

Technical Specification ROS: 6309 Rev 00**For****Absorber Recirculation Pumps**

Customer : National Aluminum Company Limited (NALCO)
Project : Odisha
Application : FLUE GAS DESULPHURIZATION SYSTEM

Department	Prepared	Checked	Approved
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ROS : 6309 Rev00		COMMENTS : -----	

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	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
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1.0 PROJECT INFORMATION:

National Aluminum Company Limited (NALCO), a Government of India Undertaking and a Navaratna Company owns and operates large integrated Mines-Alumina- Aluminum Complex in India. It has multi-locational operations as follows:

- 1.1.1 Mines & Alumina Refinery Damanjodi, Odisha.
- 1.1.2 Aluminium Smelter Angul ,Odisha.
- 1.1.3 Captive Power Plant Angul, Odisha.
- 1.1.4 Port Handling Facilities Visakhapatnam, Andhra Pradesh
(for Alumina Export & Caustic Soda Import)

National Aluminum Company Limited 18.5MW project site is located in Damanjodi village, Semiliguda block, Koraput district in Odisha state. The project is proposed for the States & Union Territories of Northern, Western and Eastern Regions.

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

A) SITE CONDITION**Guarantee point**

	Ambient Temperature	:	Normal 35 deg C , Max. 46.6 deg C
	Relative Humidity	:	Design 60 %, Max. 89%
	Barometric Pressure	:	908 hpa
	Site Elevation	:	+910 meters above sea level.

The above site conditions shall apply for Guarantee Values as well as for the Guarantee test/ Performance test.

- 1) Equipment and Material shall be suitable for the range of ambient site conditions.

B) PROJECT LOCATION AND APPROACH

a.	State/ Division	Odisha
b.	District	Koraput

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

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pump shall follow the latest applicable Indian/International (ASME/EN/Japanese) Standards only.

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, performance testing at the manufacturer's works, delivery supervision of erection & performance testing at bidder's works of Recirculation pump along with accessories. The following points may be noted.

- A total of 03 nos Recirculation pumps are required
- Bidder shall take full responsibility for the entire equipment assembly and shall comply strictly with the requirements of this specification and other relevant specifications/attachments to inquiry/order.
- In the event bidders' consider that deviations are essential, the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (Annexure-IV)".
- Any deviation by the vendor not listed in Annexure - IV, though reflected in any other part of the offer, shall not be considered.
- BHEL discretion is final in acceptance / rejection of exceptions / deviations listed by Bidders' proposal in Annexure – IV. Only written & signed approval by BHEL is valid means of acceptance of deviation / exception.
- In case, Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment shall be recommended along with reasons in a separate section and included in scope of supply.
- Bidder shall ensure completeness of the Slurry Recirculation Pump in all respects and provide all necessary components, instruments and fulfil statutory requirements required to make the system complete for its safe, efficient, reliable, trouble free operation and maintenance irrespective of mention in the specification unless specifically excluded by BHEL.

4.0 PROVENNESS CRITERIA:

Bidders shall meet the Qualification Requirement (QR) for Recirculation Pumps as per **Annexure-I & submit the Annexure to qualification requirement. Offers of Bidders not meeting Qualification Criteria shall not be considered for evaluation.**

5.0 TECHNICAL INFORMATION – Properties of Fluid being Handled & Physical data.

S.No	Description	Requirement
1.	Quantity	
	Quantity of Recirculation Pumps	3 nos. (2 working + 1 standby)
2.	Parameters	
	Pump Design capacity	4700 m ³ /hr.

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S.No	Description	Requirement
	Pump discharge head (excluding suction head)	17.1 m H(Liquid Column)
	Medium to be handled	Gypsum slurry
	Operating Temperature	~61° C
	Slurry Analysis	Refer Clause 5.1
	Type of Recirculation pump	Impeller Centrifugal (non- Clogging) type
	Nozzle Orientation	End Suction- Top Discharge
	Seal Type	Single Mechanical seal with Flushing
	Duty	Continuous
	Location	Outdoor
	VFD	Pump shall be suitable for VFD operation. VFD for all recirculation pumps will be provided by BHEL.
	Expansion Joint / Bellows	Expansion joint / bellows shall be provided at suction and discharge of each pump.
	Noise	≤ 85 dB at 1.0 meter distance.
3.	Cooling Water	For Gear Box Cooling if applicable
	Inlet Temperature	36° C
	Outlet Temperature	<46 ° C
	Pressure Loss	0.05MPa
	Supply Pressure	0.2-0.3 MPa
4.	POWER SUPPLY	
	The following voltage levels shall apply:	
	For > 185 kW rated motors	Voltage: 6.6kV +/-10% Frequency: 50hz +/-3% 3Phase - 3wire
	For < 180 kW rated motors	Voltage: 415V +/-10% Frequency: 50hz +/-5% 3Phase - 4wire
	Bidder shall design and supply equipment suitable for satisfactory operation as per above mentioned power supply condition.	

5.1 SLURRY ANALYSIS

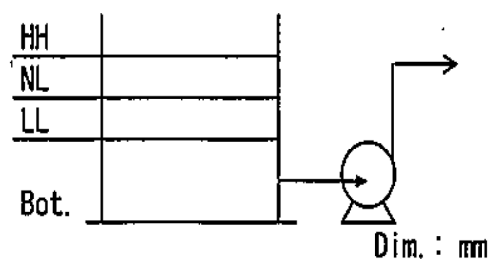
S.No	Constituents	Parameters
1.	Slurry to be handled	Gypsum Slurry
2.	Chloride Content	<20,000 ppm
3.	Specific Gravity at pump section	1.215 t/m ³ @design (for motor design) and 1.202 t/m ³ @ guarantee point(for guarantee parameters)
4.	Vapor Pressure at Pump	0.203 kg/cm ²
5.	Viscosity at Pump	0.01 Pa.S
6.	Concentration of Solid	30% wt.
7.	SO ₂ Content	4 to 6 g/l
8.	pH	4-8

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S.No	Constituents	Parameters
9.	Slurry Temperature (Design)	59.3 deg c(normal) 70 deg c(max)

5.2 ABSORBER TANK LEVEL

HH	Bottom+	6000	
NL	Bottom+	5000	@NPSH
LL	Bottom+	3500	



S.No	NPSH Calculation Results	Value (Meters)	
1	NPSH available *	10.7	NPSH available arrived based on following considerations: 1. LL level of the tank as 3.50 m 2. Suction line center assumed 1.20 m from the bottom of absorber Tank. Note: If suction height changes, NPSH value shall be accordingly arrived by the vendor.

*** Note:** Bidder shall ensure that the required NPSH shall be less than available NPSH by 1.0 mtr as a minimum.

Pump Design shall be based on Low Level of the Tank Only.

5.3 WATER ANALYSIS:

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

S.No	Constituents	Unit	Water quality
1.	Calcium as CaCO ₃	ppm	80
2.	Magnesium as CaCO ₃	ppm	
3.	Sodium as CaCO ₃	ppm	100.6

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4.	Potassium as CaCO ₃	ppm	-
5.	Iron as Fe	ppm	0.21
6.	Total alkalinity as CaCO ₃	ppm	150
7.	Chlorides as CaCO ₃	ppm	28.2
8.	Sulphate as CaCO ₃	ppm	2.3
9.	Silica(Reactive)	ppm	30
10.	pH		6.5-8.2
11.	Suspended Solids	ppm	30
12.	Total Alkalinity as CaCO ₃	ppm	150
13.	Total Hardness as CaCO ₃	ppm	80
14.	Turbidity	NTU	30
15.	Conductivity	micro S/cm	300

5.4 OPERATION & PUMP PERFORMANCE

a) **Operation Mode of Pumps:** The pumps operations are as follows.

1. No of FGD Absorbers -1 No.
2. Three 03 Pumps (2W+1S) connected to the common header of the recirculation line per boiler
3. Operating modes of pumps:
 - (1) Sequential startup of the pumps one by one.
 - (2) Two 02 Pumps in continuous operation per absorber at a given point of time.
 - (3) Sequential shut down of pumps one by one.
 - (4) Emergency shutdown of maximum Two (02) pumps per boiler at the same time in case of power failure. In such case, the discharge valve of the pumps shall be fully closed within 500 sec. Pump shall endure reverse flow until the 500-second duration.

4. Table-1 Pump Operating condition

Sl. No.	Condition	Required total flow rate m ³ /hr	Required Pump Head m	Each Pump Capacity (m ³ /hr)	Pump Efficiency (%)	Pump Efficiency (%)	Pump Speed rpm	Remarks
1.	2 Pumps in Continuous operation (VFD operation)	9400	17.1	4700	> 83%			
2.	2 Pumps in Continuous operation (VFD operation)	7640	13.6	3820	>83%			Power loading guarantee point

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b) Pump Performance (Important): The following are the requirements on the pump performance

- (1) The capacity of the pump (design Condition) shall be 4700 m³/hr. with a discharge head of 17.1 m Liquid Column (**excluding suction head**).
- (2) Shaft power at design conditions specified in Table-1 in sl. no. 2 shall be kept as minimum as possible (overall pump efficiency **shall not be less than 83%**) and shaft power shall be guaranteed by vendor.

