

**TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAMANJODI 18.5 MW****FGD:NALCO:AGITATORS:R00****BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)****Flue Gas Desulphurization Group-FGD,
Ranipet****TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAMANJODI 18.5 MW**

SPECIFICATION NO : **NALCO:DMNJDI:FGD: AGITATORS**
END CUSTOMER : **NALCO**
BUYER (EPC) : **BHEL, BAP Ranipet**
PROJECT : **DAMANJODI 18.5 MW COGENERATION PLANT**
APPLICATION : **WET LIMESTONE FLUE GAS DESULFURISATION**

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REV	Date	Description	Prepared	Checked	Approved

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I) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

Sl. No.	Description	Offer part	Purpose
1.	Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents)	Part -1	Qualification requirement for considering the offer
2.	Reference list – Annexure-I	Part -1	Qualification requirement for considering the offer
3.	Compliance to the technical specification (Complete Specification with Signature and Seal along with filled Annexures)	Part-1	Technical evaluation
4.	Data sheet of all Agitators (As per Annexure-II)	Part -1	Technical evaluation
5.	GA drawing, Exploded view with Material of construction, total weight of all Agitators models offered	Part -1	Technical evaluation
6.	Performance curve & TS curve of Agitators	Part -1	Technical evaluation
7.	GA drawing of Electrical motor & Data sheet and performance curves of all motors (As per Annexure-IV)	Part -1	Technical evaluation
8.	Schedule of Guarantees (Annexure-V) specific to the Enquiry	Part -1	Technical evaluation
9.	List of Deviations (Annexure-VI)	Part -1	Technical evaluation
10.	Mandatory Spare list	Part -1	Technical evaluation
11.	Agitator Motor Sizing Calculation (Annexure-III)	Part -1	Technical evaluation
12.	Motor vendor list and mechanical seal vendor list	Part -1	Technical evaluation
13.	Quality Plan	Part -1	Technical evaluation
14.	Start-up & Commissioning Spares	Part -1	Technical evaluation
15.	List of Special Tools	Part -1	Technical evaluation
16.	Catalogue	Part -1	Technical evaluation
17.	Priced offer	Part -2	Commercial evaluation



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II DOCUMENTS TO BE SUBMITTED AFTER CONTRACT:

Sl. No.	Description	Purpose	Delivery Time
1.	GA drawing, Exploded view, sectional view with Material of construction, mechanical seal , gearbox for all Agitator models	END CUSTOMER/BHEL approval to start manufacturing	2 week
2.	Data sheet for all Agitator	END CUSTOMER/BHEL approval to start	2 week
3.	Agitator Performance curve of all Agitators	END CUSTOMER/BHEL approval to start	2 week
4.	Electrical motor GA drawing & Data sheet and performance curves of all motors	END CUSTOMER/BHEL approval to start manufacturing	2 week
5.	Quality plan & Inspection and Test Procedure	END CUSTOMER/BHEL approval for inspection	2month after contract
6.	Agitator and Motor Sizing Calculation (Annexure-III)	END CUSTOMER/BHEL approval to start	2 week
7.	Bending moment calculation	END CUSTOMER/BHEL approval to start manufacturing	2 week
8.	Utility Consumption	To arrange utility	2 week
9.	Foundation Data including Anchor plan	To civil design	2 week
10.	Lubricating oil list	Record purpose	4 week
11.	Special tools list	For maintenance	4 week
12.	Installation and assembly procedure	For erection	4 week
13.	Approximate weight of each skid	To arrange lifting device	4 week
14.	Pre Commissioning Check List	For erection	4 week
15.	Operation and Maintenance Manual	For O&M	4 week
16.	Start-up & Commissioning Spares	For commissioning	4 week
17.	List of Special Tools	For arranging	4 week
18.	P & I Diagram (if applicable)	For information	4 week

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1.0 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 Agitator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards.

2.0 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 & performance testing at bidder's works/ site of Agitators along with accessories which is furnished in the Flue Gas Desulphurization plant for END CUSTOMER Project. The following points have to be noted.

- a. Agitators are envisaged in various tanks, details of which are given in Technical Information of Agitators.
- b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
- c. The Bidder shall offer only proven design which meets the Provenness /Pre-qualification requirement of END CUSTOMER. Necessary document evidences as per **Attachment-3K for qualification** shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their offer will be rejected.
- d. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry Document (**ANNEXURE VI- LIST OF DEVIATIONS OR EXCEPTIONS TO THE ENQUIRY DOCUMENT**)
- e. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- f. No deviation or exception shall be permitted without the written approval of the purchaser.
- g. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- h. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- i. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.



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3.0 PROVENNESS CRITERIA/ Pre-QUALIFICATION REQUIREMENT:

The Bidders are required to meet the Qualification Requirement (PQR) for Agitators as per Provenness Criteria & shall submit the credentials as called in Attachment 3K. Only OEMs qualifying as per the Qualification requirement shall be considered for placement order.

4.0 POWER SUPPLY DETAILS:

Voltage and frequency ranges applicable are as shown below :

HT	For > 185kW rated motors	Voltage: 6.6kV +/-10%, Frequency: 50hz +/-3% , 3Phase - 3wire
LT	For < 180kW rated motors	Voltage: 415V +/-10%, Frequency: 50hz +/-5% , 3Phase - 4wire

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Manufacturing, 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 END 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 AGITATORS shall include but not limited to the following:

A) For Horizontal (Side Entry) Agitators:

Sl. No	Scope
1.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Single Mechanical Seals
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings



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Sl. No	Scope
viii.	Agitator Mounting Flanges with gaskets and fasteners
ix.	Drive Motor(IE3) with gearbox / belt and pulley arrangement
x.	Supporting arrangement of Side Entry Agitator on the tank Wall. Vessel Nozzle and mating flange for supporting on the tank wall , gaskets and fasteners
xi.	Flushing system for start up consisting of : Pipe with Flange , Nozzle and mating flange, Blind flange for plugging.
xii.	Foundation plate with foundation bolts, vessel nozzle
xiii.	Painting and Rust Prevention during shipment and construction
xiv.	Supervision of Erection & commissioning at site
xv.	Special tools & tackles as applicable
xvi.	Start-up spares as applicable
xvii.	Installation, operation and maintenance manuals
xviii.	Any other items required for completeness of the equipment except the items covered in the exclusions.

B) For Vertical (Top Entry) Agitators :

Sl. No	Scope
2.	AGITATOR complete with
i.	AGITATOR Blades
ii.	AGITATOR Shafts
iii.	Coupling arrangement (Flexible)
iv.	Gland Packing, Seals, O Rings, Glands
v.	Shaft Sleeve
vi.	Lanterns/ Stools (Bearing Housing), Safety Guard
vii.	Bearings
viii.	AGITATOR Mounting Flanges with gaskets and fasteners. Foundation Bolts, in case of Drain Sump Agitators , where the top of the tank is made of concrete.
ix.	Drive Motor(IE3) with gearbox/ belt and pulley arrangement
x.	Mating Flange for Supporting on Slurry Tank Roof
xi.	Painting and Rust Prevention during shipment and construction
xii.	Supervision of Erection & commissioning at site
xiii.	Special tools & tackles as applicable
xiv.	Start-up spares as applicable
xv.	Installation, operation and maintenance manuals
xvi.	Any other items required for completeness of the equipment except the items covered in the exclusions.

5.1	TECHNICAL REQUIREMENTS
1.	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc. The agitators shall be motor operated, robust in construction and capable of agitating limestone slurry and solid from time to time to prevent settlement of the slurry in the



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	tanks
2.	All agitators shall be designed for continuous operation unless otherwise specified. The design of the agitators shall be of proven type. CFD analysis, if required, shall be provided during detailed engineering or drawing approval stage at no extra cost.
3.	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
4.	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
5.	MOC of various agitator parts shall be as per "Technical Information of Agitators for respective project". This does not release the bidder of the responsibility for selecting the correct materials. All parts which are in contact with slurry or in contact with slurry fumes shall be considered as wetted part. The material selected shall be suitable to the service conditions.
6.	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. Mechanical seals of the agitator(Side entry) shall be replaceable from outside of the tank in operation with minimum fluid leakage from the tank
7.	For horizontally mounted agitators, pressurized shaft sealing and shaft supports shall be provided. Seal water leakage shall be collected and piped to a drain
8.	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.
9.	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
10.	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.
11.	Protective devices shall be provided to prevent over loading of the agitators in case of increased slurry especially during start-up
12.	The agitator must be able to mix up the contents of the tanks even after 24 hours operation break
13.	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.
14.	All exposed moving parts shall be covered by guards.
15.	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s
16.	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions
17.	It shall be noted that all Agitators (except Absorber Agitator, Auxiliary Absorbent Tank Agitator and Drain Sump Agitator) are meant for keeping the solid particles in suspended



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	mode in liquid with "Full off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration". No chemical reaction will take place.
18.	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators. If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.
19.	For Absorber, Auxiliary Tank and Drain Sump Agitators : There shall not be any slurry settlement at the Bottom of the Tank and all solids shall be suspended off the tank bottom (i.e. Off Bottom suspension)
20.	It is to be noted that in continuous process any deposit at tank bottom is the loss of material which are not getting converted as per process. Hence, total loss of material by sedimentation is a loss to FGD Process & determines the "In efficiency of the Agitator".
21.	Vendor should ensure nil settlement; utilization of solid material shall be a guaranteed parameter and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the guarantee parameter.
22.	Agitator and its driver shall perform on the test stand at shop and on the Agitator's permanent location at site within vibration limit the vibration of combined unit will be the responsibility of Agitator manufacturer. Agitator manufacturer is to ensure that Site performance of vibration is one of the "Acceptance Criteria" of the equipment. Please note vibration at test stand can only be taken as for information.
23.	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated as per "Technical Information of Agitators".
24.	Agitator must have low-pitch propeller with low solidity ratio and low Power Number. Power number shall be in the range of 0.3-0.35(preferably) or lower. The Maximum Input Power at motor terminal shall be considered as a guaranteed parameter under "Schedule of Guaranteed Parameters" in "Annexure-V-Schedule of Guarantees"- and the same shall be calculated for maximum liquid level in tank. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted along with the offer. A characteristics curve showing power versus liquid level should be submitted from the lowest liquid level, required for Agitator to maximum liquid level in the tank. Motor should be selected based on the highest power demand with a margin as per clause 5.3.1 at maximum liquid level, taking into account frequency variation.
25.	Bidder shall provide the design and arrangement of baffle plates in circular tanks. Baffle plates are in BHEL scope.
5.2	CONSTRUCTIONAL FEATURES
A)	BLADE AND HUB OF PROPELLER
i)	The type of impeller shall be selected on the basis of suspended solids where the work is being performed. The selected profile shall be consistent with the specified operating conditions ,i.e., the type of tank, solid concentration,etc.
ii)	It must be possible to remove the blades from their joining point. Each blade shall be made of one single piece.
iii)	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption. The Agitator power consumption is part of the guarantee parameters.



