	GYPSUM AREA DRAIN SUMP PUMP	LIMESTONE AREA DRAIN SUMP PUMP
1	Pump sl.no	1	2	3	4	5	6	7	8	9	10
2	Pump location	out door	out door	out door	out door	out door	out door	out door	out door	out door	out door
3	Mounting orientation (H/V) (Horizontal/vertical)	H	H	H	H	H	H	H	V	V	V
4	Specific gravity of slurry	1.215	1.216	1.216	1.071	1.113	1.216	1.216	1.216	1.213	1.215
5	Viscosity at pump	0.03Pa.S	0.01Pa.S	0.01Pa.S	0.003Pa.S	0.0037Pa.S	0.01-0.03Pa.S	0.01Pa.S	0.01Pa.S	0.01Pa.S	0.03Pa.S
6	Slurry concentration	30 wt%	30 wt%	30 wt%	10.73 wt%	16.6 wt%	30 wt%	30 wt%	30 wt%	30 wt%	30 wt%
7	Max 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)	150 mesh (140 micron)	6-7mm	6-7mm	6-7mm
8	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)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)
9	Hardness of particle	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)	5-7(Mohs scale)
10	Chloride concentration	1000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	25000 ppm (max)	1000 ppm (max)
11	Slurry to be handled	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry
12	SiO2 concentration	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l	10 g/l
13	ph	5-8	4-8	4-8	4-8	4-8	4-8	4-8	4-8	4-8	5-8
14	Minimum & Maximum liquid level in the tank(in m)	1-8.3	1.2-6.0	1-5.3	1-4.0	1-9.3	1-11.3	1.0-6.0	1.4-3.5 (Sump height As per GA)	1.4-3.5 (Sump height As per GA)	1.4-3.5 (Sump height As per GA)
15	Operating temperature range	10-45 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-70 deg C	10-45 deg C
16	Capacity of pump (in m3/hr)	45	95	190	165	110	97	532	145	75	75
17	Head of the pump (in meter of slurry column)	50	30	55	35	50	25	25	25	25	25
18	Number of pump	4 nos.	4 nos.	2 nos.	2 nos.	2 nos.	2 nos.	2 nos.	4 nos.	2 nos.	2 nos.
19	Working and standby	(1W + 1 S)*2	(1W + 1 S)*2	(1W + 1 S)	(1W + 1 S)	(1W + 1 S)	(1W + 1 S)	(1W)*2	(1W + 1 S)*2	(1W + 1 S)	(1W + 1 S)
20	Discharge orientation	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up	Vertical up
21	Duty condition(continuous/intermittent)	Cont	Cont	Cont	Cont	Cont	inter	inter	Cont	Cont	Cont
22	Power loading for bid evaluation	Applicable	Applicable	Applicable	Applicable	Applicable	NA	NA	NA	NA	NA
23	Pump Efficiency	Minimum 70 %	Minimum 75 %	Minimum 75 %	Minimum 70 %	Minimum 70 %	Minimum 75 %	Minimum 75 %	Minimum 60 %	Minimum 45 %	Minimum 45 %
24	Flange standard	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150	B16.5 class 150
25	Mechanical seal required (Duplex & SiC/SiC)-vendor also to confirm Quenching wherever called	With Quenching	With Quenching	With Quenching	With Quenching	With Quenching	With Quenching	With Quenching	NA	NA	NA
26	Power consumption (Ceiling Value) KW per Pump	11.6	13.4	24.4	12.8	12.7	12.4	61.2	6.6	4.6	5.1

27	Pump model offered to be mentioned by vendor										
28	Inlet and outlet dia of pump- vendor to furnish										
29	Impeller diameter - vendor to furnish										
30	Impeller RPM - vendor to furnish										
31	Tip speed of impeller (a) for rubber lined pumps should not exceed 25m/sec, (b) for other pumps should not exceed 30m/sec- vendor to furnish										
32	GD^2 at Drive end Shaft to be Provided.										
33	Bearing cooling air /oil/water - if any required vendor to specify										
34	Pump efficiency Vendor to specify (subject to BHEL's approval)										
35	The operating range of the pump shall be 40% to 120% of the duty point - vendor to confirm										
36	The maximum efficiency of pump shall preferably be within ± 10% of the duty point flow										
37	Shut-off head to be furnished.										
38	Common base plate to be provided by vendor A29/A36 /A283/IS2062 or equivalent international standard										
39	Vibration pad required (between base plate and pump & motor) vendor to provide & confirm										
40	Any other slurry wetted parts shall be made of Duplex 2205										
41	Name plate shall be in SS 304 - vendor to confirm										

42	Rotation arrow to be cast in the body or arrow plate with SS304 to be fixed on the pump - vendor to confirm										
43	Direct Drive flexible coupling with high tensile bolts is to be provided by vendor. Coupling make and model Number Coupling drawing with BOM to be provided after purchase order. In case of Belt drive, vendor to provide Pulley drawing & Belt size. Vendor to confirm										
44	Coupling guards with mounting fasteners with spring washerto be provided . Incase of Belt Drive Belt guard to be provided with all its fittings. Vendor to Confirm.										
45	Mechanical drawing with complete BOM to be provided after purchase order.										
46	Temporary conical strainer to be provided - vendor to confirm										
47	Mechanical seal with applicable API Plan : vendor to confirm										
48	Quenching water Quantity , quality & pressure shall be informed by the vendor										
49	pump shaft power (BKW) for each pump to be provided										
50	Motor efficiency class (minimum IE3)										
51	Guaranteed power consumption in KW (Backup calculation for power consumption to be provided)										
52	Motor rating to be furnished for all motor along with backup calculation										
53	First fill oil /grease other consumable to be sent along with pump and grade to be mentioned of the same- vendor to confirm										

POWER LOADING & LIQUIDATED DAMAGES FOR NTPL TUTICORIN (2 X 500 MW)

ANNEXURE: G515:C

BID EVALUATION CRITERIA FOR POWER CONSUMPTION

Power loading shall be applicable for slurry pumps designated as “continuous duty condition” in enclosed pump datasheet.

In case, Guaranteed Shaft power offered by the bidder exceeds the base value specified, his bid price will be loaded for excess power consumption as per the formula given below.

Adjustment factor for excess power consumption in INR = (GPC-BV) X PL X No’s of Working pumps

GPC- Guaranteed Power Consumption quoted by bidder in KW

BV- Base Value. (Auxiliary Power Consumption at motor Input, refer **Annexure-A Slno-26**)

PL- Power Loading

LIQUIDATED DAMAGES FOR POWER CONSUMPTION

1. 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) X P X No’s of Working pumps

Where

- GPC- Guaranteed Power Consumption quoted by bidder in KW
- APC- Actual Power Consumption in KW
- P- Penalty

Note:

1. LD will be levied after conducting performance test as above subjected to the maximum 25% of the main equipment value. LD will be adjusted from the pending bills payable to the bidder.