Note : 1) In order to optimize power consumption of FGD system at part load operation, all the slurry recirculation pumps are provided with Variable Frequency Drive (VFD). Pumps should be capable of delivering varying flow & head to save power consumption at part loads.

6.0 SCOPE OF SUPPLY

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

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

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, handing over to customer

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

Sl. No	Scope
1.	Recirculation pump complete with
	i. Casing
	ii. Rotor and Shaft assembly
	iii. Coupling arrangement between Motor & Pump
	iv. Common base frame and shock pads
	v. Single Mechanical seal with automatic flushing with a connection for additional manual flushing. Required API plan to be considered by the bidder.
	vi. Flushing/Quenching and drain system
	vii. Coupling guards
	viii. Expansion joints at Inlet and Discharge with limiting bolt & nuts.
	ix. Companion flanges with gaskets and fasteners
	x. Casing drain terminated at battery limit with flange as applicate
	xi. Bearing cooling/ Gear Box Cooling if applicable. Necessary equipments in bidder's scope.
	xii. Lubrication system
	xiii. Foundation bolts for supplied items
	xiv. Mechanical Running and Performance test at shop
	xv. Instrument : PG, bearing temp sensor, as per requirements
	xvi. Painting and Rust Prevention

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Sl. No	Scope
	xvii. Supervision of Erection & commissioning at site
	xviii. Special tools & tackles as applicable
	xix. Erection and start-up spares, strainers at pump suction, pre- commissioning
	xx. Installation, operation and maintenance manuals
	xxi. Mandatory spares : If Applicable
	xxii. Any other items required for completeness of the equipment except the items covered in exclusions with prior approval of BHEL.

6.1	TECHNICAL REQUIREMENTS
1.	All recirculation pumps shall be identical and interchangeable.
2.	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head as specified in the respective clauses. The slurry concentration in the pump shall not exceed 30% by weight.
3.	The Absorber Recirculation Pumps shall circulate the scrubbing liquid from the absorber sump to the spray nozzles in the absorber.
4.	The Pumps shall be wear resistant & equipped with flushing devices to prevent sedimentation. Shall be designed and installed in a manner to allow easy replacement, repair and maintenance.
5.	The recirculation pumps shall be equipped with oil level indication, coupling guard & means of collecting leakage automatically & drain out immediately. MOC of collection tray shall be resistant to Slurry corrosion.
6.	Mechanical Seals with a provision for flushing/Quenching shall be provided. Respective API plans to be considered by the bidder along with relevant pipes, valves instruments & fittings.
7.	Pump is directly coupled to the Drive Motor at both pump side & motor side end or motor with gear. (Coupling shall be provided by Vendor)
8.	All the pump wear parts in contact with the slurry shall be provided with replaceable liners suitable for the fluid handled. The Bidder may also offer a SC lined pump based on previous experience for similar applications. The material used by contractor shall meet Proveness criteria indicated in the specification on previous installations. Silicon Carbide Impeller and Silicon Carbide lined casing also be accepted in similar lines.
9.	The pump shall be provided with seals of proven type and shall be designed for minimized seal water consumption. The shaft shall be supported on heavy-duty ball/roller bearings.
10.	All pumps casings shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions
11.	Product water flushing lines and drains shall be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
12.	Pumps shall be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values shall 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.
13.	The Pump shall be capable of developing the required total head at rated capacity for continuous operation. The pumps shall also be capable of operation providing satisfactory

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	performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall be within ± 10% of the rated design flow as indicated in data sheets. 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.									
14.	Pumps shall run smoothly with vibration levels as given below during operation. (Peak to peak) <table><tr><th>Speed</th><th>Antifriction Bearing</th><th>Sleeve Bearing</th></tr><tr><td>1500 rpm and below</td><td>75.0 micron</td><td>75.0 micron</td></tr><tr><td>3000 rpm</td><td>50.0 micron</td><td>65.0 micron</td></tr></table> The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface (as per API 610 standard)	Speed	Antifriction Bearing	Sleeve Bearing	1500 rpm and below	75.0 micron	75.0 micron	3000 rpm	50.0 micron	65.0 micron
Speed	Antifriction Bearing	Sleeve Bearing								
1500 rpm and below	75.0 micron	75.0 micron								
3000 rpm	50.0 micron	65.0 micron								
15.	The pumps shall be capable of starting with discharge valve fully open and closed condition.									
16.	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.									
17.	The pumps shall be able to sustain forces owing to reverse rotation up to 150% of design RPM , at full discharge head in the event pump trips while the other operating pumps remain on line. Bidder shall provide proof of design incorporation the requirement of this clause									
18.	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head shall be minimum 125% of Best Efficiency Point (BEP).									
19.	A factor of 1.2 for “Froth” shall be taken into account for sizing the pump. If Bidder, from their own experience, specifies that froth factor need not be taken into account or a different factor to be taken into account for FGD pump, the same shall be clearly specified. Suction size of the pump shall be adequate to take additional capacity and the same shall reflect in master curve. Suction specific speed of pump shall not exceed $N_s=160$ (metric), inclusive of the “Froth factor”.									
20.	External flushing shall be provided to remove the accumulated particles immediately after shut down. All related information shall be provided for review & mentioned in data sheet.									
21.	Pump shall have adjustment provision of axial clearance between casing and impeller to ensure performance at best efficiency in the event of wear between impeller and casing.									
22.	In case rubber or nonmetallic linings are used, same shall be two piece molded under pressure and adjusted to the screwed metallic clamping welded to the casting.									
23.	Each pump shall have a coupling of adequate size, designed for full load, capable of supporting start –Up and overload moment. Each half of the coupling will be factory mounted and locked to its shaft. The coupling shall be able to accept adjustment of the impeller.									
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). Thrust bearing shall be									

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	designed for a minimum of 175 % of Design load.																
25.	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part is mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design shall 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.																
27.	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).																
28.	Make of Bearings: SKF / FAG or equivalent subject to BHEL approval.																
6.2	CONSTRUCTIONAL FEATURES																
	MOC approved by the customer for RC pumps is given below. Vendor shall offer same MOC or higher grade MOC. <table border="1" data-bbox="408 999 1321 1223"> <thead> <tr> <th>Sl. No.</th><th>Description</th><th>MOC</th></tr> </thead> <tbody> <tr> <td>1</td><td>Casing-</td><td>C.S/C.I + Rubber Liner / Hi-chrome / SiC / Highly Alloyed Stainless Steel / equivalent</td></tr> <tr> <td>2</td><td>Impeller</td><td>Hi-chrome / SiC / equivalent</td></tr> <tr> <td>3</td><td>Shaft</td><td>Carbon Steel + sleeve made of CD4M Cu ASTM A-743 (Duplex Stainless Steel)</td></tr> <tr> <td>4</td><td>Base Plate</td><td>Carbon Steel</td></tr> </tbody> </table> The materials of construction of various components of the slurry pumps shall be of proven type as per duty involved. For absorber recirculation services a silicon carbide impeller with casing having Silicon carbide lining can also be supplied as per proven practice of the contractor. All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs.		Sl. No.	Description	MOC	1	Casing-	C.S/C.I + Rubber Liner / Hi-chrome / SiC / Highly Alloyed Stainless Steel / equivalent	2	Impeller	Hi-chrome / SiC / equivalent	3	Shaft	Carbon Steel + sleeve made of CD4M Cu ASTM A-743 (Duplex Stainless Steel)	4	Base Plate	Carbon Steel
Sl. No.	Description	MOC															
1	Casing-	C.S/C.I + Rubber Liner / Hi-chrome / SiC / Highly Alloyed Stainless Steel / equivalent															
2	Impeller	Hi-chrome / SiC / equivalent															
3	Shaft	Carbon Steel + sleeve made of CD4M Cu ASTM A-743 (Duplex Stainless Steel)															
4	Base Plate	Carbon Steel															
A)	CASING																
a.	The pump casing shall be radially split for ease of maintenance and designed such that the impeller and shaft can be withdrawn from the casing without disturbing any of the main pipework and valves carrying the pumped fluid. In general, all horizontal pumps with draw-out-rotors shall be fitted with a coupling to facilitate disassembly without Motor removal.																