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iv)	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence it is mandatory that rotating assembly shall be dynamically balanced to its rated speed.
v)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
vi)	For circular tanks with Top Entry agitator, the tip diameter of the impeller shall be one-third of the Tank diameter.
vii)	For circular tanks with Top Entry agitator, Two level of impellers have to be offered for achieving uniform suspension in case of the following conditions: a) (Slurry Filling Height X specific gravity)/Tank Dia >1, b) (Slurry Filling Height X Specific Gravity)/ Impeller Tip Dia > 4. The tip diameter of both the impellers have to be same for maintaining uniform suspension. However, bidder may propose two level of impellers for other tanks if their standard design permits the same.
B)	SEAL
1.	<u>Horizontal / Side Entry Agitators:</u>
I.	Agitators should be provided with Single Stage mechanical seal. the mechanical seal should be as per ISO-21049 / API 682
II.	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.
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
IV.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
V.	All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
VI.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
VII.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.
VIII.	Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.
IX.	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer the best seal that is suitable for the offered Agitator
X.	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
XI.	The sub-vendor of the seal shall be approved by END CUSTOMER during contract execution.



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2.	<u>Vertical Agitators for Other Slurry Tanks & Drain Pit Tanks</u>
I	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.
C)	SHAFT
	Wherever Shaft has to be Rubber Lining, the thickness shall be minimum 6 mm. Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed. If split shaft is proposed for larger tanks, shaft flange at the joining interface has to be rubber lined at manufacturer's works and necessary fasteners have to be provided.
D)	BEARING & BEARING HOUSING IN GEAR BOX
	Bearing shall be of rolling type radial and thrust bearing (FAG/SKF make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.
	Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hr (minimum).
	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) number G1/2" thread (ISO-228, Part-1) port is required for remote control of temperature of bearing housing oil bath RTD.
	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
	Lubricating oil will be the responsibility of Gear Box 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.
E)	MATERIALS
	Agitator components designated as "Full Compliance Material" shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.
	A detail quality plan is to be submitted along with offer for all items marked "Full Compliance Material".
	Final acceptance of the quality plan will be approved by ultimate user (hereafter called END CUSTOMER). Hence, it is expected that manufacturer to submit quality plan (QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest.



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F)	Driver (Motor)
1	Driver shall be sized to meet all specified operating conditions including bearing housing , seal, external gear box and coupling loss(if any).
2	Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in “Site Power Supply Condition” as per Clause: 4.1.
3	It should meet Motor specification enclosed.
G)	GEAR BOX
	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing and to be manufactured by the Agitator supplier. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box. Rating of at Gear box shall be at least 1.5 times the rated torque of Agitator.
H)	COUPLING & COUPLING GUARD
I.	Coupling and coupling guard should be supplied between driver and driven equipment.
II.	Coupling should be designed taking into consideration adequate service factor.
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer length shall be of sufficient length so than Motor and Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940.
VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.
I)	PLATE AND FASTENING BOLTS
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.
II.	Base plate must have provision of leveling on its intended mounting place. Sole plate is not in the scope of supply of Agitator manufacturer. It should be noted that Sole plate will be rubber lined to prevent any leakage of corrosive gases
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as



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	per requirement of Motor and Gear Box
IV.	Sole plate with desired number of hole, will be machined on one side. Sole Plate shall be welded to the structure after leveling, as recommended by Agitator manufacturer and rubber lining is completed before placing the equipment in its desired location.
J)	OTHER COM PONENTS
	All fasteners used in wetted condition must be of alloy material or better material (bidder shall refer to the Technical Information of Agitators for details regarding the MOC of Wetted Fasteners) so that even if it comes in contact with liquid by swelling of rubber, thread remains unaffected. All fasteners provided inside the tank(even if it is exposed to the slurry vapour) shall be treated as wetted part only. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.
	GENERAL REQUIREM ENT OF SIDE ENTRY AGITATORS:
I.	All Agitators shall be designed for continuous operation.
II.	The Material of Construction (MOC) of side entry Agitators shall be as per Cl 4.0
III.	It should be of Flange mounted type.
IV.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide the nozzle and flange along with the agitator.
V.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.
VI.	<u>The following information to be provided along with the bid:</u> <u>Impeller Diameter</u> <u>Impeller Speed</u> <u>Agitator Pumping Capacity (m³/ min)</u> <u>Volume per Agitator:</u>
	<u>TOP ENTRY AGITATORS IN OTHER SLURRY TANKS & DRAIN PITS:</u>
I.	All Agitators shall be designed for continuous operation.
II.	The Material of Construction (MOC) of Top Entry Agitators shall be as per Cl 4.0
III.	It should be roof mounted.
IV.	Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type coupling between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.



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V.	Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.
VI.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top.
VII.	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.

5.3 MOTOR

➤ **Degree of Protection**

Degree of protection for various enclosures shall be as follows:

- a) Outdoor motors : IP 55
- b) Cable box-Outdoor area : IP 55

➤ **Codes and Standards**

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

➤ **Painting**

Paint shade shall be as per RAL5012

Motors shall be of IE3 energy efficient class. Motor shall confirm to the Specification given in Annexure-IV

6.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipment's. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm ² G. For instance the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, in the documents, and in the displays shall be in English
3.	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.
4.	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
5.	Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor.
6.	The overall vibration level shall be as per ISO 10816.
7.	Suitable drain connections shall be provided.



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S.No	Description
8.	The equipment shall be suitable for stable operation continuously.
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
11.	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.
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 as much as practical to minimize erection at the site.
15.	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.
16.	Bidder shall provide the necessary gaskets.
17.	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.
18.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
19.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
20.	Quality Plan to be submitted along with the offer.
21.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
22.	Material of construction for all equipment/components shall be subject to END CUSTOMER/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
23.	Bidder to provide sub vendor list and Bidder shall strictly adhere to END CUSTOMER approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by END CUSTOMER/ BHEL before placing

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S.No	Description
	order and bidder shall submit relevant documents to take up with END CUSTOMER for approval.
24.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BHEL / END CUSTOMER for all equipment's & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of END CUSTOMER/ BHEL, the same may be replaced with another END CUSTOMER/BHEL approved sub-vendor only, without any price implications to BHEL.
25.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the END CUSTOMER and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the END CUSTOMER along with BHEL.
26.	During detail engineering, bidder to strictly adhere to BHEL/END CUSTOMER drawing formats, document numbering, quality plan & FQP formats
27.	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.
28.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/END CUSTOMER during detail engineering
29.	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
30.	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/END CUSTOMER should be addressed timely by the bidder.
31.	Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.



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S.No	Description
32.	Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work" b. "Not considered in scope of work"
7.0	PACKING AND FORWARDING
1.	Proper packing to be ensured. Indigenous Supply: Agitator & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Agitator internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards PE-TS-888-100-A001. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4.	Crates and packing material used for shipping will become the property of owner.(END 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



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S.No	Description
	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 as per the dispatch instruction gives during the contract: 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 Agitator, BHEL item Code, Gross



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S.No	Description
	Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
8.0	SUPERVISION OF ERECTION, TESTING AND COM MISSIONING
1.	The erection of Agitators will be done by owner as per Erection Manual and check List. However, the bidder shall make visit as per enquiry/PO 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.
3.	All TA/DA, Site Expenses, Travel charges boarding and lodging shall be borne by the bidder and shall be inclusive in supervision portion.
4.	Price comparison for evaluating the lowest bid will be considered all main supply, supervision of E&C charges and mandatory spares price all together.
9.0	EXCLUSION
	The following work associated with the Agitators will be by others: a. Walkways, platforms and ladders b. Element handling hoists.
10.0	INSPECTION AND TESTING
	The General inspection requirements to be considered are as below:



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S.No	Description
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/END CUSTOMER prior to manufacture.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/END CUSTOMER.
3.	Since there is no standard for "Acceptance Test Procedure" for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.
4.	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.
5.	No liquid should enter the tube through any flange joint. "O"-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It is cannot be considered as a guarantee of functional objective of rubber used.
6.	DYNAMICS
7.1	CRITICAL SPEED
7.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
7.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish that the torsional critical speed is well off the operating speed by 20% from the operating speed.
7.2	VIBRATION SEVERITY
7.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.
7.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816, 1.5-2.3mm/sec even if Motor rating falls below 15kw.
7.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
7.2.5	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.



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S.No	Description
8.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
9.	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.
10.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
11.	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.
12.	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.
13.	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.
14.	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.
15.	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
16.	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
17.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
18.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
19.	Bidder to arrange all calibrated gauges, Instruments during inspection.
20.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
11.0	PAINTING
1.	Painting details for agitator support:- Surface Preparation : Blast Cleaning SA 2.5 PRIMER COAT: a. Primer: 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 DFT- 70μ Intermediate : One coat of Two component polyamide cured epoxy with MIO content



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S.No	Description
	(containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100μ . FINISH COAT: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35μ/ coat With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E) COLOUR CODE Base: To be informed during contract stage Lettering: To be informed during contract stage
2.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope
3.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BHEL / END CUSTOMER.
12.0	SPARES, 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.
12.1	START UP & COM MISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Agitators. 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 Agitator 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 equipment's are energized. The List of such spares to be provided during bidding stage
12.2	RECOM M ENDED SPARES
	Bidders shall also furnish the 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 the 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 6 months after placement of Notification of Award for the main equipment
12.3	M ANDATORY SPARES:



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S.No	Description
	Bidder to quote for the mandatory spares as per the Mandatory Spare list given for a specific project. Bidder shall quote for the "Initial Spares Part List", and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years' storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Initial spares shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan. 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.
13.0	PERFORMANCE GUARANTEE
	a) All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. b) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories c) The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. d) Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. e) 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. f) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ END CUSTOMER approval. g) 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.
14.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION:
1.	POWER GUARANTEE
	Bidder to specify the total guaranteed power of the Agitators (i.e. power consumed at Motor



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S.No	Description
	input terminal at normal liquid level) operating at the rated capacity in their offer. Vendor has to submit the calculations for the same.
2.	BID EVALUATION CRITERIA FOR POWER CONSUMPTION: The following agitators will be considered for Power Consumption: a) Limestone Slurry Storage Tank Agitator – 1 No b) Secondary Hydrocyclone Feed tank Agitator-1 No c) Filtrate Water tank Agitator-1 No d) Waste Water tanks Agitator-1 No The ceiling value for the Power consumption will be 28.5 KW considering all the agitators mentioned above. Bidder's offer will be rejected if the quoted power consumption exceeds the ceiling value.
15.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
	If actual Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible = (APC-GPC) X P Where GPC- Guaranteed Power Consumption quoted by bidder in KW APC- Actual Power Consumption in KW N- Total Number of Agitators P- Penalty per KW (INR 1.7 Lac per KW) Note : 1. LD will be levied after conducting performance test as above subjected to the maximum 10% 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.
16.0	WARRANTY/ DEFECT LIABILITY
1.	The Bidder warrants that the equipment's/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 Warranty Period shall be twenty-four (24) months from the date of Supply or eighteen (18) months from the date of commissioning, whichever first occurs. If during the Warranty/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



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S.No	Description
	discretion, determine) such defect as well as any damage to the Facilities caused by such defect.
2.	In case of failure of the equipment to meet the guarantee, END CUSTOMER/BHEL reserves the right to reject the equipment. However, END CUSTOMER/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
17.0	FIRST FILL OF CONSUM ABLES:
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 END 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 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.
18.0	TRAINING
	Successful bidder shall provide comprehensive training for END CUSTOMER/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Agitators - 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 END 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.
20.0	DOCUM ENTATION
A	DOCUM ENTS TO BE SUBM ITTED 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 Offer. Vendors are requested to comply with above in all respect.
B	DOCUM ENTS TO BE SUBM ITTED AFTER AWARD OF CONTRACT



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S.No	Description
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified in this specification. Drawings that are reviewed by the END 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. END 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 END 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 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 END CUSTOMER requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team.