2. For conducting PG test at project site for demonstrating the guaranteed parameters of pump, vendor has to make own arrangement for TA/DA and hotel charges, which is to be considered while submitting the offer.

SL NO	DESCRIPTION / PROJECTS	POWER LOADING (PL) for Clause 15 of ROS:9081 Rev:00	LIQUIDATED DAMAGES (LD) (P) for Clause 16.0 of ROS:9081 Rev:00
1	NTPL TUTICORIN (2 X 500MW)	INR 4,06,500/- (Indian rupees Four Lakh Six Thousand Five Hundred only) for every KW differential in the power consumption from the lowest value.	INR 4,06,500/- (Indian rupees Four Lakh Six Thousand Five Hundred only) for every KW increase in Auxiliary power consumption from the Guaranteed value.

Note: In case, guaranteed power input at motor terminal offered by the bidder exceeds the base value specified in the data sheet, his bid price will be loaded for excess power consumption.

For lower values no loading will be considered.

MANDATORY SPARES FOR SLURRY PUMPS TO BE SUBMITTED ALONG WITH TECHNICAL OFFER.

ANNEXURE : G515:D

(SLURRY PUMPS FOR NTPL TUTICORIN (2 X 500MW) : G515/G516)

Mandatory Spares

Note (applicable for all the following FGD projects) : Bidder to clearly mention the model number for each of the spares. Bidder to optimize the number of mandatory spares for the below project. If the model number of two or more mandatory spares is same only ONE SET should be considerd for the same (unles otherwise specified by bidder to be considered). ONE SET should contain the requried number of spares as mentioned below. For pricing also same methadology should be opted.
Bidder to clearly mention C: Considered , R: Repetitive or NA : Not Applicable in the respective coloumns for each mandatory spare.

Main Supply							Supervision		(1) Impeller - 4 nos. of each type & size.		(2) Casings - 2 nos of each type & size.		(3) Shaft - 2 nos of Each type & size.		(4) Shaft Sleeves - 2 sets of each type & size.		(5) Seals - 2set of each type and size		(6) Pump & Motor Bearings -2 Sets. of each type & size.		(7) Gear Box-1no. of each type & size		(8) Motor-Pump Coupling/ V Belt & Pulley which ever is applicable. : 1 No. of each type & size.		9) Impeller/Casing Liners (if replaceable liners applicable)- 2sets	
Sl. No.	Description	Head of each pump (in meter of slurry column)	Capacity of each pump (in m3/hr)	Total Number of pump	Model Selected (to be filled by vendor)	Bidder to furnish : QUOTED/NOT QUOTED	Total Visits	Total Supervision Charges	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable	Model	C :Considered R : Repetitive NA : Not Applicable
1	LIMESTONE SLURRY FEED PUMP	**50**	**45**	(1W + 1 S)*2			Bidder to consider 6 visits each of 5 Working Days.																			
2	GYPSUM BLEED PUMP	**30**	**95**	(1W + 1 S)*2																						
3	PRIMARY HYDROCYCLONE FEED TANK PUMP	**55**	**190**	(1W + 1 S)																						
4	FILTRATE WATER TANK PUMP	**35**	**165**	(1W + 1 S)																						
5	SECONDARY HYDROCYCLONE FEED TANK PUMP	**50**	**110**	(1W + 1 S)																						
6	AUXILIARY ABSORBENT TANK PUMP	**25**	**97**	(1W + 1 S)																						
7	EMERGENCY TRANSFER PUMP	**25**	**532**	(1W)*2																						
									(1) Impeller with Key & Nut - 1no.of each type & size		**(2) Suction Bell with strainer- 1no of each type & size**		**(3) Bowl Assembly -1set of each type & size.**		**(4) Pump shaft -1 set of each type &size**		**(5)Pump & motor bearings - 1 no of each size**		**(6) Oil Seal -1 no of each size.**		**Notes : 1) LT Motors Range : Upto 200kW (Inclusive) 2) HT Motor Range : Above 200kW 3) Wherever only pump is to be supplied, bidder needs to supply Coupling / Belt Pulley arrangement for the pump.**			
									Model	**C :Considered R : Repetitive NA : Not Applicable**	**Model**	**C :Considered R : Repetitive NA : Not Applicable**	**Model**	**C :Considered R : Repetitive NA : Not Applicable**	**Model**	**C :Considered R : Repetitive NA : Not Applicable**	**Model**	**C :Considered R : Repetitive NA : Not Applicable**	**Model**	**C :Considered R : Repetitive NA : Not Applicable**				
8	ABSORBER AREA DRAIN SUMP PUMP	**25**	**145**	(1W + 1 S)*2																						
9	GYPSUM AREA DRAIN SUMP PUMP	**25**	**75**	(1W + 1 S)																						
10	LIMESTONE AREA DRAIN SUMP PUMP	**25**	**75**	(1W + 1 S)																						

Note : Frame Plate Liner, Cover Plate Liner, Volute Liner , Back Plate Liner & throat bush (As Applicable) to be considered as replaceable Casing Liners

ANNEXURE: G515: E

Painting Specification for Slurry Pump:

Surface Preparation : Blast Cleaning to near white metal Sa 2½				
Coating Procedure :				
Sl No.	**Coat**	**Paint**	**No. of Coats / DFT**	**Total DFT μm (min)**
1.	Primer coat	One Coat of two component moisture curing zinc (ethyl) Silicate primer coat (min 80% metallic Zinc Content in dry film, Solid by volume minimum 60%±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00	1 Coat/DFT= 70μm per coat	240 Microns
2.	Inter Mediate Coat	One coat of Epoxy Glass Flake (high build) Paint	1 Coat/DFT= 100μm per coat	
3.	Finish coat	Two coats of Two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55% ±2)	2 Coat/DFT= 35μm per coat	
Shade : Grey White, RAL 9002				

GENERAL NOTES

1). Painting of Commissioning Spares & Mandatory Spares shall be as per respective items as above.

2) No painting is required for SS, Aluminum, Galvanized, non-ferrous & stainless steel items, except as indicated above.

3) Machined items are to be applied with one coat of temporary rust preventive oil.