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b.	The casing and flanges shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
c.	Pump casing shall be designed with a corrosion allowance to meet the requirement "Technical requirements" and taking into account the "Operating Parameters".
d.	Bidder shall provide for suction and discharge pressure gauge as a standard feature. Same shall reflect in the drawings.
e.	Lifting lugs shall be provided for the pump as a whole and individual casing halves as per standard material handling procedures and OSHA guidelines.
f.	Pump casing shall be provided with a vent connection and piping with valves and fittings. Casing drain shall be provided complete with drain valves suitably.
g.	All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs.
h.	Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials. Details shall be shared during Technical Bid for evaluation and record
B) IMPELLER	
a.	Impeller tip speed shall be well within the limits for rubber lined/silicon carbide or metallic pumps as per relevant standards. The vendor shall furnish the detailed calculation for the tip speed.
b.	Impellers shall be designed and furnished such that there shall be a feasibility to install a new impeller to facilitate increased Head of at least 5% over and above the specified value. Same shall be supported by documentary evidence for evaluation of Bid
C) SEALS:	
a.	Pump shall be supplied with mechanical seal. All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Offers with Hook sleeve cartridges shall be summarily rejected without intimation to Bidder.
b.	Mechanical seals chamber shall have sufficient room to lubricate and ensure seal face cooling by flowing slurry.
c.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
d.	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. 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.
e.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
f.	Pump shall have provision of collecting drip leakage (minimum volume) if any and flush out the same to nearby pit without corroding any entity around the vicinity of pump.

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g.	Mechanical seals shall be fitted and installed in the pump before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.
h.	Seal life shall be guaranteed for 20000 hrs. In the event seals fail before guarantee period, the bidder shall replace the same without any cost implication.
i.	Make of Mechanical Seals: Eagle Burgmann/ Flowserve/ John Crane or equivalent subjected to BHEL approval.
D)	SHAFT AND SHAFT SLEEVE
a.	The rotating elements shall have no critical speed within a safe margin of the operating speed range of the unit. The critical speed shall be not less than 20% above maximum speed and 20% below the minimum controlled speed. All rotating elements shall be balanced dynamically to ensure smooth and satisfactory pump operation at all loads. The critical speeds of the rotating elements shall be clearly indicated in the offer.
b.	Lubrication system shall have a sight glass for visual inspection of lubricant level.
c.	Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes / mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates to enable distinguish leakage between shaft and shaft sleeve and that past the seals/ gland. Manufacture shall indicate the shaft sleeve diameter in data sheet.
d.	Shaft shall have either a keyed joint or a threaded connection between impeller and shaft.
E)	COUPLING
a.	The HT drive motor excluded from the scope of supply. However, bidder shall supply coupling.
b.	Coupling halves shall be machine matched to ensure accurate alignment. Couplings shall have a rated capacity of at least 120% of the maximum potential power transmission requirement.
c.	Coupling shall be of flexible type as per application standard. The Bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts. Relevant datasheets of coupling shall be furnished for review & record.
d.	All exposed rotating parts shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling halves with masses > 15 kgs shall have provision of tapped hole on the hub for handling
F)	BASE PLATE
a.	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.
b.	Base plate shall 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

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	in vertical plane.
c.	Pump manufacturer shall supply base plate along with Foundation bolts & Nuts, "Taper wedge" and the necessary fasteners for Pump and Motor with Base plate. Motor is excluded from scope of supply. Necessary fasteners for motor foot with base plate shall be in pump vendor's scope of supply.
d.	Base plate shall be provided with a trough, material of which shall be compatible to the pumping liquid. Leaked liquid, if any shall be collected in a trough and routed to a designated point
e.	Base frame shall be epoxy coated with proper finishing.
G)	ACCESSORIES:
1.	Expansion bellows:
i.	Expansion Bellows (with Tie Rod Arrangement) with limiting bolt & nut shall be provided at suction and discharge of each pump. Bidder to submit the GA drawing for review. In case the drilling standard is different from the one furnished in the tender specification, bidder to provide additional equivalent number of bellows as considered for the main supply.
2.	Pump control:
i.	Each pump shall be furnished with required instrumentation and electrical accessory devices mounted and connected in a control cabinet.
ii.	Provisions shall be made for the interface between the local cabinet and the DCS such that the operation of the pumps can be controlled from the control console in the FGD Control room
iii.	Provision for Vibration sensors (XY probe) are required at both ends. These shall be provided for X axis & Y-axis vibration measurement in bearing housing (Total quantity is 4 (X-2, Y-2)). Provision shall be in line AP1 670, 15th edition. Provision shall be plugged suitably to prevent entry of foreign particles. Provision for measuring casing Vibration shall also be provided at measuring locations. The Bidder in the drawing being submitted along with the offer shall indicate it.
iv.	Alarm Signal- Bearing temperature sensor to indicate/Provide alarm during when "Bearing Temperature high" shall be supplied by Bidder. Bidder shall submit the Specification for Pressure and Temperature measurement during detail Engineering in line with the specification and shall be subject to approval of BHEL / NALCO. Please see Annexure- VIII for Pressure and Temperature measurement. The following instruments shall be provided for each pump and the same shall be wired to a junction box for onward termination to DCS & control room for monitoring and control. Wiring shall be protected by armoured / sheathed conduit appropriately.

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7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipments. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance, the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English
3.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.
4.	The equipment shall be designed to withstand the corrosive and moist environment.
5.	Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dBA measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. Predicted sound pressure levels for the pump drive assemblies shall be submitted as part of the proposal data.
6.	Suitable drain connections shall be provided.
7.	The equipment shall be suitable for stable operation continuously.
8.	Service life:- Entire equipment except wear parts shall be designed and fabricated for a minimum service life of 20 years of operation.
9.	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.
10.	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150, ASME 16.47 ; AWWA C-207 CLASS D.
11.	Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Nameplates 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.
12.	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
13.	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.
14.	Skid Mount/ Transportation: Equipment shall be fabricated as skid mount design to the extent practical to minimize erection at the site.
15.	Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The

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S.No	Description
	position of earth lugs shall be shown on each GA and/or outline drawing.
16.	Provide double nuts for anchor bolts
17.	Bidder shall indicate allowable vibration level on foundation in foundation drawings and general arrangement drawings as per applicable standards.
18.	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.
19.	Bidder shall provide the counter flanges with the necessary gaskets and fasteners fitted in.
20.	All the surfaces of the carbon steel should be applied with a rust preventive prior to shipment considering storage period of at least 12 months.
21.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
22.	The list of all Bought out items with makes and country of origin shall be mentioned along with offer to be submitted
23.	Quality Plan shall be submitted along with the offer.
24.	Providing shim plates for erection of equipment / item at site shall be in the scope of bidder.
25.	During detail engineering, bidder to strictly adhere to BHEL/NALCO drawing formats, document numbering, quality plan & FQP formats
26.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
27.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/ NALCO during detail engineering
28.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word / Excel format.
29.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Comments from BHEL/ NALCO shall be addressed suitably by the bidder.
30.	While every effort is made to specify the requirements of the slurry recirculation pumps, omission of any component / entity essential for the equipment, if observed, shall be duly informed to BHEL & indicated in the Technical / Commercial offer. Supply of the same shall be ensured. In the event the requirement of the component / entity is noticed at a later stage Bidder shall ensure Supply without any cost implication to BHEL.
31.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer.

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S.No	Description
	a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"
8.0	PACKING AND FORWARDING
	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. The packing material has to withstand the conditions for storage in the outside yard for a minimum period of 12 months. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure - VI. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
9.0	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING
1.	The erection of Recirculation Pumps will be done by owner as per Erection Manual and check List. However, the bidder shall make Two visits per boiler for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.
2.	The bidder will be informed well in advance for the visit. Bidder shall include 15 working days at Site per visit in the offer with minimum 2 visits. Travel duration shall be additional.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supervision portion.
10.0	EXCLUSION
	The following work associated with the recirculation pump are excluded from bidder's scope: a. Supply of main drive HT motor b. Civil foundations c. Walkways, platforms and ladders d. Equipment/item handling hoists

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S.No	Description
11.0	INSPECTION AND TESTING -
A)	Minimum Testing requirements to be considered are as below: Quality Plan shall be submitted for approval by BHEL.
1.	Hydrostatic test shall be conducted at 150 % of design pressure for duration of 30 minutes, taking into consideration of the fact that actual operating temperature is 60 deg Celsius (maximum).
2.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
3.	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
4.	List of Non-Destructive test over and above the material test are as follows: a. Casing: Material test, Magnetic particle (MPI), DP and Hydro test as applicable. b. Impeller- DPT and MPI as applicable. c. Shaft- Ultrasonic (UT), DPT and MPI. d. Sleeve- DP and Hardness test / Manufacturer's recommendation. e. Mechanical Seal- Manufacturer's recommendation. f. Base Plate- Stress relieving of weld. g. Replaceable Rubber liner- Shore Hardness, Class and Type certificate
5.	Each pump shall be put on operation to determine Charactersitic Curves with reference to rated parameter and Flow Mechanical running & general performance test shall be conducted by vendor & witnessed by buyer.
6.	NPSH Test, Vibration test and Noise level test shall be witnessed at shop.
7.	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 pockets & surface without adherence.
8.	For surfaces with rubber lining, Coating thickness shall be checked at 100%.A High voltage porosity test will be conducted on 100 % of the applied surface.
9.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
10.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to

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S.No	Description
	verify the absence of air packets (or) surface without adherence.
11.	For surfaces with rubber lining, Coating thickness shall be checked at 100%.A High voltage porosity test will be conducted on 100 % of the coated surface.
12.	Radiography Test to be carried out for various parts of the pumps such as casing, impeller etc. as applicable.
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 / NALCO prior to manufacture. Inspection of above-mentioned tests by BHEL/ NALCO 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/ NALCO.
3.	Out of 3 Recirculation Pumps, One Number of Recirculation Pump will be inspected at the Bidder's works before dispatch or where the test facilities are available. However, if BHEL insists for performance testing of all the pumps the same shall be carried out at no additional cost.
4.	The Bidder shall conduct performance test for the remaining pumps and submit the reports.
5.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to NALCO/ 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 monitoring shall be carried out during entire duration of shop running/ performance tests. Data shall be recorded
8.	Contract shaft seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition.
9.	Recirculation pumps shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
10.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
11.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
12.	Bidder to arrange all calibrated gauges, Instruments during inspection. The list shall be submitted to BHEL for review.
13.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.