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ANNEXURE-I – REFERENCE LIST

Project :

Enquiry No :

REFERENCE LIST as per format shown below. (Reference plant details for Horizontal and Vertical Agitators)

S.No	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limest one Based FGD Yes/No	Model	Size of Tank	Type / Hor / Vertical	Speed rpm	Year of Commg	Qty

Note :

Bidders shall also submit reference list of Horizontal /Vertical agitators as per the format given above.

BIDDER SIGN : _____

DESIGNATION : _____

DATE : _____

BIDDER SIGN WITH SEAL AND DATE:

**TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W****FGD:NALCO:AGITATORS:R00****Annexure-II TECHNICAL DATASHEET OF AGITATORS (TO BE FILLED FOR EACH AGITATOR)****Project :****Enquiry No :**

Sl.no	General	Units	DATA
1.1	Project		
1.2	Ultimate Customer		
1.3	Location		
1.4	Order Number/Enquiry No		
1.5	Agitator Name		
1.6	Service		
1.7	Installation		
1.8	No. of Agitator per Tank		
1.9	Total No's of Agitator for all the units		
1.10	Type of Agitator		TOP ENTRY/SIDE ENTRY
1.11	Model Number		
1.12	No of Stage(No of propeller per Agitator)		
1.13	Mounting of Agitator		
1.14	Mounting of Gear Head		
1.15	Mounting of Motor		
2	Performance Details		
a.	Input power at Motor terminal at highest frequency and Maximum liquid level in tank	KW	
b.	Input power at Motor terminal at Normal frequency (50Hz) and Normal liquid level in tank	KW	
c.	Motor rating	KW	
d.	Rated speed	rpm	
e.	Critical Speed	rpm	
f.	Tip speed	m/s	
g.	Direction of rotation of Motor and Gear box viewed from Motor non-driving end		
h.	Direction of rotation of Agitator viewed from Gear head end		
i.	Minimum submergence required over blade centre line for continuous operation	mm	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

FGD:NALCO:AGITATORS:R00

j,	Impeller diameter	mm	
k.	Minimum clearance required below impeller centre line	mm	
l.	Maximum liquid level over propeller centre line up to which Agitator can work without overloading of motor at 50Hz	mm	
3	Construction Features		
3.1	Impeller		
	a) Type		
	b) Diameter(tip to tip)	mm	
	c) Hub diameter	mm	
	d) No of blade per Impeller		
	e) Thickness of blade	mm	
3.2	Tube thickness, if any	mm	
3.3	Shaft diameter at coupling (GH-Agitator)	mm	
3.4	Length of Top shaft	mm	
3.5	Connection Details		
	· Blade to Hub:		
	· Hub to Shaft/Tube		
	· Line Shaft to Line shaft		
	· Line shaft to top shaft		
3.6	Bearings in Gear Head		
	Thrust bearings Housing		
	a) Type		
	b) Make		
	Bearing Number		
	· Radial Bearing		
	· Radial Bearing		
	· Thrust Bearing		
	c) Type of lubrication		
	d) Lubricator		
3.7	Coupling between Agitator & Gear Head		
	a) Type		
	b) Make & Model No.		
	c) Rating	KW/rpm	
3.8	Stuffing Box/Mechanical Seal		
	a) Type		
	b) Details of gland packing		
	c) No of packing		
	d) Cooling water		
	e) Lubrication type		
	f) Qty of grease and interval of lubrication.		
4	Material of Construction		
a.	Blade of Impeller		
b.	Hub of Impeller		
c.	Base Plate/Gear head Stand		
d.	Line Shaft & Line shaft Coupling		



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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e.	Impeller Shaft		
f.	Top Shaft		
g.	Gland Sleeve		
h.	Location of Thrust bearing		
i.	Coupling guard		
j.	Fasteners in Wet region		
k.	Fasteners in Dry region		
l.	Stuffing Box		
m.	Gland		
n.	Gland packing		
5	Weight		
	a) Bare Agitator weight Kgs		
	b)Rotating Assembly weight Kgs		
	c) Motor weight Kgs		
	d) Gear Head weight Kgs		
	e)Wt. of the equipment, (a+c+d)		
	f) Heaviest single piece component of Agitator to be handled. Kgs		



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Annexure-III MOTOR SIZING CALCULATION (TO BE FILLED FOR EACH AGITATOR)

Project :

Enquiry No :

S.No	Parameters		Data
1	Tank size (Dimension in m)		
2	Specific Gravity of Slurry	ρ	
3	IMPELLER TIP DIA(in m)	d	
4	AGITATOR SPEED(RPM)	n	
5	POWER NO OF THE AGITATOR	N_p	
6	NO OF IMPELLER STAGES	I	
7	AGITATOR POWER(P)	$N_p * \rho * d^5 * n^3 * I$	
8	GEARBOX EFFICIENCY	η_1	
9	BEARING TRANSMISSION EFFICIENCY	η_2	
10	EFFICIENCY DUE TO ANY OTHER LOSSES	η_3	
11	MECHAINCAL POWER REQUIRED	$\text{Agitator BkW} = P / (\eta_1 * \eta_2 * \eta_3)$	
12	MOTOR EFFICIENCY	η	
13	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency or Agitator BkW	$\text{Power consumed at Motor terminal} = \text{Agitator BkW} / \eta$	
14	MOTOR POWER (KW)	Motor Power shall be at least 1.2 times the Power consumed at Motor Terminal.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Annexure-IV MOTOR SPECIFICATION

SPECIFICATION FOR GENERAL PURPOSE 415 V AC MOTORS (NOTE: TENDERER TO CONFIRM CLAUSE-WISE)

Sl. No.	Description	Requirement	Confirmation by Tenderer
1.0	General	General Purpose 415V Motors, Energy efficient type, generally rated up to 180 KW, with robust industrial design, fully derated for the ambient and duty conditions specified and fully conforming to Indian standards for Design, Construction and Testing features	
2.0	Applicable Standards		
2.1	Flame proof enclosure for electrical apparatus	IEC: 60079-1, 2007	
2.2	Permissible limits of noise level by rotating electrical machines	IS: 12065, 1987 (2009)	
2.3	Mechanical vibration of rotating electrical machines	IS: 12075, 2008	
2.4	Dimensions of 3-phase foot/flange mounted induction motors / vertical shaft motors	IS: 1231 / IS: 2223 / IS: 2254	
2.5	Energy Efficient 3 phase squirrel cage induction motors.	IS: 12615, 2011	
2.6	Method of determination of Efficiency of rotating electrical machines	IS: 4889	
2.7	Designation of methods of cooling of rotating electrical machines	IS: 6362, 1995 (2017)	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
2.8	Rotating Electrical Machines - Rating & Performance	IS/IE:- 60034, Part-1 2004	
2.9	Degree of protection provided by enclosure for rotating electrical machinery.	IS/IEC: 60034, Part-5, 2000 (2007)	
2.10	Terminal marking and direction of rotation for electrical machines	IS/IEC: 60034, Part-8, 2002	
2.11	Methods of measuring temperature rise of electrical equipment	IS: 9678, 1980 (2009)	
2.12	Safety	Central Electricity Authority (CEA), I.E. Rules and guidelines of statutory authorities of Odisha State Government.	
3.0	Environment		
3.1	Voltage/System	415V $\pm$ 10%, Frequency 50 Hz $\pm$ 5%, 3 Phase, 4 wire System, solidly grounded neutral	
3.2	System Short circuit level	36 MVA	
3.3	Altitude/Temperature/RH	Less than 1000 m above MSL / 50 Deg C/ 100% RH	
3.4	Special requirements	Based on actual site requirements/ higher ambient where required	
3.5	Starting requirements for Direct On Line (DOL) starting	All DOL start motors shall be capable of starting and accelerating the coupled loads with 75% of the rated voltage at the motor terminals without injurious heating, within the rated hot thermal withstand time of the motor.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
3.6	Derating	The motor as well as its various components shall be suitably derated for satisfactory operation for specified altitude, ambient temperature, relative humidity, voltage and frequency variations, derating for special requirements stated above.	
4.0	Execution Options		
4.1	Adoption of type of motor		
4.1.1	Squirrel cage induction motors	For continuous duty applications for centrifugal fans/pumps and compressor drives	
4.1.2	Inverter grade motors	For satisfactorily working with IGBT transistor based inverter supplies	
4.2	Location	Indoor / Outdoor	
4.3	Speed (no of Poles)	To suit mechanical equipment supplier's requirement.	
4.4	Type of Mounting	IM 1001 / IM 1002 / other types to suit mechanical equipment supplier's requirement	
4.5	Method of cooling	IC 410 / IC 411 (as per IS 6362)	
4.6	Duty	Continuous duty S1 / other intermittent duties like S2 / S3 / S4 or any other duty to suit driven equipment's requirement / process requirement.	
4.7	Type of Starting / Controls	DOL Starting / IGBT based Inverter Circuit for variable speed drives	
4.8	Type of braking	Type to suit the driven equipment's requirement.	
4.9	No of starts for continuous duty motors	4 cold starts or 3 hot starts on an hourly basis	
4.10	Overload requirement	To suit driven equipment's requirement.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
4.11	Over speed requirement	To suit driven equipment's requirement.	
4.12	Degree of protection	IP 54 for indoor. IP 55 for outdoor with additional removable canopy protection over the motor.	
4.13	Accessories	Brakes / Clutches /Geared Limit switches / encoders /Embedded temperature detectors etc., as may be required for individual application and control	
5.0	Construction details		
5.1	Frame Sizes	To conform to IS / IEC standard frame sizes.	
5.2	Energy Efficient motors for continuous duty applications	Shall conform to category, "IE2 for the VFD application and IE3 for other application as per IS: 12615.	
5.3	Ratings	Ratings shall be as per the preferred series and shall be based on design ambient temperature of 50 deg. C. The rating shall suit the driven equipment's requirement. Nevertheless, the rating of the motors including the over-load requirement selected shall be based on the class of duty and the load imposed by the equipment with a minimum reserve of 10% over the maximum load demand of the driven equipment at the design duty or any other duty that may arise during operation.	
5.4	Starting Current requirements	To be limited to 6 times the rated full load current in the case of squirrel cage motors when started directly on line.	
5.5	Starting Torque Requirements	To suit driven equipment's requirement and in conjunction with the selection of the speed – torque characteristics described in 5.6 below.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
5.6	Matching of Speed-Torque Characteristics	The speed-torque characteristics of the motor and its driven equipment shall be fully matched in order to obtain smooth acceleration without overheating of the motor and over-stressing of the mechanical parts of the driven equipment.	
5.7	Moment of Inertia	The motor inertia shall be taken into account along with that of the driven equipment to arrive at the starting time which shall be within the limit value set by the thermal withstand time (hot) specified for the motor.	
5.8	Pull out torque	Pull out torque as required by the driven equipment shall be considered. However, a minimum 200% at rated voltage and frequency for squirrel cage motors shall be considered.	
5.9	Construction aspects in brief		
5.9.1	Housing	Cast Iron / Fabricated steel	
5.9.2	Stator	Low loss, insulated CRGNO silicon steel	
5.9.3	Rotor	Die cast aluminium / copper bars	
5.9.4	Shaft	Carbon steel EN8 with open key ways as required	
5.9.5	End shield and bearing cover	Cast Iron	
5.9.6	Bearing and lubrication	Ball/roller bearing with Lithium complex based lubrication.	
5.9.7	Oil seal	Synthetic rubber	
5.9.8	Fan	Polypropylene / aluminum alloy, bi-directional and with aerodynamic design	
5.9.9	Fan cover	Deep drawn steel	
5.9.10	Motor feet	To be integrated cast with the stator to prevent breakage from vibrations.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
5.10	Windings and insulation for stator and rotor		
5.10.1	Windings	99.9% pure, electrolytic grade copper windings	
5.10.2	Insulation	Class F for DOL/RDOL application. Class H for VFD application.	
5.11	Temperature Rise	Limited to that of Class B.	
5.12	Terminal Boxes	The terminal boxes shall be of adequate size for terminating the required no. and size of XLPE insulated, armoured, stranded aluminium conductor cables. Adequate clearance shall be given between live terminals and covers. All six terminals shall be brought out in the terminal box for making star or delta connections as needed. Material: Pressed steel / Cast iron - Degree of Protection IP 55 and shall be possible to mount at top. Terminal Plate: DMC /Epoxy board with steel / brass studs. The orientation of the terminal boxes shall be changeable at site through rotation by 90 degrees.	
5.13	Number of shaft extensions	To suit driven equipment's requirement.	
5.14	Rating Plate / Lifting hooks/ lugs / drain holes with plugs / guards for free shaft ends and couplings	Standard arrangement to be provided.	
5.15	Anti-condensation Heaters	To be provided through separate terminal boxes. Indoor duty = 37 KW and above; Outdoor duty = 30 kW and above.	
5.16	Limits of vibration	The motor shall be dynamically balanced and shall satisfy the requirement specified in IS:12075.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
5.17	Limits of Noise level	The motor shall satisfy the requirement specified in IS: 12065 or lower values in specified cases / as per customer's requirement.	
5.18	Temperature Detectors	As required the motors shall have duplex type, two nos. per phase for winding temperature and two nos. for each bearing temperature, one for driven end & one for non driven end.	
5.19	Special Requirement for Inverter grade Motors for satisfactory working in conjunction with IGBT Transistor based Inverters.		
5.19.1	Increased insulation levels	For stator windings - turn to turn insulation, phase to phase insulation and ground insulation. (Insulation shall withstand a peak value of not less than 1600 V at the motor terminals)	
5.19.2	Formed coils	For higher frame sizes / kW ratings in place of wound coils	
5.19.3	Derating	Thermal derating due to reduced ventilation obtained in lower speeds for motors with IC 411 cooling. As an alternative, suitable separately powered cooling blowers mounted on the motor may be considered	
5.20	Painting	As per IS 5, Finish coat shall confirm to shade 632 for outdoor equipment and shade 631 for indoor equipment	
6.0	Safety features		
6.1	Earthing	The Motor body shall be provided with two (2) separate earthing terminals for earthing in compliance with I.E. Rules.	
6.2	Canopy for motor	To be provided for all outdoor installed motors.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Sl. No.	Description	Requirement	Confirmation by Tenderer
7.0	Documents		
7.1	Performance Curves	Tenderer to furnish the following Performance Curves 1) Matched speed-torque curves of the motors superimposed with those of the driven load. 2) Performance curves for Starting Current, Starting Time, Efficiency & Power Factor for each motor 3) Thermal withstand curves for both Hot and Cold condition.	
7.2	Calculation / data sheets supplied by drive manufacturer	Tenderer to furnish required data sheets for the Motor. Tenderer shall also furnish calculation for Motor Sizing.	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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LT MOTOR FOR NALCO DAM ANJODI PROJECT