3) For Sub Assembly where plates /sheets of thickness less than or equal to 5mm & rods are used & tiny items less than 100kg, Power Tool Cleaning or hand Tool Cleaning to SSPC-SP3/SP2 shall be followed. Painting to be followed 2 coats of zinc phosphate primer (DFT 30 μ per coat) & Two coats Synthetic Enamel (DFT 20 μ per coat) with total DFT 100 microns.

4). Primer coat on steel shall be applied in shop immediately after blast cleaning by airless spray technique.

5) Panting of damaged surfaces will be same as the painting scheme as furnished above with power tool cleaning.

ANNEXURE: G515:F

DOCUMENT TITLE : TECHNICAL SPECIFICATION FOR BOUGHT OUT ITEMS

ITEM : LT MOTOR

PROJECT : BHEL STANDARD

	NAME	DESIGNATION	SIGNATURE	DATE
PREPARED BY	ALAN S G	ENGINEER		28/7/2021
REVIEWED BY	CHANDRASEKAR A P	DM		28-07-2021
APPROVED BY	JEYAMURUGANAND M	AGM		28/07/2021

ISSUED BY EDC – ECI

RECORD OF REVISIONS:

REVISION NUMBER 00	INITIAL RELEASE - Dt. 19.03.2013
REVISION NUMBER 01	
REVISION NUMBER 02	Cl. No: 5- Packing and Drawing included
REVISION NUMBER 03	Cl. No: 2.20, 2.21, 2.38, 2.39, 2.43 added
REVISION NUMBER 04	Cl.No: 2.3, 4(b) - ECI:DATASHEET:LTMOTOR:00 added
REVISION NUMBER 05	Cl.No: 2.36, 2.40, 4(b), 5(a) Updated

		SPECIFICATION	VENDOR COMPLIANCE/ REMARKS
1	**SITE CONDITIONS**		
1.1	**Altitude above mean sea level**	>1000 m.	
1.2	**Ambient temperature condition**	6 to 50°C.	
1.3	**Relative humidity**	100%	
1.4	**Atmosphere**	Tropical, Dusty, salty, corrosive & highly polluted as in a coal based Thermal power plant.	
2	**GENERAL**		
2.1	**Reference standards**	IS 15999, IS 12615, IS/IEC-60034,IS 1231, IS 6362, IS 2253, IS 12065, IS 12075	
2.2	**Design ambient**	50 Deg.C	
2.3	**Application/ Type(Normal/ Energy efficient)**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.4	**Duty cycle**	Continuous S1	
2.5	**Rated voltage, frequency & Phases**	415 V AC ±10%; 50 Hz (+5% to -5%); 3 phase	
2.6	**Combined variation of Voltage and frequency**	10% absolute sum	
2.7	**Motors efficiency class**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.8	**Minimum starting voltage**	80% of the rated voltage	
2.9	**Minimum voltage under which motor will run satisfactorily**	75% of the rated voltage for 5 minutes	
2.10.	**Capacity to restart (at specified voltage)**	i. Two successive starts from cold condition ii. Two HOT restarts starts from Hot condition iii. Three equally spread start per hour	
2.11	**High speed bus transfer withstand capability**	Suitable to withstand 150 % of rated voltage	
2.12	**Type of balancing for rotor**	Dynamic balancing	
2.13	**Direction of rotation**	Suitable for both direction	
2.14	**Direction of cooling air**	Non-drive end to driving end	
2.15	**Class of insulation**	Class F with temperature rise limited to Class B.	
2.16	**Winding treatment**	The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid & tropical climate.	
2.17	**Allowed winding temperature rise at continuous full load**	60°C by thermometer method & 70°C by resistance method	
2.18	**Accelerating Torque at minimum permissible Starting voltage**	10% of full Load Torque	

2.19	**Pullout Torque at rated voltage**	205% of full load torque	
2.20.	**Ratio of Locked rotor KVA to KW for**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.21	**Starting current**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.22	**Starting time & locked rotor withstand time**	The locked rotor withstand time (LRWT) at 110% rated voltage (RV) under HOT condition shall be at least 2.5 sec more than the starting time at 80% of rated voltage for motors with acceleration time upto 20 sec at RV and 5 sec where the accelerating time is more than 20 sec at RV.	
2.23	**Momentary overload withstand capability**	60% of full load torque for 15 second without any damage.	
2.24	**Over speed withstand**	120% of rated speed for 2 minutes without any mechanical damage.	
2.25	**Hot thermal withstand curve**	margin of at least 10% over the full load current	
2.26	**Cooling**	Totally enclosed fan cooled- IC 411(TEFC)	
2.27	**Vibration**	The peak amplitude of vibration shall be as per IS 12075	
2.28	**Noise level**	Within the limits specified by IS 12065 / <85 dB at 1 meter distance from motor.	
2.29	**Type of enclosure**	TEFC, IP 55 as per IS/IEC 60034-5	
2.30.	**Type of mounting**	Horizontal foot mounted.	
2.31	**Bearings**	Ball or roller type / bearings effectively sealed against ingress of dust. The bearing shall be so constructed that the loss of lubricating grease is kept to minimum. Sealed bearings are also acceptable	
2.32	**Lubricant Type**	Grease	
2.33	**Bearing life**	minimum life of 40000 Working hours	
2.34	**Shaft extension**	Key slotted bare shaft extension with key at the driving end.	
2.35	**Terminal box Type**	Weather proof IP 55 as per IS/IEC 60034-5; Capable of being turned through 360° in steps of 90°.	
2.36	**Cable gland and lugs**	Double compression type nickel plated brass cable glands and annealed tinned copper crimping lugs to suit the cable size i) Size of power cables will be intimated after PO. ii) For space heater cable glands and lugs suitable for 2CX2.5 to be provided	