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S.No	Description
14.	The performance test may be carried out using water at shop and shall be converted to the design condition.
15.	Inspection and testing will be done as per NALCO approved Quality Plan. In case of order on Overseas Vendor (supplies from outside India), Vendor shall engage and appoint at their cost a reputed Third Party Inspection Agency of international presence for carrying out inspection of equipment's and material at vendor's & sub vendors works.
12.0	PAINTING –
	Bidder shall submit the painting scheme during detail Engineering in line with the specification and shall be subject to approval of BHEL / NALCO. Please see Annexure- IX for Painting.
13.0	SPARES, TOOLS & TACKLES
13.1	FINAL SPARE PARTS LIST (RECOMMENDED SPARES)
	Bidders shall also furnish the Final Spares Part List (i.e. recommended spares list) along with the offer required for 3 years of normal operation of the plant and should be independent of the list of mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 12 months after placement of purchase Order for the main equipment.
13.2	M ANDATORY SPARES: IF APPLICABLE
	Bidder to quote for below mentioned Mandatory spares with break up price. (As per Annexure-X) 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 corresponding main equipment's. Each item shall be labelled in English and packed to prevent damage & 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. 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

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S.No	Description
	tagged to indicate its intended usage. Levers and eyebolts for the removal of parts to be serviced shall be submitted with special tools.
13.4	SPECIAL TOOLS & TACKLES:
	Special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, shall be included in the quotation and furnished as part of the initial supply of the machine. Bidder as per his proven practice shall decide list of special tools & tackles. When special tools are provided, they shall be packed in separate boxes with lifting lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eyebolts for the removal of parts to be serviced shall be submitted with special tools.
14.0	PERFORMANCE GUARANTEE
	All performance tests for Recirculation pumps shall be carried out in accordance with the approved procedure in line with latest international codes/standards. 1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Recirculation pump and its accessories 2) Capacity and head of the pump to be guaranteed. 3) All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs. 4) Noise level-≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 5) 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. 6) Acceptance tests to be carried out as per the procedure defined by the bidder that shall be submitted for BHEL/ NALCO approval. 7) 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	POWER LOADING & PENALTY
	Bidder to specify the guaranteed shaft power consumption of Recirculation Pump including gear box losses (if applicable) in their offer. The following equipment shall be considered for Guaranteed Power consumption calculation (GPC). a. Recirculation Pump -2 Nos.
1.	Ceiling kW value for power loading : 393 kW for Two Pumps : No Power Loading Upto Ceiling kW Value

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S.No	Description
2.	Power Loading: Power loading for excess kW : Rs. 1.7 lakhs per kW : Applicable if bidder's guaranteed power consumption exceed ceiling kW value
3.	Penalty Penalty / kW: Rs. 1.7 lakhs per kW: The rate will be applicable over and above the guaranteed kW furnished by the bidder during PG test or testing as applicable.
16.0	WARRANTY/ DEFECT LIABILITY
1.	The Bidder warrants that the equipments/items shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed. The Defect Liability Period shall be 24 months from the date of supply or 18 months from the date of commissioning, whichever first occurs. If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Bidder, the Bidder shall promptly, in consultation and agreement with BHEL regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Bidder shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. Even after defect liability period it is the responsibility of the bidder to provide support in case of failure of the pumps
2.	In case of failure of the equipment to meet the guarantee, NALCO/BHEL reserves the right to reject the equipment. However, NALCO/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement.
17.0	FIRST FILL OF CONSUMABLES:
1.	Bidder's scope shall include supply and filling of all lubricants, grease, and filters if applicable 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.
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, including item qualities and quantities required per month of the plant operation for the NALCO/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 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.

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S.No	Description
18.0	TRAINING
	Successful bidder shall provide comprehensive training for NALCO/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Recirculation pumps - Operation & Maintenance, Troubleshooting etc.
19.0	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 BHEL 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.
20.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. As a minimum requirement, the following information shall be furnished to fully describe the scope of work and services offered. Duly filled-in Technical Data sheets (Annexure II) and guarantee schedule furnished under Annexure-III. - PID diagram - Performance curve - Terminal point details. - GA drgs indicating dimensional data with civil loads and pocket details. - Rotor GD₂ (kg-m²) - Torque Vs Speed curve - Calculation of Motor rating, Bearing capacity and selection of coupling - Bill of material along with material and code - Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipment. - Erection, Operation & Maintenance manual with lubrication schedule - Procedure for shop / site performance tests

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S.No	Description
	l. Time schedule for delivery. m. Quality Assurance Plan. n. Make of all bought out items. o. Deviation list p. Spares list q. Hoist / Crane requirement. r. Reference list of similar projects executed. s. List of proposed makes and vendors t. Training program and schedule for BHEL/ NALCO Personnel u. Equipment maintenance schedules The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified under Annexure-V. However, as minimum the following shall be Submitted. a. Duly filled technical datasheet. b. Warranted performance curves. c. General arrangement drawings indicating dimension and civil loading details. d. Foundation Drawing . e. Motor Data f. Recommended repair procedure etc. g. Operation and maintenance manuals h. Any unique installation instructions shall be noted on the submitted drawings or be provided as a separate document prior to the submission of the Operation and Maintenance Manual. i. Erection schedule and component list. j. Successful Bidder shall submit Calculation for HT Motor power requirement for sizing HT Motor within 2 weeks from the date of ordering. k. The characteristic curves of Recirculation pumps shall be provided along with the documents. These shall be identical and uniform for all the pumps. The pumps

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S.No	Description
	shall be designed for optimum power consumption and should not fall under surge point between the operating range. I. The following characteristic curves of the pump shall be submitted: i. Flow v/s Head ii. Flow v/s NPSH iii. Flow v/s Efficiency iv. Flow v/s power consumption v. Torque vs. speed curve for Motor selection The system-resistance Point at different loads shall be indicated in the above performance curves. Drawings reviewed by the NALCO/ 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. NALCO/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. Bidder must furnish all necessary GA drawings, sections, sub-assembly drawings, specifications of main, sub components, and necessary set of operation & maintenance manual as asked by NALCO in soft & hard copies. 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, and 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 NALCO 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.

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21.0 ANNEXURES

ANNEXURE-I (PROVENNESS CRITERIA)

QUALIFYING REQUIREMENTS FOR EQUIPMENTS/ SYSTEMS

Bidder should have previous experience of manufacturing and supplying of Slurry Recirculation Pumps for the FGD system with a minimum pump rating as stipulated below such that the pump should have been in successful operation in at least one plant for a period not less than one year as per Techno-Commercial BID.

Type and Rating for Qualification (Bidder shall refer the document enclosed).

Name of Equipment	Type of Equipment	Application	Equipment Rating
Slurry Recirculation Pumps	Centrifugal type	FGD Application	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump as Minimum.

Bidder shall offer and supply only the type of the above equipment(s) for which the he himself is qualified.

Bidder to furnish end-user performance Certificate to meet the above qualification requirement.