ENERGY EFFICIENT	IE3
SUPPLY	Supply: 415V + 10%, 3 Phase, 50 Hz, +3% & - 5%. System fault level of 50kA rms for 1s
STARTING CURRENT	As per IS 12615
RATIO OF LOCKED ROTOR KVA TO KW	
i) Below 110KW	11
ii) 110KW to 200KW	9
MIN. SPACING BETWEEN GLAND PLATE AND CENTER STUD(IN M M)	
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	203
PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE(IN M M) 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	Will be informed during datasheet approval.
a) LT Motor is applicable for < 180kW rated motors. Voltage: 415V +/-10%, Frequency: 50hz +/-5% , 3Phase - 4wire ; b) HT Motor is applicable For > 185kW rated motors. Voltage: 6.6kV +/-10%, Frequency: 50hz +/-3% , 3Phase - 3wire ;	



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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Annexure-V -Schedule of Guarantees (TO BE FILLED FOR EACH AGITATOR)

Project:

Enquiry No:

Agitator Name:

Sl. No.	Description	Unit	Data
1	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency (*)	KW	
2	Possible Rate of deposit of solid particles at tank bottom of total solid particle inflow/outflow	%	
2	Noise level at a distance of 1.0 meter from the equipment at site	dB(A)	85
3	Maximum vibration velocity at site (RMS)	mm/sec	
4	Life of Agitator components parts from the date of Commissioning for continuous operation		24 months
5	Anti-friction Bearing		25000 hrs.

BIDDER SIGN : _____

DESIGNATION : _____

DATE : _____

**Annexure-VI-- LIST OF DEVIATIONS OR EXCEPTIONS TO THE ENQUIRY DOCUMENT****Project :****Enquiry No:**

*We hereby accept to the Technical Specification for agitators and **all the parameters for this project**

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

(OR)

*The following are the technical deviations to the specification:

Sl No	Clause No	Page No	Description of Deviation

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

*Strike out whichever is not applicable



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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ANNEXURE- 3K : Qualifying Requirements for Agitators

Agitator Vendor shall meet the below qualification requirement of NALCO . In the event of order, only manufacturers who are meeting the below QR will be considered:

Clause No.	DESCRIPTION			
1.1 (a)	The Bidder is required to meet the provenness criteria and qualification requirement for agitator as stipulated below			
(b)	Agitators for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously manufactured and supplied the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on Technical bid opening date:			
	Type and Rating for Qualification			
	Name of Equipment	Type of Equipment	Application	Equipment Rating
	Agitators	Horizontal /Vertical	Wet Limestone based FGD application in Coal fired power plant (or) Similar process/duty application in petrochemical or metals and mining industry .	Any other process application with minimum rating of 10 KW & 10 KW (each for vertical and Horizontal respectively)
1.2	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no.1.1 above in India, shall also be considered qualified for manufacturing such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 1.1 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).			
1.3	Bidder shall offer and supply only the type of the above equipment for which it, itself or the Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.			



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1.4	The Employer(NALCO) reserves the right to fully satisfy himself regarding capability and capacity of Bidder and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 1.1 : Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.
	REM ARKS: Agitator vendor shall furnish the 3K- form as per the enclosed format along with all supporting documents. The offer will be considered only after obtaining approval from the end-customer(NALCO) and the above conditions for qualification criteria may be relaxed subject to the end-customer's approval for the vendors participating in this enquiry.



TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

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3K Format for Agitators(to be submitted separately for Horizontal and Vertical Agitators):

We declare that, we have manufactured and supplied at least one (1) number of Agitators with rating not less than 10 KW & 10KW (each for vertical and Horizontal respectively), Horizontal/Vertical type working in Wet Limestone based FGD application in Coal fired power plant (or) Similar process/duty application in petrochemical or metals and mining industry and which has been in successful operation for minimum one(1) year reckoned as on technical bid opening, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether power plant is coal fired	-*Yes/*No
5.	Whether operating in a Wet Limestone based FGD application in coal fired power plant	-*Yes/*No
6.	Name of equipment manufacturer & address:	
7.	Date of commission of the equipments:	
8.	Model no. of the equipment:	
9.	Brief Technical particulars of the equipments:	

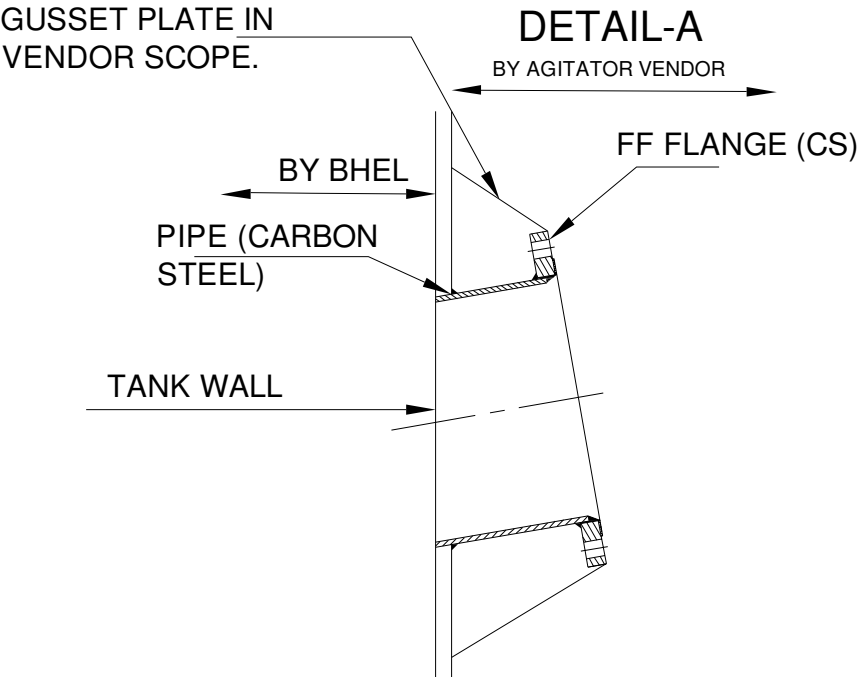
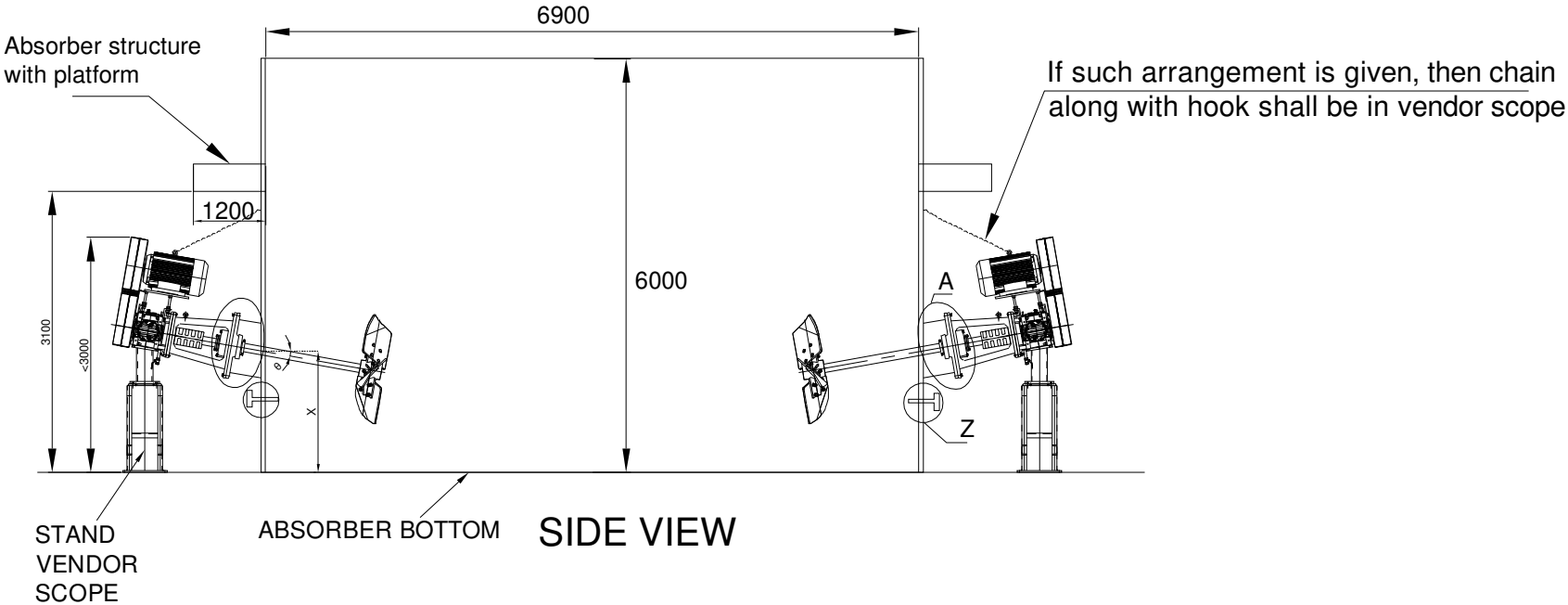


TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAM ANJODI 18.5 M W

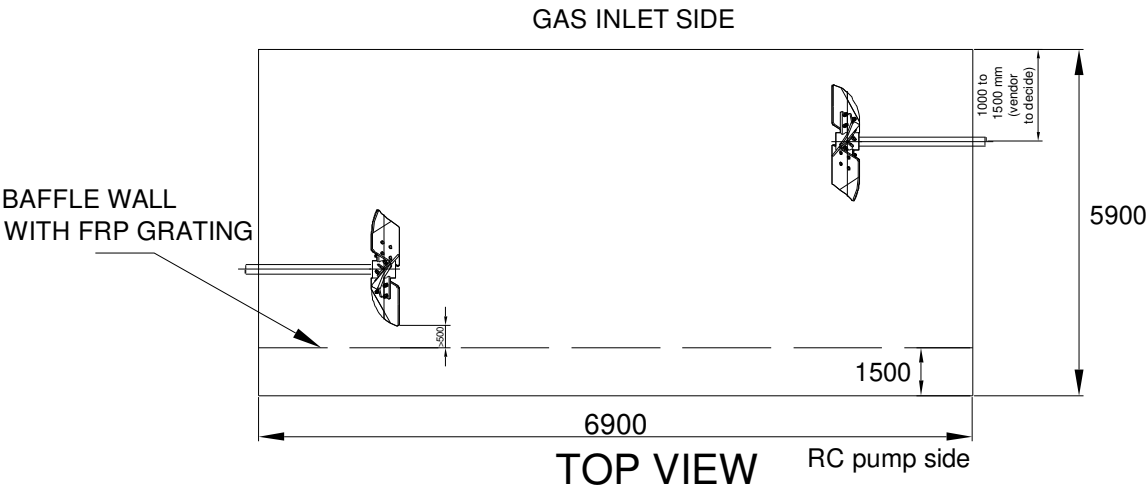
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10.	Agitators supplied for	MW unit size or for Application
11.	Whether the equipment(s) are in successful operation in atleast one(01) plant for a period not less than one(01) year reckoned as on the date of technical bid opening	
12.	Flue gas Desulphurization system details/Process Application Details:	*Technical extract/ *paper letter/ *email/ *Drwaing from user or *contract document or *scheme or *any document in public domain enclosed at annexure.....to Attachment-3K
13.	Scope of Work:	Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K
14.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K

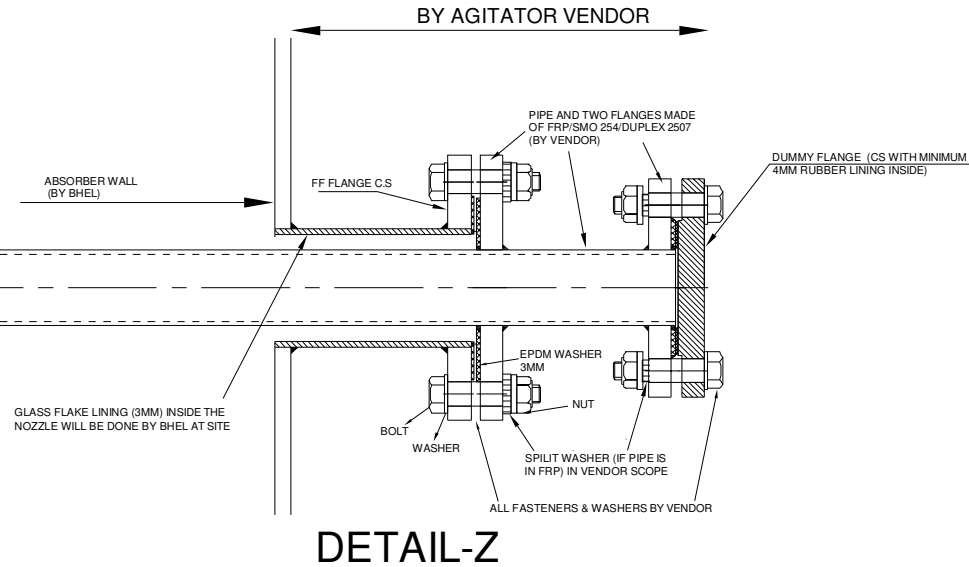
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FLANGES SHALL BE AS PER ASME B16.5 CLASS 150.



**EMERGENCY FLUSH PIPE ARRANGEMENT
(ABSORBER AGITATOR)**

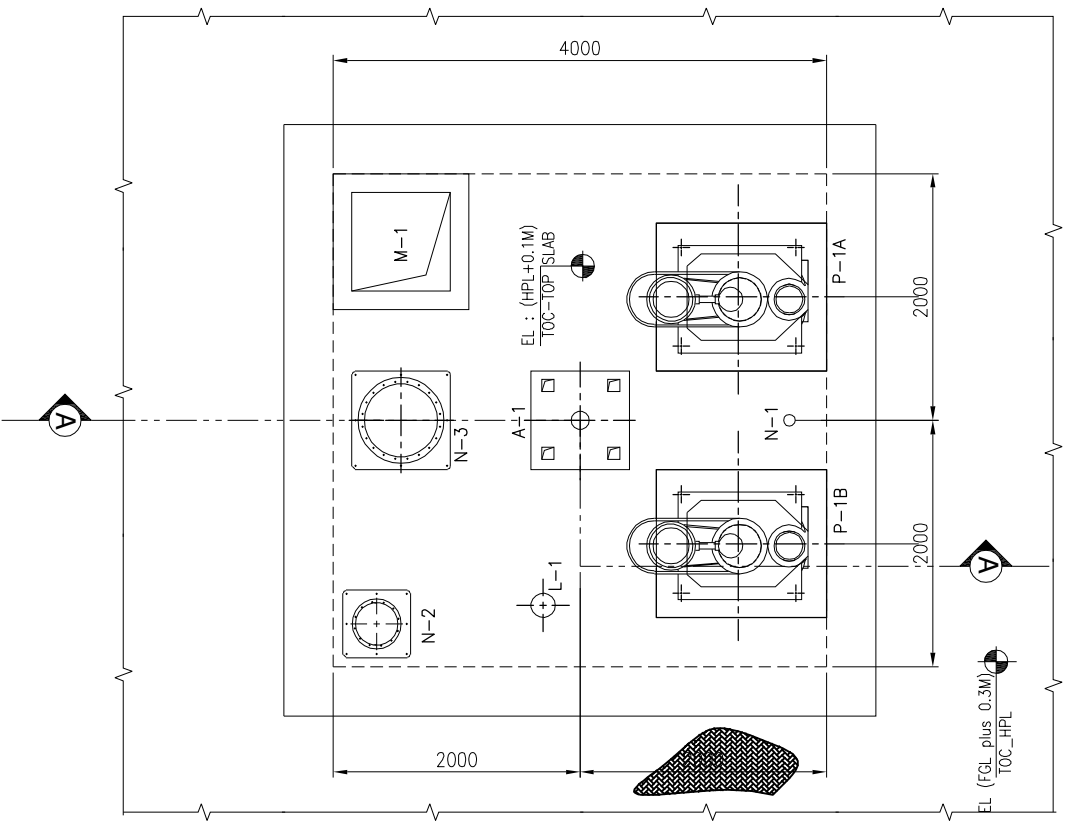


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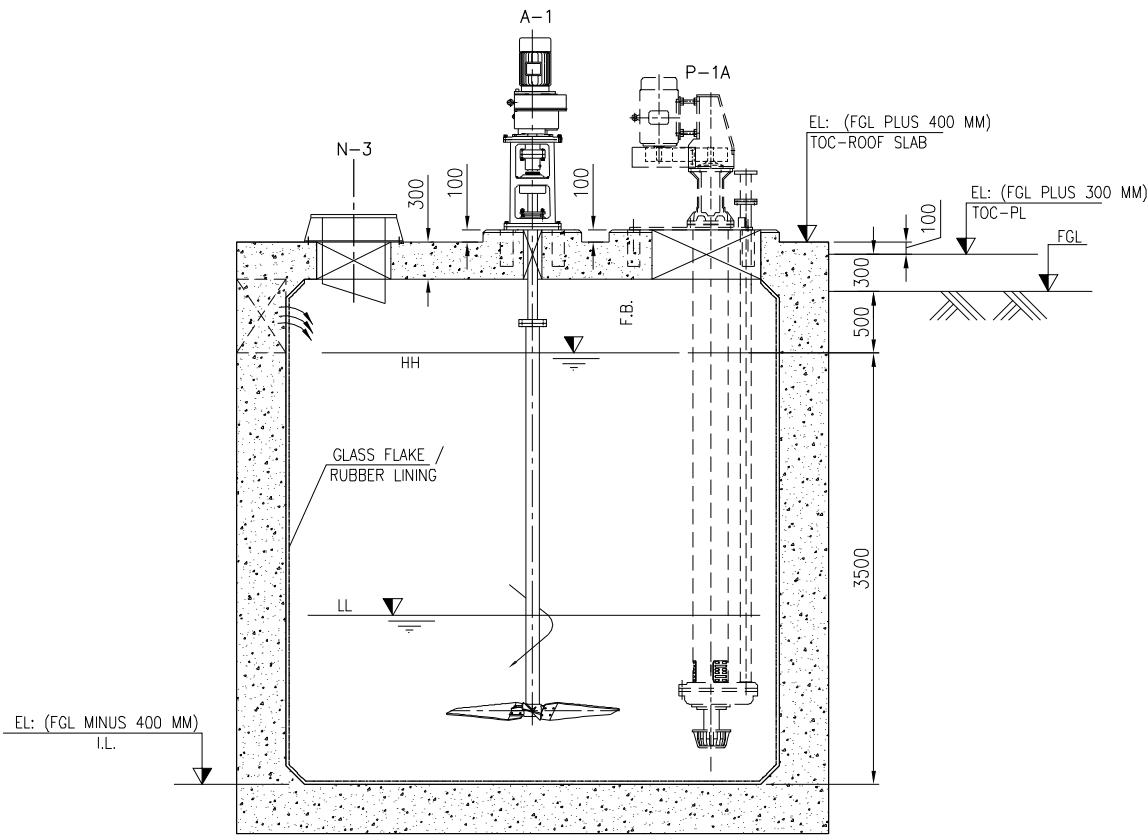
- 1- ALL DIMENSIONS ARE IN MM.
- 2- TYPICAL ARRANGEMENT IS SHOWN WITH V BELT & PULLEY. VENDOR CAN ALSO OFFER GEAR BOX DRIVEN AGITATOR.
- 3- FOR TANK HEIGHT (H), WIDTH(W) AND LENGTH(L), BIDDER SHALL REFER TO BE TECHNICAL INFORMATION OF AGITATORS.
- 4- THE AGITATOR LOCATION SHALL BE SUGGESTED BY VENDOR CONSIDERING THE LOCATION OF THE BAFFLE WALL. BAFFLE WALL IS MADE OF FRP GRATINGS, VENDOR TO INDICATE THE VALUE OF X AND θ .
- 5- VENDOR HAS TO SUPPLY THE AGITATOR & FLUSHING PIPE MOUNTING NOZZLE WITH FLANGE (CS MATERIAL) & FASTENERS.