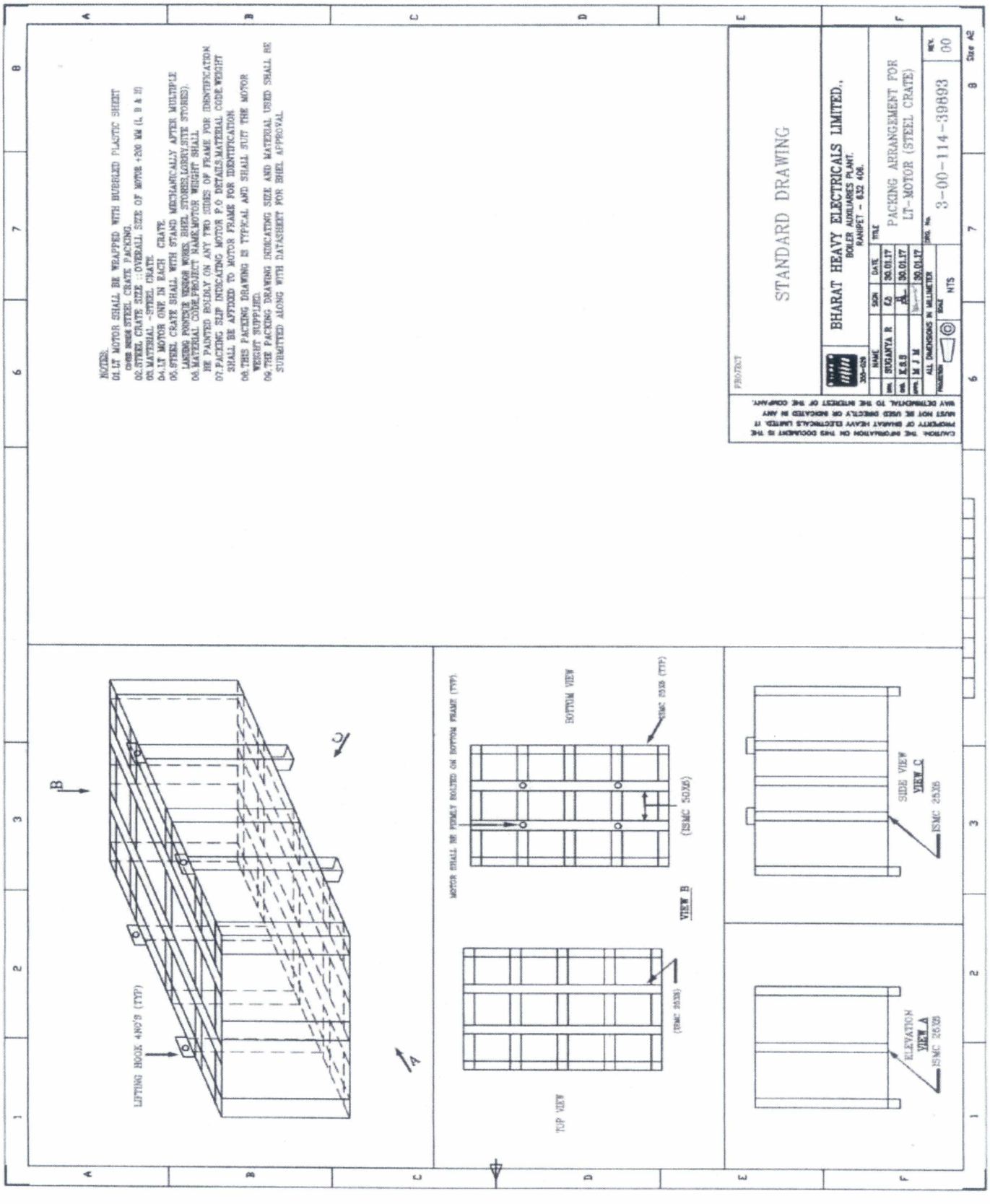
2.37	**Type of terminals**	Stud / screw type with plain washers, spring washers / checknuts & lugs	
2.38	**Min.Spacing between Gland plate and Center stud(in mm)**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.39	**Phase to Phase/Phase to Earth air clearance(in mm) in Terminal Box**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.40.	**Fault level**	40KA for 0.25Sec	
2.41	**Painting**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.42	**Space heaters:**		
2.42.a	i) Motors above 30 kW	Separate space heater suitable for 240V, Single Phase, AC,50 Hz	
2.42.b	ii) Motors below 30 kW	Winding shall be suitable for heating at 24 V, Single phase, AC,50 Hz	
2.43	**Terminals for space heater**	As per the document LT MOTOR:PROJECT SPECIFIC DETAILS	
2.44	**RTD for winding**	Two numbers of Thermistors / RTD for each phase as below are to be provided A. Motors above 37 Kw shall have thermistors Or RTD if specifically called for in enquiry. B. Motor rated 160kW and above shall have RTDs	
2.45	**Bearing RTD**	For motors 132 Kw and above	
2.46	**Terminals for RTD/ Thermistor**	Thermistors/ RTDs shall be terminated in an auxiliary terminal box. Details shall be furnished in TB diagram.	
2.47	**Earthing**	Two no of earthing provisions on terminal box and on motor body(on opposite sides)	
2.48	**Name plate**	As per IS/IEC 60034-8 and Additional data on name plate : a. Bearing DE/ NDE details. b. Year of manufacture	
2.49	**Lifting Device**	Eye bolt or lugs to facilitate safe lifting	

3	**INSPECTION & TESTING**	As per applicable quality plan	

4 **DOCUMENTS**

a) Along with offer:	One set of technical data sheet as per the enclosed format and Motor general arrangement drawing giving foundation details, shaft details.	
b) After placement of Purchase order (within 15 days)	Three sets of the following for approval: 1. Technical Data sheet as per the enclosed format ECI:DATASHEET:LTMOTOR:00 2. Motor general arrangement drawing giving foundation details, shaft details and weight 3. Motor Terminal box arrangement drawing 4. Motor characteristic curves : Torque vs Speed with load curve superimposed Speed vs Current Time vs Current Thermal with stand curve Load vs Efficiency Load vs Slip Load vs Power factor Speed vs Time Load vs Current 5. Suggested steel crate packing drawing (Drawing No:- 3-00-114-39893) or vendor standard packing drawing subject to approval. The following shall be submitted: 1.Guarantee certificate. 2. 0 & M manuals. 3. Acceleration time and LRWT calculation shall be submitted for review.	

5	**PACKING**	a) As per suggested Drawing No:- 3-00-114-39893 b)The packing shall meet the Transport, Environment & Storage hazards. c) As per Packing Procedure QA:CI: STD:PR:03 or as per Manufacturer's Standard Practice subject to approval.	


