

601401/2021/BAP-9762_FGD



TECHNICAL SPECIFICATION OF AGITATORS

FGD:AGITATORS:REV01



BHARAT HEAVY ELECTRICALS LIMITED
(A GOVT OF INDIA UNDERTAKING)

Flue Gas Desulphurization Group-FGD,
Ranipet

TECHNICAL SPECIFICATION OF AGITATORS

SPECIFICATION NO : FGD:AGITATORS
BUYER (EPC) : BHEL
APPLICATION : WET LIMESTONE FGD

01	09-09-2021	Generally Revised	<i>Jyotish Kumar Patel</i> Jyotish Kumar Patel	<i>S. Shanmuga Sundaram</i> Shanmuga Sundaram S	<i>V Kesavan</i> V Kesavan
00	24-09-2020	Fresh Release	Jyotish Kumar Patel	Shanmuga Sundaram S	V Kesavan
REV	Date	Description	Prepared	Checked	Approved

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

CONTENTS:

MAIN SUPPLY	
1.0	APPLICABLE CODES & REGULATIONS
2.0	INTENT OF SPECIFICATION
3.0	PROVENNESS CRITERIA / QUALIFICATION REQUIREMENTS
4.0	MATERIAL OF CONSTRUCTION
5.0	SCOPE OF SUPPLY
6.0	GENERAL REQUIREMENTS
7.0	PACKING & FORWARDING
8.0	SUPERVISION OF ERECTION, TESTING & COMMISSIONING
9.0	EXCLUSION
10.0	INSPECTION AND TESTING
11.0	PAINTING
12.0	SPARES, TOOLS & TACKLES
13.0	PERFORMANCE GUARANTEE
14.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION
15.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
16.0	WARRANTY / DEFECT LIABILITY
17.0	FIRST FILL OF CONSUMABLES
18.0	TRAINING
19.0	DELIVERY CONDITION
20.0	DOCUMENTATION

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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/Agitator Selection Criteria.
- 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.

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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 Annexure-3K. Only OEMs qualifying as per the Qualification requirement shall be considered for placement order.**

4.0 POWER SUPPLY DETAILS:

POWER SUPPLY	
The following voltage levels shall apply:	
3 phase, 3.3 kV AC ,50 Hz	Voltage for motors equal to / bigger than 200KW and for power distribution within the plant.
3 phase, 415 V, AC , 50 Hz	Standard voltage for power supplies to electric power consumers and motors Above 0.2 KW and upto 200 kW.
240V AC / 3 phase 415 V AC, 50 Hz	Standard voltage for power supplies to electric power consumers and motors Upto 0.2 kW.
<ol style="list-style-type: none"> 1. All equipments shall be suitable for rated frequency of 50 Hz with a variation of + 3% & -5%, and 10 % combined variation of voltage and frequency unless specifically brought out in the specification. 2. Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition. 	

5.0 SCOPE OF SUPPLY

Scope for the bidders shall include Design, Manufacturing, Supply, and Supervision of Erection & Commissioning, Performance Testing at Site for satisfactory Performance

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:



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

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
	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.
	xi. Flushing system for start up consisting of Pipe with Flange . Gaskets and Fasteners to be provided for mounting the flush pipe on the Tank Nozzle
	xii. Foundation plate with foundation bolts
	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 and Commissioning Spares as applicable
	xvii. First fill Lubricants
	xviii. Installation, operation and maintenance manuals
	xix. 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
	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 and Commissioning Spares as applicable
	xv. First fill Lubricants
	xvi. Installation, operation and maintenance manuals



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

Sl. No	Scope
	xvii. 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.
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 Offer stage 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 /Agitator selection Criteria". 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. It shall be possible to remove the sealing devices of the absorber vessel without having to drain completely the absorber.
7.	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.
8.	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
9.	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.
10.	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.
11.	All exposed moving parts shall be covered by guards.
12.	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

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
13.	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions	
14.	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 mode in liquid with “Full Uniform Suspension” of solid particles to 98% of liquid column to virtually “Uniform Solid Concentration”. No chemical reaction will take place.	
15.	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)	
16.	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”.	
17.	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.	
18.	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.	
19.	Impeller shall be kept above the sedimentation level of the tank (just 100-200mm above the sedimentation level).	
20.	Agitator must have low-pitch propeller with low solidity ratio and low Power Number. Power number shall 0.35 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.	
21.	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.	
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.	