SIGNATURE OF BIDDER

NAME

DESIGNATION

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ANNEXURE – II

TECHNICAL DATA SHEET

Sl. No	Description	Data
1.0	GENERAL	
	a. Client	: BHEL-Ranipet
	b. Project	: Nalco FGD 18.5M W
	c. Ultimate Customer	: NALCO
	d. Location	: Damanjodi village, Semiliguda block, Koraput district in Odisha
	e. Service	: Continuous
	f. Installation	: Inside steel structure shed with roof side sheeting
	g. No of pumps for each unit	: 2W + 1S
	h. Total number of pumps for all units	: 03 No's
2.0	MANUFACTURER DETAILS	
	a. Model	: Bidder to provide
	b. Type	: Centrifugal
	c. Type of Driver	:
3.0	OPERATING CONDITION	
	Medium to be handled	: Gypsum slurry
	Maximum solid particle size	: 200 mesh (75 microns)
	Normal solid particle size, d 50	: 325 mesh (43 micron) and fine particles
	Concentration of chloride	: <20,000 ppm (Max)
	Vapor Pressure at Pump	: 0.203 kg/ cm ²
	Viscosity of slurry	: 0.01 Pa. s
	Concentration of slurry	: 30(% by weight)
	SiO ₂ Content	: 4-6 g/l
	Specific gravity of slurry	: 1.215@design and 1.210@ guarantee point
	pH of slurry	: 4-8
	Slurry Temperature	59.3 deg.C (normal) & 70 deg.C (max)
4.0	PERFORMANCE DATA	
	a. Capacity m ³ /hr	: 4700
	b. Head M	: 17.1 Liquid Column
	c. Pump efficiency (Not Less Than 87%)	: Bidder to specify efficiency
	d. BkW Normal / Maximum KW	: Bidder to specify
	e. Motor rating KW	: Bidder to specify
	f. Motor Speed Rpm	: Bidder to specify
	g. Differential pressure (inclusive of losses) Kg/ cm ²	: Bidder to specify
	h. Speed Maximum/ rpm	: Bidder to specify (Max check any

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	Normal/ Minimum	max limit)
i.	Noise level <85 dB(A)	: Bidder to specify noise level.
j.	Performance curve	: Bidder to Provide
4.0	CONSTRUCTION DATA	
a.	Make	: Bidder to specify
b.	Model No.	: Bidder to specify
c.	Suction Rating / Size	: Bidder to specify
d.	Discharge Rating / Size	: Bidder to specify
e.	Type of rotor	: Bidder to specify
f.	Size of rotor Dia mm	: Bidder to specify
g.	Journal bearing: Type / Size:	: Bidder to specify
h.	Thrust bearing: Type / Size:	: Bidder to specify
i.	Bearing cooling required	: Yes / No - Bidder to specify.
j.	Cooling water required qty	: Bidder to specify the quantity
k.	Type of drive with gear box	: Bidder to furnish details
l.	Shaft seal – Mech seal.	: Bidder to confirm and specify make.
m.	Size / Code	: Bidder to specify
n.	Type of coupling	: Bidder to furnish details
o.	Service factor	: Bidder to specify
p.	GD ² at drive shaft end	: Bidder to specify
q.	Rotation viewed from coupling end	: Clock wise / Counter clock wise
r.	Coupling type-flexible	: Bidder to confirm and furnish details.
s.	Coupling make	: Bidder to specify
t.	Base plate common to pump, bearing housing, coupling	: Bidder to confirm
u.	Total weight kg	: Bidder to Provide
v.	Maximum Erection weight kg	: Bidder to Provide
5.0	MATERIALS	
a.	Casing	: Bidder to specify
b.	Impeller	: Bidder to specify
c.	Shaft	: Bidder to specify
d.	Shaft Seal	: Bidder to specify
e.	Base frame	: Bidder to specify

SIGNATURE OF BIDDER

NAME

DESIGNATION

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ANNEXURE III

SCHEDULE OF GUARANTEES

S. No	Description	Data
1.	Rated capacity of pump m ³ /hr.	:
2.	Total head at design capacity M	:
3.	Guaranteed shaft power consumption at rated capacity & head kW	:
4.	Noise level at a distance of 1.0 meter from the equipment at site in all directions and 1.5 m above operating floor dB(A)	:
5.	Maximum vibration (peak to peak amplitude at site) microns	:
6.	Equipment Availability (%)	:
7.	Pump Efficiency (%)	:
8.	Life of Pump wear parts including, Casing liners, bearing etc Hours	: ≥14000 hours operation

SIGNATURE OF BIDDER

NAME

DESIGNATION

	TECHNICAL SPECIFICATION OF RECIRCULATION PUM P NALCO 18.5M W
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ANNEXURE – IV

LIST OF DEVIATIONS/ EXCEPTIONS TO THE ENQUIRY DOCUMENT

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER

NAME

DESIGNATION

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

ANNEXURE -V

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	No of copies With proposal
1.	Clause wise Compliance to Specification	1
2.	Un-Price Sheet	1
3.	Annexure I –Qualification documents along with Attachment 3K	1
4.	Annexure II - Data Sheet	1
5.	Annexure III- Schedule of Guarantee	
6.	Annexure IV- Deviation List	
7.	Annexure VI, Annexure VII	
8.	Performance curve(flow vs total pressure, flow vs efficiency, flow vs power consumption, Torque vs speed for motor selection)	1
9.	Approximate weight of each skid	1
10.	Anchor Plan & Civil foundation Loading details	
11.	Required Electric power & other Utility List	1
12.	General Assembly Drawing	1
13.	Pump and Motor Sizing Calculation	1
14.	Cross-sectional Drawing	1
15.	Sub-Vendor List	1
16.	Spare List (Mandatory, Recommended)	1
17.	Start-up & Commissioning Spares	1
18.	List of Special Tools	1
19.	Delivery Schedule	1
20.	Test Arrangement & Test procedure	1
21.	T-S curve	1
22.	Hoist/ Crane requirement	1
23.	P & I Diagram	1
24.	Catalogue	1

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

B) DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	No of copies After award of contract	Delivery Time
1.	Utility Consumption	1	2 weeks after contract
2.	HT Motor sizing calculation	1	2 weeks after contract
3.	Foundation Data including Anchor plan	1	2 weeks after contract
4.	Performance curve(flow vs total pressure, flow vs efficiency, flow vs power consumption, Torque vs speed for motor selection)	2	2 weeks after contract
5.	Assembly drawings of each equipment	1	1 month after contract
6.	Exploded view, Cross section detail drawing	1	1 month after contract
7.	Data Sheet	1	2 weeks after contract
8.	Lubricating oil list	1	2 months after contract
9.	Special tools list	1	2 months after contract
10.	Installation and assembly procedure	1	4 months after contract
11.	Inspection and Test Procedure	1	1 month after contract
12.	Inspection & Test record	1	In 2 weeks after test
13.	Inspection Certificate	1	In 2 weeks after test
14.	Sub vendors List	1	2 weeks after contract
15.	Manufacturing Schedule	1	2 weeks after contract
16.	Progress report	1	Every month
17.	Proforma Packing List	1	2 months prior to shipping
18.	Approximate weight of each skid	1	2 months after contract
19.	Required Electric power	2	2 weeks after contract
20.	Pump and Motor Sizing Calculation	1	2 weeks after contract
21.	Material Test Certificates	2	In 2 weeks after test
22.	Pre Commissioning Check List	2	4 months after contract
23.	Quality Plan	4	1 month after contract

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

Sl. No.	Description	No of copies After award of contract	Delivery Time
24.	Operation and Maintenance Manual	• 10 hardcopies and 5 electronic copies in English	4 months after contract
25.	Spare List (Mandatory, Recommended)	1	1 month after contract
26.	Start-up & Commissioning Spares	2	1 month after contract
27.	List of Special Tools	1	1 month after contract
28.	Delivery Schedule	1	2 weeks after contract
29.	Test Arrangement & Test procedure	2	1 month after contract
30.	T-Scurve	2	2 weeks after contract
31.	P & I Diagram	2	2 weeks after contract
32.	Catalogue	2	2 weeks after contract

SIGNATURE OF BIDDER

NAME

DESIGNATION

	TECHNICAL SPECIFICATION OF RECIRCULATION PUM P NALCO 18.5M W
National Aluminum Company Limited: ROS6309 Rev 00	

ANNEXURE-VI

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING (applicable for supplies from outside India)

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

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

	TECHNICAL SPECIFICATION OF RECIRCULATION PUM P NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

ANNEXURE-VII**INSPECTION & TESTING**

(Refer to all clauses for Inspection & testing requirements. Sample QP enclosed)

SIGNATURE OF BIDDER

NAME

DESIGNATION

ANNEXURE -VII -A-SAMPLE MQP

STANDARD QUALITY PLAN										
 Ranipet			MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU			ITEM: RECIRCULATION PUMP SYSTEM: FGD				
QP NO			FGS:723							
REV. NO:			00							
DATE:			12.02.2019							
PAGE NO:			Page 1 of 3							
FORMAT OF RECORD			AGENCY			REMARKS				
			M C N							
9.			D*			** 10.				
11.										