NOTES:
01.LT MOTOR SHALL BE WRAPPED WITH BUBBLED PLASTIC SHEET OVER MESH STEEL CRATE PACKING.
02.STEEL CRATE SIZE : OVERALL SIZE OF MOTOR +200 MM (L B & H)
03.MATERIAL -STEEL CRATE.
04.LT MOTOR ONE IN EACH CRATE.
05.STEEL CRATE SHALL WITH STAND MECHANICALLY AFTER MULTIPLE LANDING POINTS(IN VENDOR WORKS, BHEL STORES,LOCAL SITE STORES).
06.MATERIAL CODE,PROJECT NAME,MOTOR WEIGHT SHALL BE PAINTED BOLDLY ON ANY TWO SIDES OF FRAME FOR IDENTIFICATION
07.PACKING SLIP INDICATING MOTOR P.O DETAILS,MATERIAL CODE,WEIGHT SHALL BE AFFIXED TO MOTOR FRAME FOR IDENTIFICATION
08.THIS PACKING DRAWING IS TYPICAL AND SHALL SUIT THE MOTOR WEIGHT SUPPLIED.
09.THE PACKING DRAWING INDICATING SIZE AND MATERIAL USED SHALL BE SUBMITTED ALONG WITH DATASHEET FOR BHEL APPROVAL.
STANDARD DRAWING
BHARAT HEAVY ELECTRICALS LIMITED.
BOILER AUXILIARIES PLANT.
RANIPET - 632 406.
PACKING ARRANGEMENT FOR LT-MOTOR (STEEL CRATE)
3-00-114-39893
00
NTS
LIFTING HOOK 4NO'S (TYP)
MOTOR SHALL BE FIRMLY BOLTED ON BOTTOM FRAME (TYP)
BOTTOM VIEW
TOP VIEW
VIEW B
SIDE VIEW
VIEW C
ELEVATION
VIEW A

ECI: DATASHEET: LTMOTOR: 00

TECHNICAL DATA SHEET OF LT MOTOR

P.O No:

DATA SHEET - Customer No: Project:

CL.NO	CHARACTERISTICS	VENDOR DATA(To be filled by Vendor)
1.0	Application	
1.1	Fan / Load Curve referred	
2.0	Manufacturer	
3.0	Type & frame size	Normal/ Energy efficient Frame size:
3.1	Degree of Protection	IP55
4.0	Rated output in kW	
4.1	Rated speed	
5.0	Rated voltage , frequency & phases	415 V±10% AC; 50 Hz ± 5%; (Check voltaqe as per Enquiry) 10% absolute sum; 3 phase
6.0	Full load current	Amps
7.0	Energy efficient	As per IS 12615
8.0	Efficiency & power factor at Full load	Eff- Pf-
9.0	Efficiency & power factor at 75 % load	Eff- Pf-
10.0	Efficiency & power factor at 50 % load	Eff- Pf-
11.0	Duty Cycle	Sl - Continuous
12.0	Rated torque	
13.0	Starting current	As per IS standards
14.0	No load current (with mechanism coupled)	(at Rated.V and Frequency)
15.0	Starting torque in % of full load torque	
16.0	Pull up torque in % of full load torque	
17.0	Pull out torque in % of full load torque	

18.0	No load starting time (without mechanism coupled)	
19.0	Locked rotor withstand time at rated voltage	a.Hot b.Cold
20.0	Locked rotor withstand time at minimum starting voltage	a.Hot b.Cold
21.0	Locked rotor withstand time at 110% rated voltage	a.Hot b.Cold
22.0	Starting time at minimum starting voltage with mechanism coupled	
23.0	Starting time at rated voltage with mechanism coupled	
24.0	Maximum permissible starting time	
25.0	Stator thermal time constant	Minutes
26.0	Type & No of terminals brought out	
27.0	Stator winding connection	Delta / Star
28.0	Class of insulation & temperature rise	Class F; 60^0C by thermometer method / 70^0 C by resistance method.
29.0	Minimum permissible starting voltage	Volts
30.0	Resistance per phase at 20Deg C (Indicative)	Ohms
31.0	No of successive starts in Hot condition	
32.0	Quantity and power consumption of space heater	Quantity: Watts:
33.0	Direction of rotation	Bi-Directional.
34.0	Bearing make & type	Make: Drive End: Non Drive End:
35.0	Lubricant quantity grade & recommended interval of lubrication	

36.0	Type of mounting & shaft orientation	Foot mounting; Horizontal.
	Terminal Box	
37.0	Location & angle of rotation	
38.0	Gland size for stator winding	
39.0	Gland size for space heater	Suitable for 2CX2.5 sq.mm (armoured), if applicable.
40.0	Cable entry	
41.0	GD^2 of motor (kg-m^2)	
42.0	Total weight of motor (kg).	
43.0	Weight of stator (kg)	
44.0	Weight of rotor (kg)	
45.0	Anticipated bearing life in Hours	
46.0	Method of connection to driven equipment	
47.0	Limiting rotor temperature for determining safe stall time	
48.0	RTD for winding/ Bearing	Applicable: YES ☐ NO ☐
49.0	Grade of balance of motor	
50.0	Standard continuous rating at 40 Deg C ambient.	
51.0	Derated rating of motor at 50 Deg C.	
52.0	a. Locked Rotor KVA	
	b. Ratio of Locked rotor KVA / Rated KW	
53.0	a. Motor Dynamic Load	Upward/ Downward—
	b. Motor Static load	Upward / Downward—
54.0	PAINT SHADE	

Vendor's signature and seal Rev No : Date :

The following curves are to be enclosed during datasheet approval.

1.GA drawing , Terminal box arrangement
2.Torque Vs Speed with load curve superimposed.
3. Speed Vs Current
4. Time Vs Current
5. Thermal with stand curve
6. Load Vs Efficiency
7. Load Vs Slip
8. Load Vs Power factor
9. Speed Vs Time
10. Load Vs Current.

The following information shall be specifically provided for motors suitable for VFD drive (if called for in eqny during datasheet approval in addition to datasheet.

1. Stator Resistance
2. Stator leakage reactance
3. Magnetising reactance
4. Rotor resistance referred to stator
5.Rotor reactance referred to stator

Vendor's signature and seal.

Date

ANNEXURE-G515: G
SCHEDULE OF GUARANTEES

SL NO	DESCRIPITION	LIMESTONE SLURRY FEED PUMP	GYPSUM BLEED PUMP	PRIMARY HYDRO CYCLONE FEED TANK PUMP	FILTRATE WATER TANK PUMP	SECONDARY HYDRO CYCLONE FEED TANK PUMP	AUXILIARY ABSORBENT TANK PUMP	EMERGENCY TRANSFER PUMP	ABSORBER AREA DRAIN SUMP PUMP	GYPSUM AREA DRAIN SUMP PUMP	LIMESTONE AREA DRAIN SUMP PUMP
1	Rated Capacity of the Pump. (m3/hr)										
2	Total Head at design capacity. (m)										
3	Guaranteed power consumption at Motor input Terminal at rated Head & capacity. (kw)										
4	Noise level at a distance of 1.0 meter from the equipment at site and 1.5m above operating floor. dB(A)										
5	Maximum vibration (peak to peak amplitude at site). (Microns)										
6	Equipment Availability. (%)										
7	Pump Efficiency (%)										
8	Life of the Pump wear parts including Casing liners bearing etc. (Hours)										

Note: Bidder to provide the details for the applicable pumps.