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
v)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft (wherever applicable)	
vi)	For circular tanks with Top Entry agitator, the tip diameter of the impeller shall be one-third of the Tank diameter.	
vii)	<p>For circular tanks with Top Entry agitator, Two level of impellers have to be offered for achieving uniform suspension if both the following conditions are satisfied:</p> <p>a) (Slurry Filling Height X specific gravity)/Tank Dia >1,</p> <p>b) (Slurry Filling Height X Specific Gravity)/ Impeller Tip Dia > 4.</p> <p>The tip diameter of both the impellers have to be same for maintaining uniform suspension(if uniform suspension is applicable). Bidder shall refer to the Technical Information of Agitator/Agitator Selection Criteria where two level of impellers are required for tanks with Uniform Suspension.</p> <p>However, bidder may propose two level of impellers for other tanks if their standard design permits the same.</p>	
B)	SEAL	
1.	Horizontal / Side Entry Agitators:	
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 20000 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.	

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

2.	<u>Vertical Agitators for Other Slurry Tanks & Drain Pit Tanks</u>
I	Agitator shall be supplied with stuffing box or Labyrinth seal 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
	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 (preferably) 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. All the connecting fasteners shall be Alloy 926 or better material. All the Fasteners coming inside the tank (below the Mounting base or Mounting flange) shall be Alloy 926 or better material.
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 every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hr (minimum).
	None of the Shaft bearings shall be allowed to be inside the tank or drain.
	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

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
	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.	
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. Gear Reducers shall confirm to AGMA standard as follows: A. 1.25 Service Factor based on Motor Horsepower B. 1.5 Service Factor based on calculated brake Horsepower	
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	

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
	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 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 COMPONENTS	
	All fasteners used in wetted condition must be of Nickel alloy material or better material (bidder shall refer to the Technical Information of Agitators/Agitator Selection Criteria 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 REQUIREMENT 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 “Technical Information for Agitator/Agitator Selection Data” enclosed.	
III.	It should be of Flange mounted type.	
IV.	Nozzle, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to suggest the nozzle size . Purchaser will provide the Nozzle based on Vendor’s recommendation.	
V.	Bidder shall consider Gypsum Sedimentation during stoppage of Agitator.	
VI.	The following information to be provided along with the bid: a) Impeller Diameter b) Impeller Speed c) Agitator Pumping Capacity (m³/min) d) Volume per Agitator:	
	TOP ENTRY AGITATORS IN OTHER SLURRY TANKS & DRAIN PITS:	
I.	All Agitators shall be designed for continuous operation.	
II.	The Material of Construction (MOC) of Top Entry Agitators shall be as per “Technical Information for Agitator/Agitator Selection Data” enclosed.	
III.	It should be roof mounted.	

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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.
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, 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. The Motor speed shall be **1500 rpm or less.**

AC Motors:

All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. **Rating of motor must be at least 1.2 times the maximum power demand of the driven equipment.**

Bidder shall refer to the detailed LT Motor Specification enclosed.

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.



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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.
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.



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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 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.	<p>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.</p> <ul style="list-style-type: none"> - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: <ul style="list-style-type: none"> b. Relevant Standards c. Specifications d. Approved drawings e. Data Sheets f. Calibration certificate for all the measuring instruments g. 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



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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.
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)



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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: <ol style="list-style-type: none"> a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as per the dispatch instruction givens 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: <ol style="list-style-type: none"> a. Upright position b. Sling position and center of Gravity position



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	<p>c. Storage category</p> <p>d. Fragile components (to be marked properly with a clear warning for safe handling)</p>
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.	<p>The packing slip shall contain the following information: -</p> <p>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 Weight and Net weight of Supplied items.</p>
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.	<p>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.</p> <p>Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.</p>
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 COMMISSIONING
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.