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

CUSTOMER/PROJECT: NALCO DAMANJODI 1X18.5 MW			FGD SYSTEM PACKAGE			
	Bharat Heavy Electricals Ltd		DRN	NAME	DATE	NO. OF VAR
	BOILER AUXILIARIES PLANT RANIPET-632 406			S. SHANMUGA SUNDARAM	01/04/2021	—
TITLE:				SCALE		
TYPICAL ARRANGEMENT OF SIDE ENTRY AGITATOR IN ABORBER TANK				 N.T.S.		
DRG. NO:				BHEL DRG NO:		REV



SUMP PLAN



SECTION A-A

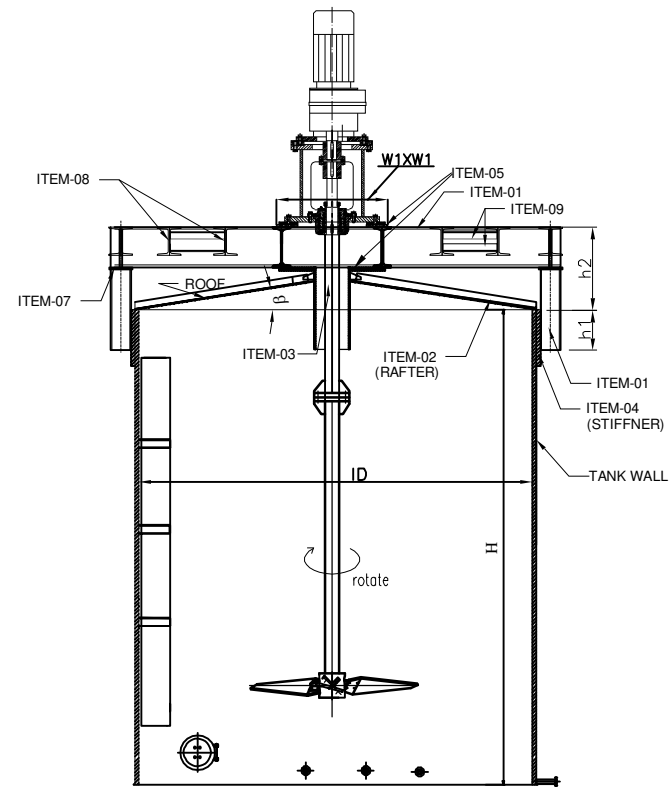
GENERAL ARRANGEMENT DRAWING OF DRAIN SUMP

NOTE:

1. Top of the sump is made of Concrete. Agitator vendor has to provide the Foundation Pocket Size in their offer/during ordering. Buyer will provide the pockets on the top of the sump as per vendor's recommendation.
2. All the necessary foundation bolts for mounting the Agitator on the Top of the sump has to be supplied by vendor along with the complete agitator assembly.

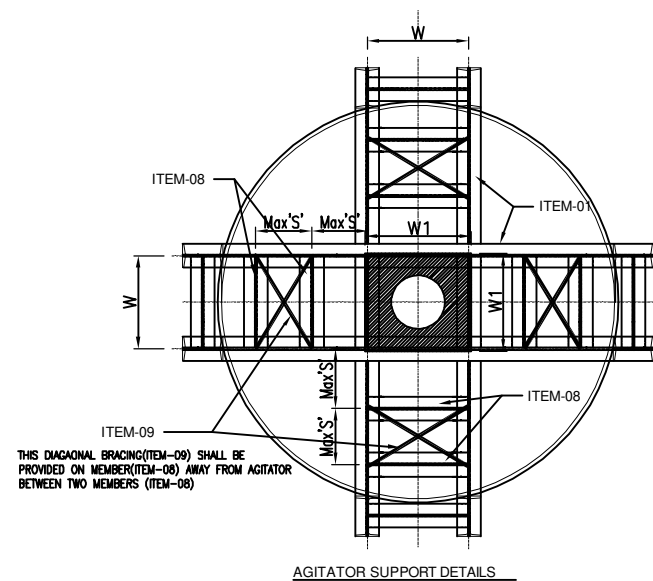
CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

CUSTOMER/PROJECT: NALCO DAMANJODI 1X18.5 MW			FGD SYSTEM PACKAGE			
	Bharat Heavy Electricals Ltd		DRN	NAME	DATE	NO. OF VAR
	BOILER AUXILIARIES PLANT RANIPET-632 406			S. SHANMUGA SUNDARAM	01/04/2021	
	TITLE: GENERAL ARRANGEMENT DRAWING OF AGITATOR DRAIN SUMP			SCALE  N.T.S.		
DRG. NO:			BHEL DRG NO:			REV

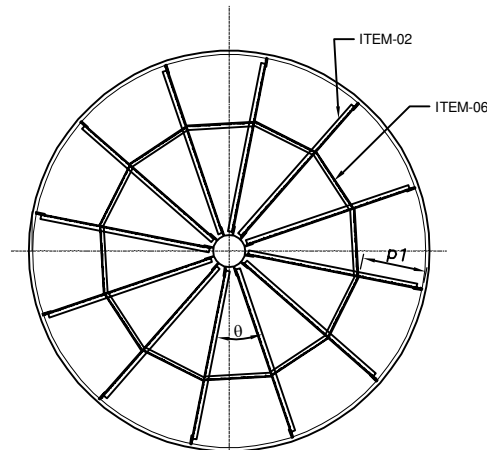


TYPICAL AGITATOR SUPPORT IN TANK

REV: 00
DATE: 01.04.2021
SHEET: 01/01

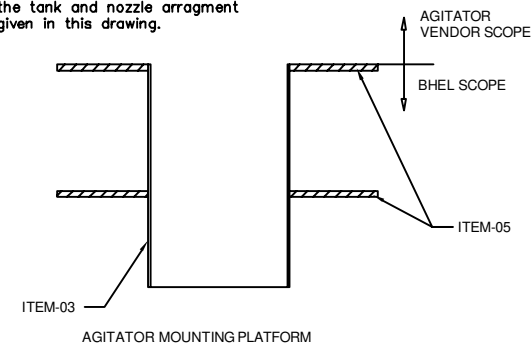


AGITATOR SUPPORT DETAILS



ROOF STIFFENER DETAILS

ITEM-05 is in BHEL scope and it is welded to agitator structure at the top of the tank nozzle. Agitator vendor to design the agitator considering the slope of the tank and nozzle arrangement given in this drawing.



AGITATOR MOUNTING PLATFORM

* - UPTO TOP OF ITEM -05 ** - SHALL BE AT EQUAL INTERVALS

Sl.NO	Tank-ID	h1	h2	p1	S**	W&B	W1	item-1	item-2	item-3		item-4	item-5	item-6	item-7	item-8	item-9	θ	β
										Desc.	Height (Ht)	Height x Width x Thk.							
1	UPTO 3000	650	650	NA	NA	600	650	UB-305	MC100	ERW323.9X4.0	700	850x565x10	PL32	NA	PL20	UB203	NA	60°	5°
2	3001 to 6000	1000	1000	1000	2000	600	650	UB-406	MC150	ERW323.9X4.0	950	1150x578x10	PL32	MC75	PL20	UB203	NA	45°	5°
3	6001 to 9000	1200	1200	1500	1800	800	850	NPB-500	MC250	ERW323.9X4.0	1000	1400x600x10	PL32	MC75	PL20	UB305	ISA 75X 75X8	45°	5°
4	9001 to 13000	1700	1700	2000	1500	1000	1050	NPB-600	MC400	ERW508X4.8	1350	1700x620x10	PL40	MC75	PL25	UB305	ISA 75X 75X8	20°	5°
5	13001 to 16000	1900	1900	2000	1200	1200	1250	NPB-600	MC400	ERW508X4.8	1400	2100x620x10	PL45	MC75	PL32	UB406	ISA 75X 75X8	20°	5°

END CUSTOMER: NALCO DAMANJODI 1X18.5 MW FGD SYSTEM PACKAGE

UNIT: BOILER AUXILIARIES PLANT. RANIPET-632 406.

NAME (BHEL) S.SHANNUGA SUNDARAM

DATE 01.04.2021

DRG NO:

BHEL DRG NO FILE NO REV NO

TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAMANJODI 18.5 MW FGD:NALCO:AGITATORS:R00

REF: FGD:NALCO:AGITATORS:R00
INPUT FOR TANKS & AGITATORS

TECHNICAL INFORMATION OF TANKS & AGITATOR											
SLNO	Description	ABSORBER	AUXILIARY ABSORBENT TANK	LIMESTONE SLURRY STORAGE TANK	SECONDARY HYDROCYCLONE FEED TANK	FILTRATE WATER TANK	WASTE WATER TANK	ABSORBER AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP	LIME NEUTRALIZATION TANK
1	Agitator Sl.No	1	2	3	4	5	6	7	8	9	10
1.1	Tank shape	Rectangular	Circular	Circular	Circular	Circular	Circular	Rectangular	Rectangular	Rectangular	Circular
1.2	Dimension of the tank (m)	5.9 W x 6.9 L x 6.0 H	7.0 Dia X 7.5 H	5.5 Dia X 6.6 H	4.6 Dia X 5.5 H	5.5 Dia X 5.5 H	4.0 Dia X 4.0 H	4.0 W X 4.0 L X 4.0 H	4.0 W X 4.0 L X 4.0 H	4.0 W X 4.0 L X 4.0 H	1.2 Dia X 2.4 H
1.3	Capacity of the tank (in m3)	244.3 m ³	257.7 m ³	144.9 m ³	83.1 m ³	118.7 m ³	44 m ³	56 m ³	56 m ³	56 m ³	2.37 m ³
1.4	No of Tanks	1	1	1	1	1	1	1	1	1	1
1.5	MOC of Tanks	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CARBON STEEL	CONCRETE	CONCRETE	CONCRETE	CARBON STEEL
2	Agitator Selection Data										
2.01	Type	Side Entry	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)
2.02	Medium to be handled	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Limestone slurry
2.03	Mechanical Seal Type	Required	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required
2.04	Duty	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
2.05	Agitator location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
2.06	Operation	Whenever Recirculation Pumps are not running.	Whenever FGD is under maintenance	Continuous.	Continuous.	Continuous.	Continuous.	Continuous.	Continuous.	Continuous.	Continuous.
2.07	MOC of Agitator	Agitator Shaft and Impeller blades shall be made of Alloy 926 or better material.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.	Impeller blades shall be made of Alloy 926 or better material. Agitator shaft shall be carbon steel with min 6 mm Rubber Lining.
2.08	Minimum liquid level in the tank	4.0	1.0	1.0	1.0	1.0	1.0	1.4	1.4	1.4	0.1
2.09	Normal liquid level in the tank	5.0	6.5	5.9	4.8	4.8	3.3	3.3	3.3	3.3	1.9
2.10	Maximum liquid level in the tank	6.0	6.7	6.1	5	5.0	3.5	3.5	3.5	3.5	2.1
2.11	Quantity of Agitators per Tank	2 No's Working + 2 No's warehouse spare	1 working	1 working	1 working	1 working	1 working	1 working	1 working	1 working	1 working
2.12	Total Quantity of agitators	4 No's	1 No's	1 No's	1 No.	1 No.	1 No.	1 No's	1 No's	1 No's	1 No's