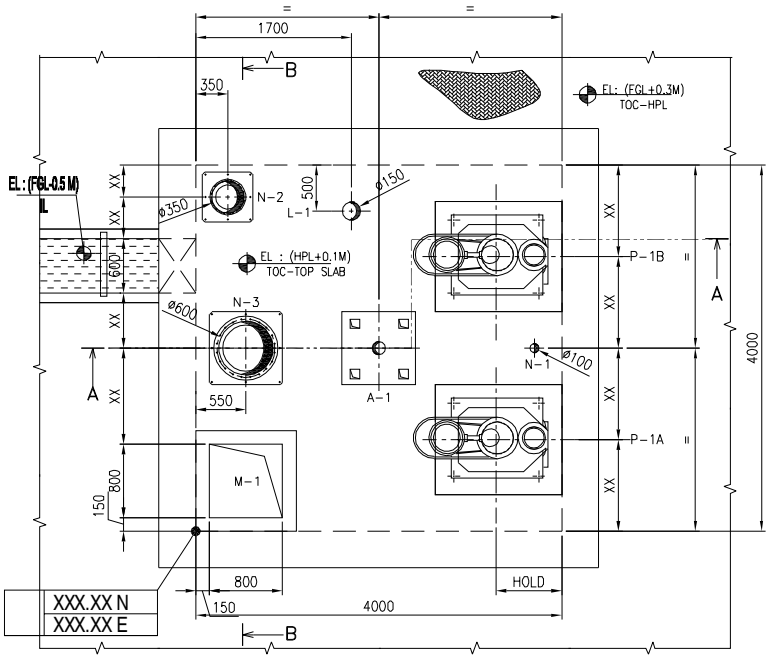
Signature of the Bidder……
Name……

LT MOTOR: PROJECT SPECIFIC DETAILS (ANNEXURE :G515:I)

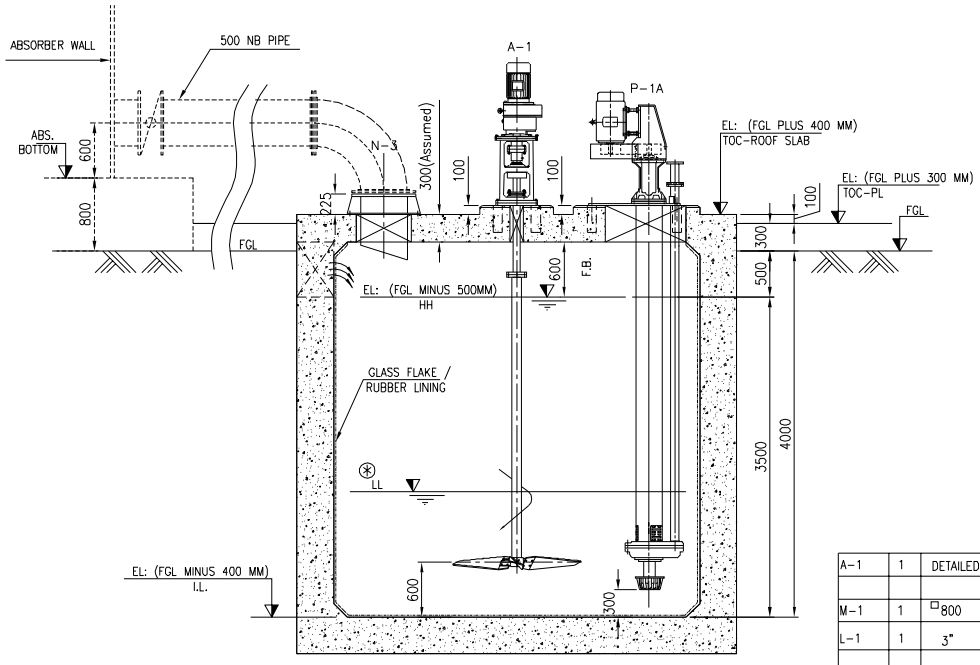
INDENT NO: RFW11288, RFW11289 **Customer No: G515**

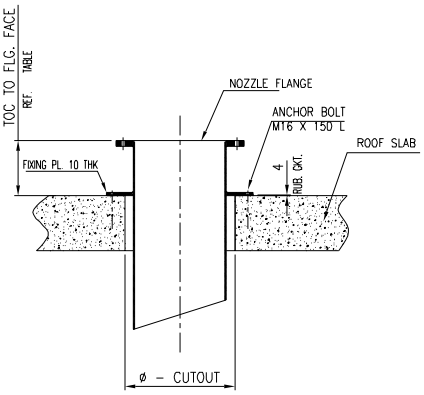
ENERGY EFFICIENT	IE3
SUPPLY	Supply: 415V + 10% & -10%, 3 Phase, 50 Hz +5% & -5%.
STARTING CURRENT	As per IS 12615
RATIO OF LOCKED ROTOR KVA TO KW	
i) 50KW to 110KW	11
ii) 110KW to 200KW	9
MIN. SPACING BETWEEN GLAND PLATE AND CENTER STUD(IN MM)	
upto 3KW	As per manufacturer's practice
above 3KW and upto 7KW	85
above 7KW and upto 13KW	115
above 13KW and upto 24KW	167
above 24KW and upto 37KW	196
above 37KW and upto 55KW	249
above 55kw and upto 90KW	277
above 90KW and upto 125KW	331
above 125KW and upto 200KW	385/203 (For Single core cables only)
PHASE TO PHASE/PHASE TO EARTH AIR CLEARANCE(IN MM) IN TERMINAL BOX	
upto 110	10
above 110kw and upto 150KW	12.5
above 150KW	19
ADDITIONAL DATA TO BE INCLUDED IN DATASHEET	
GRADE OF BALANCING OF MOTOR	
STANDARD CONTINUOUS RATING AT 40DEG.C AMBIENT	
DERATED RATING OF MOTOR AT 50DEG.C(DESIGN POINT)	
NO LOAD CURRENT OF MOTOR AT RATED VOLTAGE AND FREQUENCY	
STARTING TORQUE VALUE IN KGM	
LOCKED ROTOR KVA @ RATED KW	
POWER FACTOR AND EFFICIENCY AT 75% LOAD	
POWER FACTOR AND EFFICIENCY AT 50% LOAD	
SPACE HEATER TERMINAL	Separate terminal box shall be provided
PAINTING	RAL 5012 (Blue)