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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: <ol style="list-style-type: none"> a. Walkways, platforms and ladders b. Element handling hoists.
10.0	INSPECTION AND TESTING
1.	The General inspection requirements to be considered are as below:
	Test in the Workshop:
	a) Once the manufacturing process is completed, and before the material is sent to site, the Successful bidder must conduct in his own facilities or other certified facilities , all the test that are listed in this section. The successful bidder shall specify whether or not he posseses suitable facilities and installations for conducting the test on the items of equipment that are the subject of the bid.
	b) The Suppliers' standard test shall be conducted in the workshop on all the Motors, Reducers and items of the Transmission equipment.
	c) The mechanical locks shall be checked on the bed to ensure that they have the design differential pressure And design speed.
	d) All the shafts shall be ultrasonically tested.
	e) In the event there being elements or components that are stuck together, the adherence , hardness , lack of porosity shall be checked.
	f) An operating test shall be conducted in the workshop on every type of agitator model, with a view of verifying that the operating parameters comply with the guarantee parameters. The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/END CUSTOMER
2.	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.
3.	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.
4.	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 cannot be considered as a



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	guarantee of functional objective of rubber used.
5.	DYNAMICS
	5.1 :CRITICAL SPEED
	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
	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.
	5.2 : VIBRATION SEVERITY
	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.
	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, even if Motor rating falls below 15kw.
	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
6.	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.
7.	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.
8.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
9.	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.
10	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.
11	Out of all Agitators, One Number of each type will be inspected by the Purchaser at the Bidder's



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	works before dispatch or where the test facilities are available.
12	However, the Bidder shall conduct performance test for the remaining Agitators and submit the reports.
13	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
14	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
15	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
16	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
17	Bidder to arrange all calibrated gauges, Instruments during inspection.
11.0	PAINTING
1.	Painting details :- Agitators shall be painted as per the painting scheme which will furnished to the Successful Bidder during contract stage. The Total DFT will be maximum 300 micron
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 follow the painting scheme which will be furnished by the Purchase during contract stage.
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 & COMMISSIONING 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



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	energized. The List of such spares to be provided during bidding stage. Bidder shall consider and supply all the spares required for the operation of the equipment within the warranty or guarantee period.
12.2	RECOMMENDED 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	MANDATORY SPARES:
	<p>Bidder to quote for the mandatory spares as per the Mandatory Spare list enclosed.</p> <p>The mandatory spares will be considered for L1 evaluation. Mandatory spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and 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.</p> <p>All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the Mandatory spare s shall be manufactures along with the main equipment components as a continuous operation as per same specification and quality plan.</p> <p>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.</p>
13.0	PERFORMANCE GUARANTEE
	<p>a) All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards.</p> <p>b) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories</p> <p>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.</p> <p>d) Noise level ≤ 85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed.</p>