Customer / Plant: NALCO 18.5 MW Co-Generation Plant								
Cont. No. : R182	Rev. 00		Rev. 01		Rev. 02		Rev. 03	
	Sign	Date	Sign	Date	Sign	Date	Sign	Date
	Engineer : RY	24.02.2021						
	Reviewer : PNR	24.02.2021						
	Approver : ACR	24.02.2021						

TECHNICAL SPECIFICATION OF AGITATORS FOR NALCO DAMANJODI 18.5 MW
FGD:NALCO:AGITATORS:R00

REF: FGD:NALCO:AGITATORS:R00
INPUT FOR TANKS & AGITATORS

TECHNICAL INFORMATION OF TANKS & AGITATOR											
SLNO	Description	ABSORBER	AUXILIARY ABSORBENT TANK	LIMESTONE SLURRY STORAGE TANK	SECONDARY HYDROCYCLONE FEED TANK	FILTRATE WATER TANK	WASTE WATER TANK	ABSORBER AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP	LIME NEUTRALIZATION TANK
3	Slurry Analysis										
3.01	Slurry to be handled	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Limestone slurry
3.02	Maximum solid particle size	200 mesh (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	6-7 mm	200 mesh (75 μ)	6-7 mm	6-7 mm	6-7 mm	150 mesh (104 μ)
3.03	Normal solid particle size, d50	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)
3.04	Solid to be handled	Gypsum & other impurities	Gypsum & other impurities	Limestone & other impurities	Gypsum & other impurities	Gypsum & other impurities	Gypsum & other impurities	Gypsum & other impurities	Gypsum & other impurities	Limestone + impurities	Lime Powder
3.05	Chloride concentration	Max 20000 ppm	Max 20000 ppm	Max 1000 ppm	Max 20000 ppm	Max 20000 ppm	Max 20000 ppm	Max 20000 ppm	Max 20000 ppm	Max 1000 ppm	Max 1000 ppm
3.06	Hardness of particle	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale
3.07	Slurry concentration, wt%	30%	30%	30 wt%	16.60%	12.5%	3%	30%	30%	~47 wt%	10 wt%
3.08	Sp. Gravity of slurry	1.215	1.215	1.220	1.111	1.071	1.021	1.215	1.215	1.431	1.1
3.09	Sp. Gravity of Lime Stone & Gypsum	2.32(avg)	2.32(avg)	2.7(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.7(avg)	NA
3.10	Viscosity of Slurry	10 cP	10 cP	30 cP	4 cP	4 cP	3 cP	10 cP	10 cP	100 cP	250 Cp
3.11	pH	4 to 8	4 to 8	5 to 8	4 to 8	4 to 8	4 to 8	4 to 8	4 to 8	5 to 8	5 to 14
3.12	SiO ₂ Content	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	NA
3.13	Temperature	Normal -59.3 °C; Design-70 °C.	Normal -59.3 °C; Design-70 °C.	Normal -35 °C; Design-70 °C.	Normal -59.3 °C; Design-70 °C.	Normal -54.1 °C; Design-70 °C.	Normal -59.3 °C; Design-70 °C.	Normal -59.3 °C; Design-70 °C.	Normal -59.3 °C; Design-70 °C.	Normal -35 °C; Design-70 °C.	Normal -35 °C; Design-60 °C.
4	Power loading for agitator auxiliary power consumption	Not applicable	Not applicable	Applicable	Applicable	Applicable	Applicable	Not applicable	Not applicable	Not applicable	Not applicable
4.1	Penalty / KW*	-	-	Rs. 1.7 lakhs	Rs. 1.7 lakhs	Rs. 1.7 lakhs	Rs. 1.7 lakhs	-	-	-	-

* Power loading will be applicable for agitator SI.No. 3,4,5,6. Power consumption shall not exceed 28.5KW (Considering all these agitator 3,4,5,6)

Customer / Plant: NALCO 18.5 MW Co-Generation Plant								
Cont. No. : R182	Rev. 00		Rev. 01		Rev. 02		Rev. 03	
	Sign	Date	Sign	Date	Sign	Date	Sign	Date
Engineer : RY		24.02.2021						
Reviewer : PNR		24.02.2021						
Approver : ACR		24.02.2021						

269011/2021/BAP-QA_MECH

BAP: QA: MECH: 234

Dt: 15.04.2021

Item Name	Indent No.	Date	W/O	PGMA	Technical Specification
AGITATORS	RFW01156	07/04/2021	R182	FW720	FGD:NALCO:AGITATORS:R00 dated 25/02/2021
	RFW01154	07/04/2021	R182	FW241	
	RFW01153	07/04/2021	R182	FW241	
	RFW01155	07/04/2021	R182	FW720	

“Customer has informed that in case the item is covered under Customer approved Cat-I List /Sub-QR list, the proposed vendors for the same shall be accepted by QA after acceptance of vendor by Customer”

Quality Assurance (Mechanical) comments as below:

1. Since Limestone Grinding system appears under Sub-QR item, Sub-QR approved vendor by NTPC Engineering is acceptable to Quality also.
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. FGD: 705, Rev: 01 DT: 02.01.2021). 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		MANUFACTURING QUALITY PLAN						PROJECT: PACKAGE: FGD PACKAGE CUST No: Main Contractor: M/s BHEL.						
		Manufacturer Name and Address:										ITEM: AGITATOR		
												QP NO: FGD:705,REV:01 DT: 02.01.2021		
												Page 1 of 4		
SL. NO.	COMPONENT & OPERATION	CHARATERISTICS	CLASS	TYPE OF CHECK	QUATUM 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 INSPECTION.

1.1	Shaft & Blades, rubber composition & other material including castings & forgings.	Chem. & Mech Properties	Major	Review of MTC	1/ Heat	-	NTPC Approved Drawing / Data Sheet	TC	√	P	V	V	For shaft Dia ≥ 40mm UT shall be done as per ASTM A 388.
		Dimensions		Measure ment	100%			IR		P	-	-	
		Surface Defects		Visual	100%			IR		P	-	-	

2.0 Motor **Refer Separate MQP for Electric Motor.**

3.0	Gear box	Make, Type, Rating, vibration, noise, Routine/Run test.	Major	Review of manufacture's test report	100%	-	Drawing/Data Sheet	TC/ Report	√	P	V	V	
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4.0 IN PROCESS INSPECTION.

4.1	Welding Qualifications	WPS,PQR,WPQ	Major	WPS, PQR & WPQ	100%	-	ASME Sec IX/AWS D1.1	WPS/ PQR	√	P	V	V	
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MANUFACTURER SIGN & STAMP	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A 'QA' DOCUMENTATION PACKAGE., C: MAIN CONTRACTOR M: MANUFACTURE/SUB SUPPLIER, (BHEL/BHEL AIA), N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION / REVIEW OF RECORDS, MTC: MATERIAL TEST CERTIFICATE, TC: TEST CERTIFICATE, MA: MAJOR, MI: MINOR, COC: CERTIFICATE OF CONFORMANCE, IR: INSPECTION REPORT, TR: TEST REPORT, AIA: AUTHORISED INSPECTION AGENCY.			
		Rakesh Kr Madhu (Dy.Mgr/QA)	K Renjith (Manager/QA)	R Arunachalam (DGM/QA)
		PREPARED BY	REVIEWED BY	APPROVED BY

 Ranipet		MANUFACTURING QUALITY PLAN						PROJECT: PACKAGE: FGD PACKAGE CUST No: Main Contractor: M/s BHEL.						
		Manufacturer Name and Address:											ITEM: AGITATOR	
													QP NO: FGD:705,REV:01 DT: 02.01.2021	
													Page 2 of 4	
SL. NO.	COMPONENT & OPERATION	CHARATERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	10			11
4.2	Marking, cutting, Edge preparation Tacking	Dimensions	Major	Measure ment	100%	-	Approved Drawings	IR	-	P	-	-		
4.3	Shaft & Impeller	Visual & Dimension check, face out and run out of shaft (after flange welding)	Major	Measure ment	100%	100 %	As per Spec. & NTPC Appd. Drawing / Datasheet	IR	√	P	V	V		
4.4	Welds	Visual, Dimension	Major	Visual, Measure ment	100%	100 %	ASME Sec-VIII/ AWS D1.1	IR	√	P	V	V		
4.5	Weld surface check	Weld surface check	Major	Measure ment DPT	10%	10%	ASME Sec-VIII/AWS D1 Appendix 8	IR	√	P	W	V		
4.6	Impeller	Balancing	Major	Visual, Measure ment	100%	10%	ISO 1940/Appd.Drg.& Data sheet/Relevant standard	TR	√	P	W	V		

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		Rakesh Kr Madhu (Dy.Mgr/QA)	K Renjith (Manager/QA)	R Arunachalam (DGM/QA)
		PREPARED BY	REVIEWED BY	APPROVED BY

 Ranipet		MANUFACTURING QUALITY PLAN						PROJECT: PACKAGE: FGD PACKAGE CUST No: Main Contractor: M/s BHEL.						
		Manufacturer Name and Address:											ITEM: AGITATOR	
													QP NO: FGD:705,REV:01 DT: 02.01.2021	
													Page 3 of 4	
SL. NO.	COMPONENT & OPERATION	CHARATERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	10			11

4.7	Rubber Lining	Thickness of Rubber, Hardness, Spark test, Adhesion test on test piece	Major	Measure ment	100%	10%	As per Specs./ Appd. Drg. & data sheet	Appd.Drg.& Data sheet,	TR	√	P	W	V	
5.0 FINAL INSPECTION														
5.1	Final Assembly Base Frame,Agitator etc.	Visual-Workmanship, Dimensional.	Major	Visual, Measure ment	100%	10%	NTPC Appd.Drg./ Datasheet & Spec,		IR	√	P	W	V	
5.2	Run test of Agitator assembled with Gearbox & job Motor. Medium-Slurry (Duration-30 minutes)	Current,RPM, Vibration,Noise & Temperature rise	Major	Measure ment	100%	20% of each type (side & top entry)	Manufacturer's procedure/ Approved Drawing/Data Sheet		IR	√	P	W	W	For top agitator with shaft length >5Meter run test to be carried out with bearing shaft only.
5.3	Painting	Visual,DFT	Major	Paint Shade & DFT measure ment	100%	10%	NTPC Approved Painting Schedule		IR	√	P	W	V	
5.4	Marking	Visual	Major	Visual	100%	10%	Approved Drawing		IR	√	P	V	V	

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		Rakesh Kr Madhu (Dy.Mgr/QA)	K Renjith (Manager/QA)	R Arunachalam (DGM/QA)
		PREPARED BY	REVIEWED BY	APPROVED BY

 Ranipet		MANUFACTURING QUALITY PLAN						PROJECT: PACKAGE: FGD PACKAGE CUST No: Main Contractor: M/s BHEL.						
		Manufacturer Name and Address:											ITEM: AGITATOR	
													QP NO: FGD:705,REV:01 DT: 02.01.2021	
													Page 4 of 4	
SL. NO.	COMPONENT & OPERATION	CHARATERISTICS	CLASS	TYPE OF CHECK	QUATUM 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	11
5.5	Quality Dossier	Compliance of Reports	Major	Document	100%	100 %	Completion of all documents, Test Report as per Approved MQP.	Report	√	P	V	V		
5.6	Packing	Compilation of PO	Major	Visual	100%	100 %	PO/specification/ Packing Drawing	Report	√	P	V	-		

Notes: This QP is applicable for Mandatory spare also. All other minor items, which are not cover under this QP, shall be manufactured inspected as per OEM (Original equipment Manufacturer)/BHEL standard practice and relevant standard. Relevant TC/COC will be submitted for the same.