ANNEXURE : G515: J



PLAN

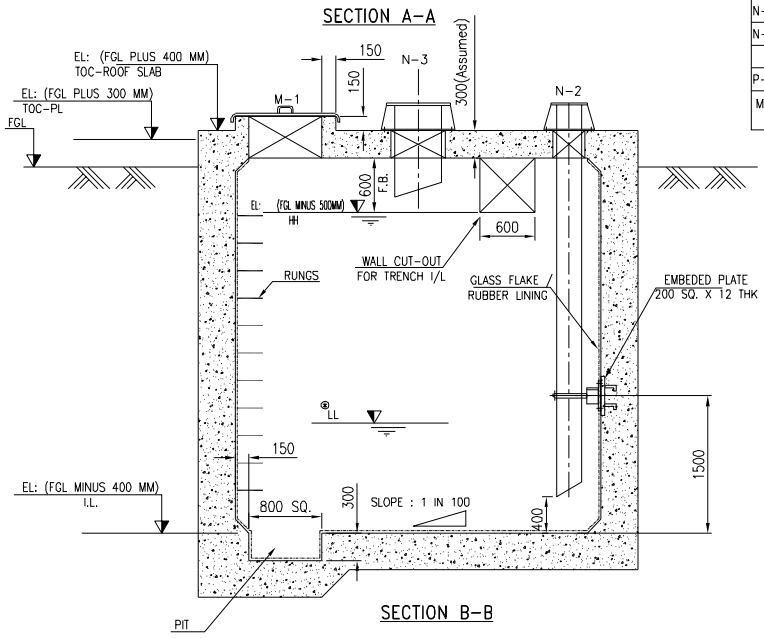




TYP. NOZZLE FIXING DETAIL

MARK	Nos.	SIZE	RATING	FACING	SERVICE	TOC TO FLG. FACE	SLAB CUTOUT SIZE	REMARKS
A-1	1	DETAILED	——	–	AGITATOR CONN.	--	DETAILED	
						--		
M-1	1	□800	——	–	MANHOLE	--	□800	WITH COVER
L-1	1	3"	ASME 150^{LB}SO	FF	LEVEL TRANSMITTER	200	ø150	
N-3	1	20"	ASME 150^{LB}SO	FF	LIQUID INLET(ABS. DRAIN)	225	ø600	
N-2	1	10"	ASME 150^{LB}SO	FF	LIQUID INLET(OVER FLOW)	200	ø350	EXTENDED INSIDE
N-1	1	2"	ASME 150^{LB}SO	FF	PUMP DRAIN	200	ø100	
P-1 A/B	2	DETAILED	——	–	PUMP	--	DETAILED	

SECTION A-A



SECTION B-B

NOTES :

1. ALL DIMENSION ARE IN MILLIMETER AND ELEVATION ARE IN METER.
2. SUITABLE DYNAMIC LOAD SHALL BE CONSIDERED FOR ROTARY EQPT . FDN. DESIGN.
3. SUMP BOTTOM FLOOR SLOPE SHALL BE MAINTAINED TOWARDS PIT.
4. SUMP INSIDE SURFACE SHALL BE GLASS FLAKE LINED.
5. DIMENSION MARKED WITH 'XX' SHALL BE FURNISHED INLINE WITH LAYOUT, PUMP GAD REQUIREMENT.
6. LL LEVEL SHALL FIXED BY BOI GROUP (BASED ON AGITATOR / PUMP REQUIREMENT)
7. A-1(AGITATOR SLAB CUTOUT) AND P-1 A/B(PUMP SLAB CUTOUT) WILL BE BASED ON VENDOR DETAILS TO BE OBTAINED FROM BOI GROUP
8. M-1, L-1, N-2, N-1 WILL BE STANDARD CUTOUTS AS PER THE SIZES MENTIONED ABOVE.
9. N-3(ABS. DRAIN CUTOUT) TO BE TAKEN BASED ON THE ABS. DRAIN PIPE SIZE IN ABS. P&ID FROM PROCESS GROUP.

LEGEND :

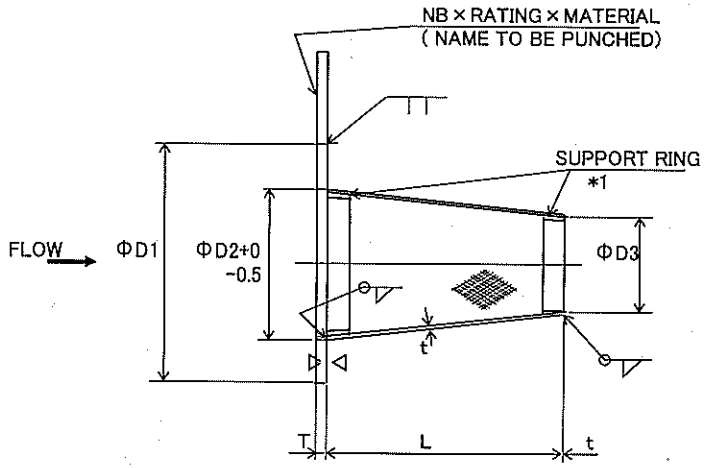
FGL - FINISHED GRADED LEVEL
FFL - FINISHED FLOOR LEVEL
PL - PAVED LEVEL
IL - INVERT LEVEL