1.0 RAW MATERIALS											
1.1	Volute Casing, Casing Cover	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical Properties test	1 Sample / Heat	Approved GA Drawing / Data Sheet/ Specification	MTC	✓	P	V	V
1.2	Impeller, Wear Plate SS	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical Properties test	1 Sample / Heat	Drawing & Specification	MTC	✓	P	V	V
1.3	Volute Casing	Surface Defects	Major	DPT on machined surface	100%	ISO4987	DPT Report	✓	P	V	V
1.4	Shaft	Chemical Composition	Major	Chemical composition	1 Sample/Heat	Drawing/Specification	Test Report	✓	P	V	V
		Mechanical Properties		Test Report			✓	P	V	V	
		Hardness Test		Test Report			✓	P	V	V	
		Internal Soundness		UT			✓	P	V	V	
1.5	Impeller	Surface & Sub Surface Defects	Major	DPT	Accessible Areas	ISO4987	PT Report	✓	P	V	V

2.0 IN PROCESS INSPECTION											
2.1	Impeller/Volute Casing/ Wear Plate	Surface Condition/ Defects/	Major	Visual and Measurement	100%	Drawing	IR (Protocol)		P	-	Spot Check by BHEL

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.
M: MANUFACTURER / SUB SUPPLIER, C: MAIN CONTRACTOR.
N: CUSTOMER/CONSULTANT P: PERFORM W: WITNESS V: REVIEW OF RECORDS
MA: MAJOR AND MI: MINOR

PREPARED BY



Rakesh Kumar Madhu,(SEr/QA)

REVIEWED & APPROVED BY



K C Gandhi Parimalam,(DGM/QA)

Receipt No : 262852/2021/BAP-WS(CON)

MANUFACTURER'S NAME AND ADDRESS		STANDARD QUALITY PLAN										
ITEM: RECIRCULATION PUMP SYSTEM: FGD		QP NO	FGS:723									
M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU		REV. NO:	00									
		DATE:	12.02.2019									
		PAGE NO:	Page 2 of 3									
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M C N	REMARKS		
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	** 10.	11.	
	SS/ Casing Cover/ Shaft After Machining	Measurement										
2.2	Couplings/Other Parts/Semi finished Products	Verification	Major	Compliance With Order	100%	Drawing		COC	P	-	-	Spot Check by BHEL
2.3	Rotating Parts	Balancing	Major	Static & Dynamic Balancing	100%	ISO 1940	ISO 1940, grade 2.5	Balancing Report	P	V	V	
2.4	Volute Casing	Water Pressure (Static) Testing	Major	Static Pressure Testing of Casing	100%	See Remarks Column	No Leakage	Test Report	P	W	W	Test Pressure at 2x rated head or 1.5x shut of head whichever is higher for 30min
3.0 FINAL INSPECTION												
3.1	Complete Pump Assembly	Completeness	Major	Visual & Dimensional	100%	Manufacturer Drawing		IR	P	W	W	
		Measurement- Flow vs Head(Complete operating range), Power, Efficiency	Major	Performance testing of pump	100%	Approved Drawing /Data Sheet		Performance Test Report	P	W	W	
		Vibration Velocity RMS [MM/S] Bearing Temperature Noise		Measurement	100%	Approved Drawing. Approved Data Sheet		Performance Test Report	P	W	W	
LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. M: MANUFACTURER / SUB SUPPLIER, C: MAIN CONTRACTOR. N: CUSTOMER/CONSULTANT P: PERFORM W: WITNESS V: REVIEW OF RECORDS MA: MAJOR AND MI: MINOR						PREPARED BY 			REVIEWED & APPROVED BY 			
						Rakesh Kumar Madhu,(SEr/QA)			K C Gandhi Parimalam,(DGM/QA)			

STANDARD QUALITY PLAN															
MANUFACTURER'S NAME AND ADDRESS M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU				ITEM: RECIRCULATION PUMP SYSTEM: FGD				QP NO REV. NO: DATE: PAGE NO:				FGS:723 00 12.02.2019 Page 3 of 3			
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS		
1.	2.	3.	4.	5.	M	C/N	7.	8.	9.	D*	** 10.		11.		
		Level RMS[MM/S]													
		NPSH Test	Major	Measurement	1 Pump / each type / design		Design Standard of Pump		NPSH Test Report	✓	P	W	W		
3.2		Leakage Test	Major	Leakage Testing	100 % *		Approved Ga Drawing & Data Sheet		IR	✓	P	W	W		
3.3		Strip Down Test Not Required If Performance Test is Fine	Major	Visual	100%		Mfg. Drawing, Approved Data Sheet			✓	P	W	W		
3.4	Painting	Dry Film Thickness/Color	Major	Visual & Measurement	Spot Check		Approved Painting Scheme		IR(Protocol)	✓	P	V	V		
4 DOCUMENTATION															
4.1	Check of Quality Assurance Documentation	Compliance to MQP	Major	Check of Compliments	100%		Manufacturing Quality Plan		Protocol	✓	V	V	V		

NOTE: Electrical Motor for Recirculation Slurry Pump is in BHEL Bhopal Scope. Separate MQP to be submitted for Motor.

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. M: MANUFACTURER / SUB SUPPLIER, C: MAIN CONTRACTOR. N: CUSTOMER/CONSULTANT P: PERFORM W: WITNESS V: REVIEW OF RECORDS MA: MAJOR AND MI: MINOR	PREPARED BY 	REVIEWED & APPROVED BY 
Rakesh Kumar Madhu,(SEr/QA)		K C Gandhi Parimalam,(DGM/QA)

Note:- QAP attached for reference - Inspection stage / type of check / quantum of check may change in case of project or customer specific requirements (if applicable).

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

ANNEXURE-VIII
Instruments Specification

A). SPECIFICATION FOR PRESSURE MEASUREMENT

S.NO	FEATURES	ESSENTIAL/ MINIMUM REQUIREMENTS
<u>1</u>	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.
<u>2</u>	Material of Sensing element	SS 316
<u>3</u>	Material of movement	SS 304
<u>4</u>	Body material	Die-cast aluminium
<u>5</u>	Dial size	150mm
<u>6</u>	End connection	1/2 inch NPT (M)
<u>7</u>	Accuracy	± 1% of span
<u>8</u>	Scale	Linear, 270° arc graduated in metric units
<u>9</u>	Range selection	Shall cover 125% of max. operating press
<u>10</u>	Over range	125% of FSD
<u>11</u>	Housing	Weather and dust proof as per IP-55
<u>12</u>	Zero/span adjustment	Provided
<u>13</u>	Identification	Engraved with service legend or laminated phenolic name plate
<u>14</u>	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve
<u>15</u>	List of Supplier	1. GIC 2. H.GURU 3. WAREE 4. INDUSTRIAL INSTRUMENTATION 5. WIKA 6. GENERAL INSTRUMENTS 7. GOA INSTRUMENTS 8. AN INSTRUMENTS

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

B). SPECIFICATION FOR TEMPERATURE MEASUREMENT

<u>S.NO</u>	<u>FEATURES</u>	<u>ESSENTIAL/ MINIMUM REQUIREMENTS</u>
<u>1</u>	Type of RTD.	Three wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
<u>2</u>	No. of element	Duplex
<u>3</u>	Housing/Head	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
<u>4</u>	Insulation and sheathing of RTD	Mineral (magnesium oxide) insulation and SS316 sheath,
<u>5</u>	Calibration and accuracy	As per IEC-751/ DIN-43760 Class-A for RTD
<u>6</u>	Accessories	Thermo well and associated fittings
<u>7</u>	Standard	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.
<u>8</u>	Quantity	6
<u>9</u>	List of Supplier	1. NAGMAN 2. TEMPSSENS 3. TOSHNIWAL INDUSTRIES 4. PYROELECTRIC 5. GIC 6. GOA INSTRUMENTS 7. ALTOP 8. FUJI

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

	TECHNICAL SPECIFICATION OF RECIRCULATION PUMP NALCO 18.5MW
National Aluminum Company Limited: ROS6309 Rev 00	

ANNEXURE-IX**Painting Scheme**

Service Condition : Exposed to atmosphere					
Surface Preparation : Power Tool Cleaning					
Coating Procedure :					
S No.	Coat	Paint	No. of Coats / DFT	Shade	Total DFT μm (min)
1.	Primer coat	Red oxide Zinc phosphate primer as per IS 12744	2 Coat/DFT= 30μm per coat (2x30 = 60 μm (min))	--	120 μm (min)
2.	Intermediate Coat	--	--	--	
3.	Finish coat	Synthetic enamel as per IS 2932.	2 Coat/DFT= 30μm per coat (2x30 = 60 μm (min))	smoke grey shade 692 of IS 5	
Colour Code : Shade smoke grey shade 692 of IS 5					

Note:-

- The above painting schedule is tentative. Painting shall be carried out as per end customer approved painting schedule, which will be informed during the contract stage.
- Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder.
- Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope.
- Bidder should submit shop Painting certificate. Shop Painting Certificate as per format FM VIA shall be submitted.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

BHARAT HEAVY ELECTRICALS LIMITED**RANIPET – 632 406****QUALITY ASSURANCE (MECHANICAL)**

BAP: QA: MECH: 235

Dt: 15.04.2021

Item Name	Indent No.	Indent Date	Work Order	PGMA	Technical Specification
Recirculation Pumps	RFW01142	31/03/2021	R182	FW212	ROS:6309 / REV.00
	RFW01143	31/03/2021	R182	FW212	

Quality Assurance (Mechanical) comments as below:

1. Since RC Pumps appears under Sub-QR item/ Cat- I approved vendor by Customer, Customer approved vendor is acceptable to Quality also. Applicable vendor list shall be obtained from commercial coordinator.
2. Inspection and testing shall be done as per approved Quality Plan, Quality plan to be approved by customer / NTPC after review of BHEL.
3. Panting shall be as per customer approved painting schedule.
4. Arrange acceptance on our QP from sub QR cleared vendor for taking up with customer for their review and approval. Find herewith our QP (QP No. FGS: 723, Rev: 00 DT: 13.10.2020). This MQP contains minimum check with nil deviation applicable and actual quantum of check / stage may differ based on project / customer requirement and their approved MQP.
5. All the items shall be inspected at manufacturer works as per BHEL approved QP, Drawing, approved data sheet and relevant standard.
6. BHEL authorized representatives shall have the right to witness the necessary inspection and testing of goods mentioned in the P.O. The supplier shall inform BHEL in advance about the readiness of the goods for inspection and testing. Material test certificates / Inspection reports as per approved quality plan shall be submitted to BHEL.
7. Annexure-Q and BOI's detail shall be a part of the enquiry file and shall be filled by supplier with their duly sign and seal.
8. Packing of the items shall be as per BHEL Engineering approved packing drawing / data sheet / Specification / Packing procedure.
9. General inspection notes.
 - a. Latest version of standards & Specification shall be applied
 - b. Materials shall be procured in compliance to Functional Technical Specification.
 - c. Gauges and measuring instruments with valid calibration only shall be used.
 - d. BHEL /BHEL Authorized representatives shall have the right to witness the necessary inspection and testing of goods mentioned in the PO.
 - e. Inspection / Inspection wavier / approval by BHEL do not absolve Supplier's responsibility for conformity of the specification as per the terms of PO.
 - f. In case of Vendor Drawing & Datasheet, it needs approval by BHEL Engineering.
 - g. QP shall be read along with relevant PO, BHEL drawing and approved data sheet.


Prepared by.
Rakesh Kr Madhu (Dy.Mgr/QA)

Reviewed & Approved by.
K Renjith(Mgr/QA)

 Ranipet	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN							
			ITEM: RECIRCULATION SLURRY PUMP				PROJECT:			
			SYSTEM: FGD APPLICATION				OWNER:			
			QP NO.	FGS: 723, REV:00		DATE: 13.10.2020		MAIN CONTRACTOR		M/S BHEL, RANIPET
						PAGE NO:		Page 1 of 4		
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1.	2.	3.	4.	5.	M C/N	7.	8.	9.	D* ** 10.	11.

1.0 RAW MATERIALS

1.1	Volute Casing, Casing Cover	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical Properties test, Hardness check	1 Sample / Heat	NTPC Approved GA Drawing / Data Sheet/ Specification		MTC	√	P	V	V	
1.2	Impeller, Wear Plate.	Chemical & Mechanical Properties	Major	Composition analysis & Mechanical properties test, Hardness check	1 Sample / Heat	Drawing & Specification		MTC	√	P	V	V	
1.3	Volute Casing	Surface Defects	Major	DPT on machined surface	100%	ISO4987	ISO4987	DPT Report	√	P	V	V	
1.4	Shaft	Chemical Composition	Major	Chemical composition	1 Sample/Heat	Drawing/Specification		Test Report	√	P	V	V	
		Mechanical Properties		Mechanical Tests, Heat treatment if applicable		Drawing/Specification		Test Report	√	P	V	V	V, HT Chart Review
		Hardness Test		Mechanical Hardness	100%	Drawing/Specification		Test Report	√	P	V	V	
		Internal Soundness		UT	100%	ASTM A 388	ASTM A 388	UT Report	√	P	V	V	

Legend: * Record, identified with "tick" (√) under column 'D' shall be submitted to customer as a QA documentation package.

M: Manufacturer / Sub supplier, **C:** Main Contractor/BHEL/BHEL AIA.

N: NTPC (Owner/ Owner (QA &I) Consultant) **P:** Perform: witness, **V:** review of records, **MA:** Major and **MI:** Minor, **DPT:** Dye Penetrant Test, **UT:** Ultrasonic Testing **TC:** Test Certificate, **IR:** inspection report, **MTC:** Material Test Certificate.

COC: Certificate of conformance.

Rakesh Kr Madhu (Dy Mgr / QA)	K Renjith (Mgr / QA)	R Arunachalam (DGM/QA)
Prepared by	Reviewed by	Approved by

 Ranipet	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN										
			ITEM: RECIRCULATION SLURRY PUMP				PROJECT:						
			SYSTEM: FGD APPLICATION				OWNER:						
			QP NO.	FGS: 723, REV:00		DATE: 13.10.2020		MAIN CONTRACTOR		M/S BHEL, RANIPET			
						PAGE NO:		Page 2 of 4					
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
1.	2.	3.	4.	5.	M C/N	7.	8.	9.	D*	M C N	10.	11.	
		Surface & Sub Surface Defects		MT-on m/c Surface	100%	ASTM E709	ASTM E709	MT Report	√	P	V	V	MT-Magnetic Particle Test
1.5	Impeller	Surface & Sub Surface Defects	Major	DPT	Accessible Areas	ISO4987	ISO4987	DPT Report	√	P	V	V	
2.0 IN PROCESS INSPECTION													
2.1	Impeller/Volute Casing/ Wear Plate / Casing Cover/ Shaft After Machining	Surface Condition/ Defects/ Measurement	Major	Visual and Measurement	100%	Drawing		IR (Protocol)		P	-	-	Spot Check by BHEL
2.2	Couplings/Other Parts/Semi finished Products	Verification of TC	Major	Review of TC	100%	Drawing, Balancing as per ISO1940, Gr 2.5 or Lower		COC & Balancing Report	√	P	V	-	Spot Check by BHEL
2.3	Rotating Parts	Balancing	Major	Static & Dynamic Balancing	100%	ISO 1940	ISO 1940, grade 2.5 or lower	Balancing Report	√	P	V	V	
2.4	Volute Casing	Water Pressure (Static) Testing	Major	Static Pressure Testing of Casing	100%	See Remarks Column	No Leakage	Test Report	√	P	W	W (\$)	Test Pressure at 2x rated head or 1.5x shut of head whichever is higher for 30min.
3.0 FINAL INSPECTION													

Manufacturer Sign & Seal	Legend: * Record, identified with "tick" (√) under column 'D' shall be submitted to customer as a QA documentation package. M: Manufacturer / Sub supplier, C: Main Contractor/BHEL/BHEL AIA. N: NTPC (Owner/ Owner (QA &I) Consultant) P: Perform: witness, V: review of records, MA: Major and MI: Minor, DPT: Dye Penetrant Test, UT: Ultrasonic Testing TC: Test Certificate, IR: inspection report, MTC: Material Test Certificate. COC: Certificate of conformance.			
		Rakesh Kr Madhu (Dy Mgr / QA)	K Renjith (Mgr / QA)	R Arunachalam (DGM/QA)
		Prepared by	Reviewed by	Approved by

 Ranipet	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN											
			ITEM: RECIRCULATION SLURRY PUMP					PROJECT:						
			SYSTEM: FGD APPLICATION					OWNER:						
			QP NO.	FGS: 723, REV:00		DATE: 13.10.2020		MAIN CONTRACTOR		M/S BHEL, RANIPET				
						PAGE NO:		Page 3 of 4						
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1.	2.	3.	4.	5.	M	C/N	7.	8.	9.	D*	** 10.			11.
3.1	Complete Pump Assembly	Completeness	Major	Visual & Dimensional	100%	*	Approved GA Drawing	IR	√	P	W	W		
		Measurement- Flow vs Head(Complete operating range), Power, Efficiency	Major	Performance testing of pump	100%	*	Approved Drawing /Data Sheet	Performance Test Report	√	P	W	W	*BHEL to witness 100% and NTPC- one Pump random.	
		Vibration Velocity RMS [MM/S] Bearing Temperature Noise Level RMS[MM/S]		Measurement	100%	*	Approved Drawing. Approved Data Sheet	Performance Test Report	√	P	W	W		
		NPSH Test	Major	Measurement	1 Pump / each type / design		Design Standard of Pump	NPSH Test Report	√	P	W	W		
3.2	Complete Pump Assembly	Leak test	Major	Leakage testing	100%		Mfg. Drawing, Approved Data Sheet	No Leakage	Report	√	P	W	W	
3.3		Strip Down Test (Not Required If Performance Test is Fine.)	Major	Visual	100%		Mfg. Drawing, Approved Data Sheet		Report	√	P	W	W	Only Required in case of Abnormal Sound
3.4	Painting	Dry Film Thickness/Color	Major	Visual & Measurement	Spot Check		NTPC Approved Painting Schedule	IR(Protocol)	√	P	V	V		
4.0 DOCUMENTATION														

Manufacturer Sign & Seal	Legend: * Record, identified with "tick" (√) under column 'D' shall be submitted to customer as a QA documentation package. M: Manufacturer / Sub supplier, C: Main Contractor/BHEL/BHEL AIA. N: NTPC (Owner/ Owner (QA &I) Consultant) P: Perform: witness, V: review of records, MA: Major and MI: Minor, DPT: Dye Penetrant Test, UT: Ultrasonic Testing TC: Test Certificate, IR: inspection report, MTC: Material Test Certificate. COC: Certificate of conformance.			
		Rakesh Kr Madhu (Dy Mgr / QA)	K Renjith (Mgr / QA)	R Arunachalam (DGM/QA)
		Prepared by	Reviewed by	Approved by

 Ranipet	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN											
			ITEM: RECIRCULATION SLURRY PUMP				PROJECT:							
			SYSTEM: FGD APPLICATION				OWNER:							
			QP NO.	FGS: 723, REV:00		DATE: 13.10.2020		MAIN CONTRACTOR		M/S BHEL, RANIPET				
						PAGE NO:		Page 4 of 4						
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1.	2.	3.	4.	5.	M	C/N	7.	8.	9.	D*	** 10.			11.
4.1	Check of Quality Assurance Documentation	Compliance to MQP	Major	Check of Complements	100%		Manufacturing Quality Plan	Protocol	√	V	V	V	V	

NOTE: 1. (\$) - 10 % for NTPC (Owner / Owner (QA &I) Consultant).