MANUFACTURER SIGN & STAMP	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A 'QA' DOCUMENTATION PACKAGE., C: MAIN CONTRACTOR M: MANUFACTURE/SUB SUPPLIER, (BHEL/BHEL AIA), N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION / REVIEW OF RECORDS, MTC: MATERIAL TEST CERTIFICATE, TC: TEST CERTIFICATE, MA: MAJOR, MI: MINOR, COC: CERTIFICATE OF CONFORMANCE, IR: INSPECTION REPORT, TR: TEST REPORT, AIA: AUTHORISED INSPECTION AGENCY.			
		Rakesh Kr Madhu (Dy.Mgr/QA)	K Renjith (Manager/QA)	R Arunachalam (DGM/QA)
		PREPARED BY	REVIEWED BY	APPROVED BY

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 (Manufacturing 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 material 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/standards to BHEL/Customer/Consultant.	
	Important Notes shall be included in MQP : (a) Latest revision of Standards & 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.	
2	Domestic / Inland Inspection will be carried out by BHEL/BHEL appointed Third Party Inspection Agency (TPIA) / Customer/Customer Appointed Inspection Agency/Consultant. 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 Instrumentation Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable).	
3	Inspection Agency for Foreign Bidders and also for Indian Bidder but importing from Foreign Sources: (1) Any one of the following 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. List of TPIA 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 Lloyd 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	

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 Indian 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 Foreign Source/Supplier: (a) As in SI no: 3. shall be ensured without fail (b) No material / items shall be despatched without getting the written communication from BHEL / Customer inspection carried out by Bidder appointed Third Party Inspection Agency (As per SI no.3) / Customer/Customer Appointed Inspection Agency/Consulate. 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 Instrumentation 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 assembly / skid like motors etc	
8	Specific confirmation 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 + Mechanical + 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 Built Drawings with actual make / rating used with BHEL/customer approved drawings.	
9	Packing / Seaworthy Packing shall be as per BHEL Packing schedule / approved drawing / sketch. This shall be ensured to take care of transit / handling / transshipment 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 accredited 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

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

CONTRACT QUALITY REQUIREMENTS (CQR) for LT MOTORS

PROJECT: NALCO Damanjodi 1 x 18.5 MW (BHEL W.O no: R182)		CONTRACT QUALITY REQUIREMENTS (CQR) for <u>LT MOTORS used in</u> <u>Agitators for FGD</u> <u>application</u>	DOC.NO: BAP/QR/R182 /NALCO Damanjodi/ LTM/ Agitators: 001 Rev NO.: 00 PAGE : Page 1 of 2 DATE: 16.04.2021	##Enquiry No: ## OEM Supplier Name & Address: ##Offer reference: ##Date: Contact Official Name: Mobile no: Email id:
PACKAGE: FGD PACKAGE MAIN CONTRACTOR: BHEL - RANIPET SUB CONTRACTOR (OEM) & ADDRESS: (To be filled by OEM VENDOR)		NALCO Damanjodi 1 x 18.5 MW (BHEL W.O no:R182)		
Sl. NO.	DESCRIPTION	BHEL and Ultimate Customer - NALCO Quality Requirements		##Specific confirmations by the vendor

ITEM: LT Motors

01	Quality Plan Requirement	- MQP is applicable for these LT Motors and accordingly Actual LT Motor Manufacturer and OEM shall submit the MQP for BHEL and ultimate customer NALCO and its consultant M.N Dastur approval. - If any of LT Motor manufacturer is having, ultimate customer NALCO and its consultant M.N Dastur approved MQP (Manufacturing Quality Plan) / NTPC approved RQP (Reference Quality Plan) and having validity, the same is applicable for these LT Motor for inspection subject to obtaining ultimate customer NALCO and its consultant M.N Dastur formal approval in the event of an order. - If LT Motor Manufacture / OEM vendor does not have MQP/RQP, they should submit a fresh MQP to BHEL/NALCO (in BHEL format) for review & approval. (copy attached).	
02	BHEL / Ultimate Customer – NALCO approved vendors	LT Motors are to be procured only from Ultimate Customer - NALCO approved vendors and no deviation on this specific customer requirement is acceptable.	
03	Inspection Methodology to be adopted at Actual LT Motor Manufacture works by OEM vendor	BHEL/ BHEL AIA (BHEL authorized inspection Agency) / Ultimate Customer-NALCO to witness / perform inspection at LT Motor Supplier works and submit all the inspection documents and routine & Type test reports including Degree of Protection Test Reports (IP 55) as per approved MQP & approved data sheet / drg / spec / as per relevant BIS (Bureau of Indian Standard) - BIS 325 /IS 12615/ IEC 60034 etc. No material shall be dispatched without BHEL / BHEL AIA and Ultimate Customer – NALCO Inspection and dispatch clearance.	
04	Painting Requirements	Painting requirement like paint shade and painting thickness including no of coats if any are to be ensured by the OEM vendor for these LT Motors as per BHEL/ Ultimate Customer - NALCO and its consultant M N Dastur approved data sheet/drg/spec (As applicable).	
05	Packing	Packing shall be as per Specification / Drg. / Data sheet including sea worthy packing if any to avoid any transit & handling damages.	
06	For Inspection call	Inspection call by OEM Vendor for LT Motor inspection at Actual LT Motor Manufacture works to be raised for BHEL/BHEL AIA inspection / Ultimate Customer – NALCO including for type test witnessing to be ensured / addressed to Mr R Kesavan., DGM (QC-Proc)., Mobile no: +91 9443006303., Email id: kesavan@bhel.in and Mr Zeeshan Ali., Sr.Engineer (QC-Proc)., Mobile no: +91 9443149691., Email id: kovak@bhel.in including for inspection related activities for immediate response / resolution.	

CONTRACT QUALITY REQUIREMENTS (CQR) for LT MOTORS

PROJECT: NALCO Damanjodi 1 x 18.5 MW (BHEL W.O no: R182)		CONTRACT QUALITY REQUIREMENTS (CQR) for LT MOTORS used in <u>Agitators for FGD</u> <u>application</u>		DOC.NO: BAP/QR/R182 /NALCO Damanjodi/ LTM/ Agitators: 001 Rev NO.: 00 PAGE : Page 2 of 2 DATE: 16.04.2021		##Enquiry No: ## OEM Supplier Name & Address: ##Offer reference: ##Date: Contact Official Name: Mobile no: Email id:	
PACKAGE: FGD PACKAGE MAIN CONTRACTOR: BHEL - RANIPET SUB CONTRACTOR (OEM) & ADDRESS: (To be filled by OEM VENDOR)		NALCO Damanjodi 1 x 18.5 MW (BHEL W.O no:R182)					
Sl. NO.	DESCRIPTION	BHEL and Ultimate Customer - NALCO Quality Requirements				##Specific confirmations by the vendor	

ITEM: LT Motors

07	Document Package / Dossier	Specific confirmation for Document Package in the event of an order (3 hard copies + soft copies in PDF file) is to be given containing the following with proper linkages (.) (i) Index Sheet (ii) MQP/RQP (iii) TCs identified by BHEL/NALCO for record for “CHP” (Customer Hold Point) Verification & Witness “W” portion as given in MQP / RQP / MQP (as applicable). (iv) Final Inspection Report + TC (v) BHEL AIA (BHEL Appointed Inspection Agency) / BHEL report + TC (vi) Ultimate customer NALCO CHP (Customer Hold Point) / MDCC (Material Dispatch Clearance Certificate) (vii) Type test reports conducted/submitted with approval with approved data sheet and BOM with actual make used with Customer approved drgs.																																																																					
08	Important Note	Any cost implication for conducting checks / tests including for witnessing of any of the tests at Actual LT Motor Manufacture Works by BHEL / BHEL AIA / Ultimate Customer – NALCO is in the scope of OEM Supplier only and no extra cost if any will be admissible in the event of an order and also during execution of the contract.																																																																					
09	Motor details Vendor shall furnish following Motor details for the Agitators applicable for this enquiry.																																																																						
	<table><tr><th rowspan="2">S. No</th><th rowspan="2">Agitators</th><th colspan="3">LT Motor</th></tr><tr><th>Rating (in kW)</th><th>Quantity (in nos)</th><th>Make</th></tr><tr><td>1</td><td>Absorber Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>2</td><td>Auxiliary Absorber Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>3</td><td>Filtrate Water Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>4</td><td>Secondary Hydrocyclone Feed Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>5</td><td>Waste Water Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>6</td><td>Limestone Slurry Storage Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>7</td><td>Primary Hydrocyclone Feed Tank Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>8</td><td>Absorber Area Drain Sump Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>9</td><td>Gypsum Area Drain Sump Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>10</td><td>Limestone Area Drain Sump Agitator Motor</td><td></td><td></td><td></td></tr><tr><td>11</td><td>Other LT motors involved in the system (if any)</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table>	S. No	Agitators	LT Motor			Rating (in kW)	Quantity (in nos)	Make	1	Absorber Tank Agitator Motor				2	Auxiliary Absorber Tank Agitator Motor				3	Filtrate Water Tank Agitator Motor				4	Secondary Hydrocyclone Feed Tank Agitator Motor				5	Waste Water Tank Agitator Motor				6	Limestone Slurry Storage Tank Agitator Motor				7	Primary Hydrocyclone Feed Tank Agitator Motor				8	Absorber Area Drain Sump Agitator Motor				9	Gypsum Area Drain Sump Agitator Motor				10	Limestone Area Drain Sump Agitator Motor				11	Other LT motors involved in the system (if any)										
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OEM Supplier signature with seal

Necessarily to be filled up & submitted by the OEM vendor at the time of offer itself otherwise the offer may not be considered w.r.t Quality Requirements against LT Motors being BHEL/ ultimate customer – NALCO specific requirements.

OEM SUPPLIER WITH OEM MFRG.'s LOGO (TO BE FILLED BY OEM SUPPLIER)	LT MOTOR MANUFACTURER'S NAME AND ADDRESS (TO BE FILLED BY OEM / LT MOTOR MANUFACTURER)	MANUFACTURING QUALITY PLAN		PROJECT NALCO DAMANJODI 1 X 18.5 MW FGD PACKAGE (BHEL W.O no: R182) MAIN CONTRACTOR: BHEL - RANIPET SUB CONTRACTOR (OEM) & ADDRESS: (TO BE FILLED BY OEM SUPPLIER)
		ITEM: LT MOTOR FOR FGD APPLICATION SUB-SYSTEM: FGD - AGITATORS	QP NO.: AGITATORS:LT MOTOR:001 REV.NO.: 00 DATE: PAGE: OF....	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

		LEGEND: * RECORDS, INDENTIFIED WITH “TICK” (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: OEM MANUFACTURER/LT MOTOR SUB-SUPPLIER C: MAIN SUPPLIER – BHEL/BHEL AIA , N: NALCO P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: SHALL IDENTIFIED IN COLUM “N” AS ‘ W”		DOC. NO.:		REV..... CAT.....	
OEM MANUFACTURER/ LT MOTOR SUPPLIER	MAIN (BHEL) SUPPLIER		FOR CUSTOMER USE				
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	