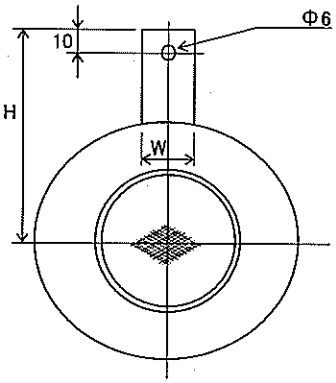
SLURRY DRAIN CHANNEL

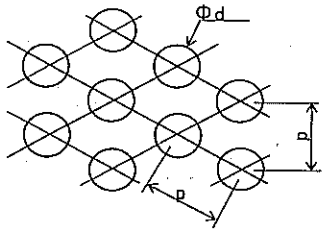
PAVED LEVEL

GENERAL ARRANGEMENT DRAWING OF ABSORBER AREA DRAIN SUMP

DIMENSIONAL LIST FOR TEMPORARY STRAINER







PUNCHING METAL DETAIL

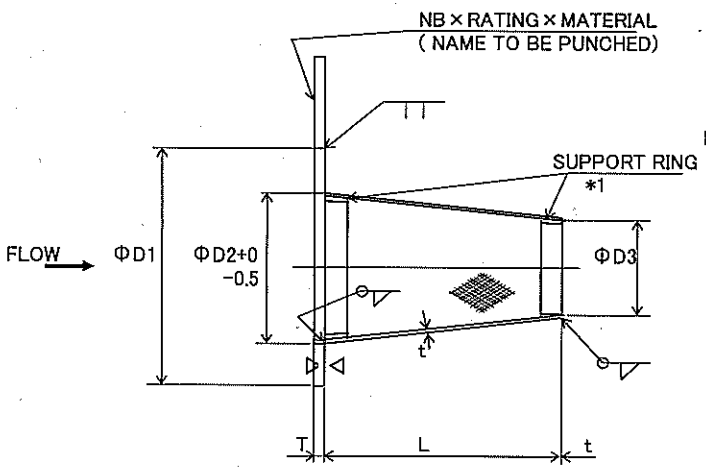
*1 TO BE DETERMINED BY VENDOR

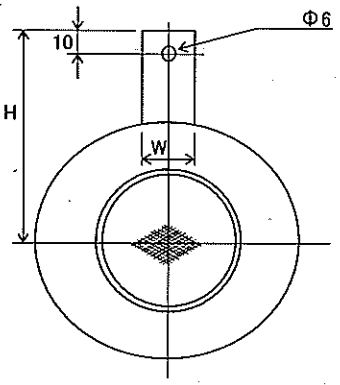
	d	p
700A≧	6	8
750A≦	12	15

MOMINAL SIZE		D1		D2	D3	H		L	t	T	W
(mm)	(in)	150#	300#			150#	300#				
25	1	64	70	23	15	107	115	80	2.3	3.2	25
40	1 1/2	83	72	30	18	117	131	80	2.3	3.2	25
50	2	102	108	40	22	130	136	80	2.3	3.2	25
65	2 1/2	121	127	55	35	142	148	80	2.3	3.2	25
80	3	133	146	65	37	148	158	100	2.3	3.2	25
100	4	172	178	85	50	167	180	100	2.3	3.2	25
125	5	194	213	110	55	197	210	110	2.3	3.2	25
150	6	219	247	130	65	209	229	130	2.3	3.2	25
200	8	276	305	175	95	241	261	180	2.3	3.2	25
250	10	337	359	225	130	278	299	220	2.3	4.5	32
300	12	404	419	275	165	316	335	270	2.3	4.5	32
350	14	448	483	315	190	342	367	300	2.3	4.5	32
400	16	511	536	365	220	374	400	300	2.3	4.5	32
450	18	546	594	410	240	393	431	300	2.3	4.5	32
500	20	603	651	460	270	426	464	350	3.2	6	32

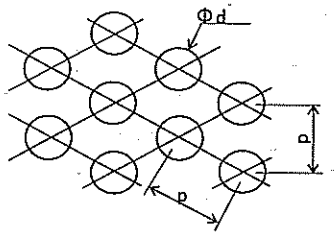
MOMINAL SIZE		D1		D2	D3	H		L	t	T	W
(mm)	(in)	150#	300#			150#	300#				
600	24	714	772	550	330	490	535	370	3.2	6	32
650	26	772	–	600	360	520	–	400	3.2	6	32
700	28	828	–	640	380	550	–	430	3.2	6	32
750	30	880	–	690	410	590	–	430	4.5	9	50
800	32	937	–	740	440	630	–	430	4.5	9	50
850	34	988	–	780	470	650	–	450	4.5	9	50
900	36	1045	–	830	500	690	–	480	4.5	9	50
1000	40	1157	–	930	560	750	–	520	4.5	9	50
1100	44	1273	–	1030	620	800	–	560	4.5	9	50
1200	48	1381	–	1130	680	860	–	600	4.5	9	50
1350	54	1546	–	1280	770	950	–	670	4.5	9	50

DIMENSIONAL LIST FOR TEMPORARY STRAINER





*1 TO BE DETERMINED BY VENDOR



PUNCHING METAL DETAIL

	d	p
700A ≧	6	8
750A ≦	12	15

① 追加

MOMINAL SIZE (A)	MOMINAL SIZE (B)	D1 GB 1.6MPa	D2	D3	H	L	t	T	W
25	1	71	15	15	107	80	2.3	3.2	25
40	1 1/2	92	25	18	117	80	2.3	3.2	25
50	2	107	35	22	130	80	2.3	3.2	25
65	2 1/2	127	50	35	142	80	2.3	3.2	25
80	3	142	60	37	148	100	2.3	3.2	25
100	4	162	80	50	167	100	2.3	3.2	25
125	5	192	105	55	197	110	2.3	3.2	25
150	6	218	125	65	209	130	2.3	3.2	25
200	8	273	175	95	241	180	2.3	3.2	25
250	10	329	225	130	278	220	2.3	4.5	32
300	12	384	275	165	316	270	2.3	4.5	32
350	14	444	300	190	342	300	2.3	4.5	32
400	16	495	340	220	374	300	2.3	4.5	32
450	18	555	390	240	393	300	2.3	4.5	32
500	20	617	430	270	426	350	3.2	6	32

MOMINAL SIZE (A)	MOMINAL SIZE (B)	D1 AWWA	D2	D3	H	L	t	T	W
600	24	734	550	330	490	370	3.2	6	32
650	26	772	600	360	520	400	3.2	6	32
700	28	828	640	380	550	430	3.2	6	32
750	30	880	690	410	590	430	4.5	9	50
800	32	937	740	440	630	430	4.5	9	50
850	34	988	780	470	650	450	4.5	9	50
900	36	1045	830	500	690	480	4.5	9	50
1000	40	1157	930	560	750	520	4.5	9	50
1100	44	1273	1030	620	800	560	4.5	9	50
1200	48	1381	1130	680	860	600	4.5	9	50
1350	54	1546	1280	770	950	670	4.5	9	50

テンポラリーストレーナー数量表

CODE No.	SIZE	Q'TY	MATERIAL	FLANGE	FLOW RATE	PUNTING METAL HOLE SIZE	REMARKS
ｺｰﾄﾞNo.	口径(″)	数 量	材質	フランジ	流量(m^3/h)	ﾊﾟﾝﾁﾝｸﾞﾒﾀﾙ穴径(mm)	備 考
TS-A101	32	2	SS400	AWWA CL.B	4250	12	P101/102(ABSOBER)
TS-A201	2-1/2	2	SS400	ANSI 150	20	6	P201/202(ABSORBER)
TS-D401	3	2	SS400	ANSI 150	20	6	P401/402(DWEATWER)
TS-L201	2-1/2	2	SS400	ANSI 150	20	6	P201/202(LIMWSTONE)
TS-A401	6	1	SS400	ANSI 150	110	6	P401(ABSORBER)
計		9					

注 ： 本表に記載の数量は見積用とし、発注数量は当社資材より発行される注文書によること。