2. For HT Motor Separate MQP to be submitted.

Record of revision

Rev no	Date	Description
00	13.10.2020	Original Issue – First submission.

Manufacturer Sign & Seal	Legend: * Record, identified with "tick" (√) under column 'D' shall be submitted to customer as a QA documentation package. M: Manufacturer / Sub supplier, C: Main Contractor/BHEL/BHEL AIA. N: NTPC (Owner/ Owner (QA &I) Consultant) P: Perform: witness, V: review of records, MA: Major and MI: Minor, DPT: Dye Penetrant Test, UT: Ultrasonic Testing TC: Test Certificate, IR: inspection report, MTC: Material Test Certificate. COC: Certificate of conformance.			
		Rakesh Kr Madhu (Dy Mgr / QA)	K Renjith (Mgr / QA)	R Arunachalam (DGM/QA)
		Prepared by	Reviewed by	Approved by

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Annexure Q		
	Indent No:	Enquiry no:
Sl.No	BHEL / Customer Requirements	##Specific confirmations by the manufacture(Acceptable/Not acceptable)
1	Quality Plan Requirement: (If SQP is not given & Vendor QP applicable)	
	(i) MQP (Manuafcutering Quality Plan) shall be submitted in attached format for BHEL/Customer review & approval. Our SQP/Typical MQP/ MQP Format is attached for guidance & use.	
	(ii) MQP shall invariably cover w.r.t Inward inspection including on Raw materail Procurement, In process and Final inspection in elaborated way/details.	
	(iii) Bidder shall also to give specific confirmation that on need basis, their competent officials shall visit to BHEL/customer for finalization of Quality plan including test procedure/methodology during preaward / post award approval / detailed engineering in the event of an order.	
	(iv) No deviation on BHEL/Customer approved MQP/ SQP (In case BHEL SQP is provided) is acceptable.	
	(v) Bidder shall agree to submit all cross referred documents other than codes/standrads to BHEL/Customer/Consultant.	
2	Important Notes shall be included in MQP : (a) Latest revision of Standard s & Specification shall apply. Only International Standards are applicable. (b) Materials shall be procured in compliance to Functional Technical Specification. (c) Inspection shall be in compliance with Approved Quality Control Procedure for the Product. (d) NDT shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V. (e) Gauges and measuring Instruments, with valid calibration only shall be used. (f) Cleaning and Painting of products shall be carried out as per Approved Painting Schedule. (g) Finished Products shall be packed to comply with Approved Packing Schedule. (h) Welding shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V.	
	Domestic / Inland Inspection will be carried out by BHEL/BHEL apointed Third Party Inspection Agency (TPIA) / Customer/Customer Apointed Inspection Agency/Consulatnat. This is applicable for all Stage inspection and Final Inspection identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID / PFD / SLD (Process Instrumentaion Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable).	
3	Inspection Agency for Foreign Bidders and also for Indian Bidder but importing from Forgign Sources: (1) Any one of the flowing Third Party Inspection Agency (TPIA) shall be appointed by the bidder and same shall be furnished by the bidder in techno commercial bid itself. (2) The details of TPIA with contact details like Name of the official, Phone no, Email id shall also to be submitted during pre/post award. However cost for such inspection agency shall be borne by the bidder only. Inspection charges for such inspection agency shall be indicated separately so that if BHEL/Customer is undertaking the inspection by on their own , then these charges non claimable by the bidder. <u>List of TPIA</u> 1.M/s Bureau Veritas 2.M/s TUV-Nord 3.M/s TUV-SUD 4.M/s TUV Rheinland 5.M/s Lloyds Register 6.M/s SGS 7.M/s Germanischer Lloyds 8.M/s QUEST 9.M/s Certification Engineers International 10.M/s Intertek 11.M/s IR Class Systems and Solutions 12.M/s DNV 13. M/s Fichtner 14. M/s ABS Inspection Services	

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Sl.No	BHEL / Customer Requirements	##Specific confirmations by the manufacture(Acceptable/Not acceptable)
4	Stage Inspection during manufacturing Process : Stage Inspection during manufacturing shall be carried out as per approved quality plan and all necessary documents shall be provided for review, verification and clearance for further processing. This inspection call shall be given well in advance (atleast 2 weeks before for Indeginious and 45 days for foreign) to TPI/Bidder's own inspection agency to avoid delay in the manufacturing processes.	
5	Inspection before despatch for domestic supplier : Inspection before despatch at supplier's works shall be carried out by Bidder appointed Inspection agency(As in SI no.3.) Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet .	
6	Inspection at Forign Source/Supplier: (a) As in sl no: 3. shall be ensured without fail (b) No materail / items shall be despatched without getting the written communication from BHEL / Customer inspection carried out by Bidder apointed Third Party Inspection Agency (As per SI no.3) / Customer/Customer Apointed Inspection Agency/Consulatnat. This is applicable for all Stage inspection and Final Inspection identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID / PFD / SLD (Process Instrumentaion Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable). Inspection before despatch for Foreign supplier : Inspection before despatch at supplier's works shall be carried out by bidder appointed inspection agencies having international presence at vendors and or vendor's sub vendor works. Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet by TPIA mentioned in SI no: 03 at supplier's cost.	
7	Painting shall be done strictly as per BHEL/Customer approved painting schedule / scheme only. Paint Thickness / Paint shade shall be ensured as per BHEL / Customer approved painting schedule / specification / data sheet etc. No deviation is acceptable unless otherwise accepted by BHEL/Customer in writing. Any conflict if any among BHEL / Customer approved painting schedule / Spec / data sheet etc shall be brought to the notice to BHEL well in advance before proceeding including the BOI being procured for assy / skid like motors etc	
8	Specific conformation for document package in the event of an order (2 Hard copies & soft copy in PDF file) is to be given containing the following with proper linkages (i) Index Sheet (ii) MQP/RQP/Endorsement Sheet (As applicable) (iii) TCs identified by BHEL/ Customer for record for "CHP" / "W" and Verification portion ("V") as given in approved QP. (iv) Final inspection report + TC including Chemical + Mechnaical + HT + NDT etc (v) Third party Inspection report + TC (vi) Customer CHP/ MDCC (vii) Type test / Performance Test reports conducted (viii) Type test / Performance Test approval/ clearance obtained from BHEL/Customer (ix) BOM with As Build Drgs with actual make / rating used with BHEL/customer approved drawings.	
9	Packing / Seaworthy Packing shall be as per BHEL Packing schedule / approved drg / sketch. This shall be ensured to take care tarsnit / handling / transhipment in Road / Sea / Air. Photographs are to be submitted for BHEL review before despatching the material as per contract conditions.	
10	Outsourcing of test facilities: Bidder shall ensure all the testing facilities in house. However If any of the test facilities are not available with successful bidder, then bidder shall ensure the same at NABL accreadted third party lab / Govt / Govt Lab for major testing such as NDT, Electrical & Mechanical testing.	
11	Important Note: No deviation on the above requirement 01 to 10 is acceptable w.r.t Quality Requirement and those offers not meeting these specific customer requirement is liable for rejection and hence the bidder shall submit all the required documentary evidences in the offer itself.	
12	## Necessarily to be filled up by the bidder at the time of offer itself otherwise the offer may not be considered w.r.t Quality Requirement being customer specific requirement.	
13	If the OEM/Principal engaging the services of an agent to participate on their behalf, Then mention OEM /vendor Name & address as well as agent details with their sign and seal.	
VENDOR SIGN AND STAMP:		Vendor Name & Address:

Details of BOI's/ Sub Systems with respect to Main Items

Sl No.	Item/ Sub system Name	Quantity	Supplier Name	Place of Manufacturing
OEM (ORIGINAL EQUIPMENT MANUFACTURER) SEAL AND SIGN.				