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	<p>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.</p> <p>f) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ END CUSTOMER approval.</p> <p>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.</p>
14.0	BID EVALUATION CRITERIA FOR POWER CONSUMPTION:
1.	<p>POWER GUARANTEE</p> <p>Bidder to specify the total guaranteed power per Agitators (i.e. power consumed at Motor input terminal at normal liquid level) operating at the rated capacity in their offer.</p>
2.	<p>BID EVALUATION CRITERIA FOR POWER CONSUMPTION:</p> <p>Only agitators which are in continuous operation will be considered for power consumption.</p> <p>The best of the parameter for auxiliary power consumption quoted by any qualified bidder shall be taken as the base or ceiling value. Bid prices of other bidders will be loaded for every KW excess over the ceiling value as per the formula given below.</p> <p>Adjustment factor for excess power consumption = $(GPC-BV) \times PL \times \text{No's of Working Agitators}$</p> <p>GPC- Guaranteed Power Consumption at the Motor Terminal at the Normal Liquid level quoted by bidder in KW</p> <p>BV- Base Value (Bidder shall refer to the Technical Information or Agitator Selection Document)</p> <p>PL- Power Loading per KW . (Bidder shall refer to the Technical Information or Agitator Selection Document)</p> <p>However, the maximum value of power loading will be limited to 10% of the equipment value.</p>
15.0	LIQUIDATED DAMAGES FOR POWER CONSUMPTION
	<p>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</p> <p>Liquidated damage deductible = $(APC-GPC) \times P \times \text{Total no of Working agitators}$</p> <p>Where</p> <p>GPC- Guaranteed Power Consumption at the Motor Terminal at the Normal Liquid level quoted by bidder in KW</p> <p>APC- Actual Power Consumption in KW</p> <p>N- Total Number of Agitators</p> <p>P- Penalty per KW (Bidder shall refer to the Technical Information or Agitator Selection Document)</p>



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
	<p>Note :</p> <p>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.</p> <p>2. For conducting PG test at project site for demonstrating the guaranteed parameters of Agitator, vendor has to make own arrangement. TA/DA, Stay, Travel charges shall be borne by the Bidder and charges towards the same shall be considered suitably in their Offer.</p>
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 thirty six months (36) months from the date of Supply or twenty four (24) 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 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 CONSUMABLES:
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements upto the warranty or guarantee period. 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.



**TECHNICAL SPECIFICATION OF
AGITATORS**

REF: FGD:AGITATORS

REV. No. 01

S.No	Description
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	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial Offer. Vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	<p>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.</p> <p>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.</p> <p>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.</p>

 BHEL Maharatna Company	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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

FGD:AGITATORS:REV01

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		REF: FGD:AGITATORS
				REV. No. 01
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	REF: FGD:AGITATORS
		REV. No. 01

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

FGD:AGITATORS:REV01

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	l	
7	AGITATOR POWER(P)	$N_p * \rho * d^5 * n^3 * l$	
8	GEARBOX EFFICIENCY	η_1	
9	BEARING TRANSMISSION EFFICIENCY	η_2	
10	EFFICIENCY DUE TO ANY OTHER LOSSES	η_3	
11	MECHANICAL POWER REQUIRED	$Agitator\ BKW = P / (\eta_1 * \eta_2 * \eta_3)$	
12	MOTOR EFFICIENCY	η	
13	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency or Agitator BKW	$Power\ consumed\ at\ Motor\ terminal = Agitator\ BKW / \eta$	
14	MOTOR POWER (KW)	Motor Power shall be at least 1.2 times the Power consumed at Motor Terminal.	

BIDDER SIGN : _____

DESIGNATION : _____

DATE : _____

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

Annexure-IV MOTOR DATASHEET FOR AGITATORS (TO BE FILLED FOR EACH AGITATOR)
Project :
Enquiry No :

SLNO	Description	DATA
A.	GENERAL	
1.	Manufacturer & Country of origin.	
2.	Equipment driven by motor	“Name of the Agitator”
3.	Motor type	
4.	Quantity	
B.	DESIGN AND PERFORMANCE DATA	
1.	Frame size	
2.	Type of duty	
3.	Type of enclosure /Method of cooling/ Degree of protection	
4.	Applicable standard to which motor generally conforms	
5.	Efficiency class as per IS 12615(IE3)	
6.	(a)Whether motor is flame proof	
	(b)If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting	
8.	Direction of rotation as viewed from DE END	
9.	Standard continuous rating at 40 deg.C. Ambient temp. as per Indian Standard (KW)	
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
11.	Maximum continuous load demand of driven equipment in KW	
12.	Rated Voltage (volts)	
13.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
14.	Rated speed at rated voltage and frequency(RPM)	
15.	At rated Voltage and frequency:	
	a. Full load current	
	b. No load current	

		TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
16.	Power Factor at		
	a. 100%/75%/50% load		
	b. NO load		
	c. Starting.		
17.	Efficiency at rated voltage and Frequency,		
	a.100% load		
	b. 75% load		
	c. 50% load		
18.	Starting current (amps) at		
	a. 100 % voltage		
	b. 85% voltage		
	c. 80% voltage		
19.	Minimum permissible starting Voltage (Volts)		
20.	Starting time with minimum permissible voltage/80%/ 100%/ 110%		
	a. Without driven equipment coupled		
	b. With driven equipment coupled		
21.	Safe stall time with 100% ,110% & 80% of rated voltage		
	a. From hot condition		
	b. From cold condition		
22.	Torques :		
	a. Starting torque at min. permissible voltage(kg-mtr.)/ rated voltage		
	b. Pull up torque at rated voltage.		
	c. Pull out torque		
	d. Min accelerating torque (kg.m) available at lowest permissible starting voltage		
	e.Rated torque (kg.m)		
23.	Stator winding resistance per phase (ohms at 20 Deg.C.)		
24.	GD2 value of motors		
25.	No of permissible successive starts when motor is in hot condition		
26.	Locked Rotor KVA Input		
27.	Locked Rotor KVA/KW		
28.	Vibration limit :Velocity (mm/s)		
29.	Noise level limit (dBA)		
C.	CONSTRUCTIONAL FEATURES		
1.	Stator winding insulation		

		TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS REV. No. 01
	a. Class & Type		
	b. Winding Insulation Process		
	c. Tropicalised (Yes/No)		
	d. Temperature rise over specified maximum ambient temperature of 50 deg C		
	e. Method of temperature measurement		
	f. Stator winding connection		
2.	Main Terminal Box		
	a. Type		
	b. Location(viewed from NDE side)		
	c. Entry of cables(bottom/side)		
	d. Recommended cable size(To be matched with cable size envisaged by owner)		
	e. Fault level (MVA),Fault level duration(sec)		
	f. Cable glands & lugs details (shall be suitable for power cable)		
3.	Type of DE/NDE Bearing		
4.	Motor Paint shade		
5.	Weight of		
	a. Motor stator (KG)		
	b. Motor Rotor (KG)		
	c. Total weight (KG)		
D.	List of accessories.		
1.	Space Heaters (Nos./Power in watts/supply voltage)		
2.	Terminal Box for Space Heater (Yes/No)		
3.	Speed switch (Yes/No)		
	No of contacts and contact ratings of speed switch		
4.	Insulation of bearing (Yes/No)		
5.	Noise reducer(Yes/No)		
6.	Grounding pads		
	i) No and size on motor body		
	ii) Nos on terminal Box		
7.	Any other fitments		
E.	List of curves.		

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

	Torque speed characteristic of the motor	
	Thermal withstand characteristic	
	Starting. current Vs. Time	
	Starting. current Vs speed	
	P.F. and Effi. Vs Load	



TECHNICAL SPECIFICATION OF AGITATORS

FGD:AGITATORS:REV01

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) – Shall meet as the ISO 10816 standard	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 : _____

	TECHNICAL SPECIFICATION OF AGITATORS	REF: FGD:AGITATORS
		REV. No. 01

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:

SI No	Clause No	Page No	Description of Deviation

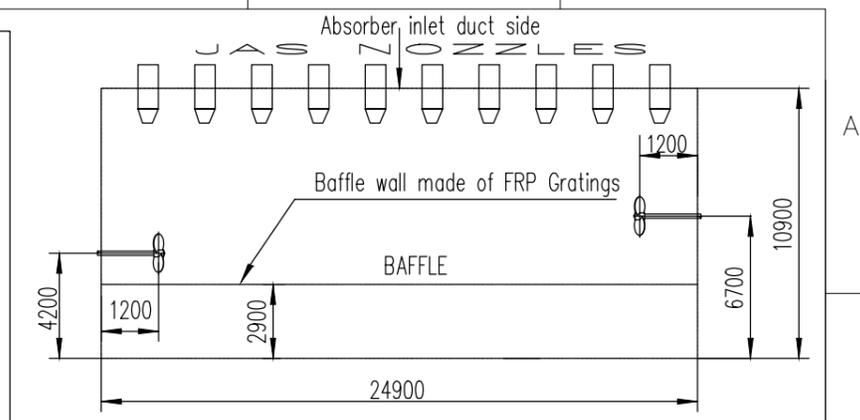
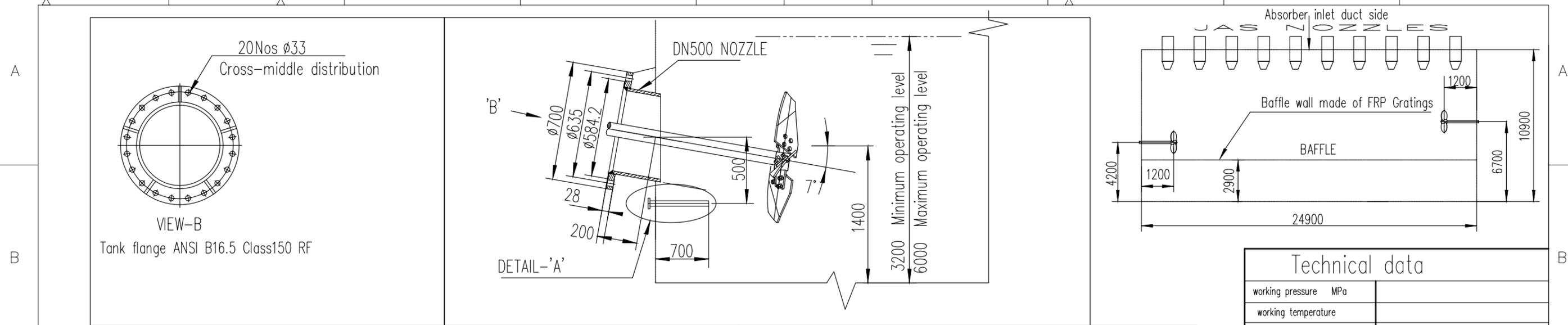
SIGNATURE OF BIDDER -----

NAME -----

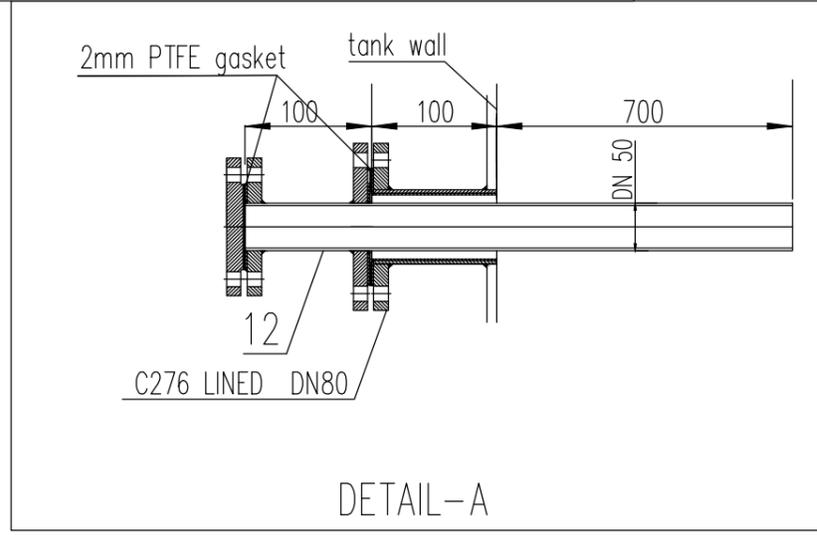
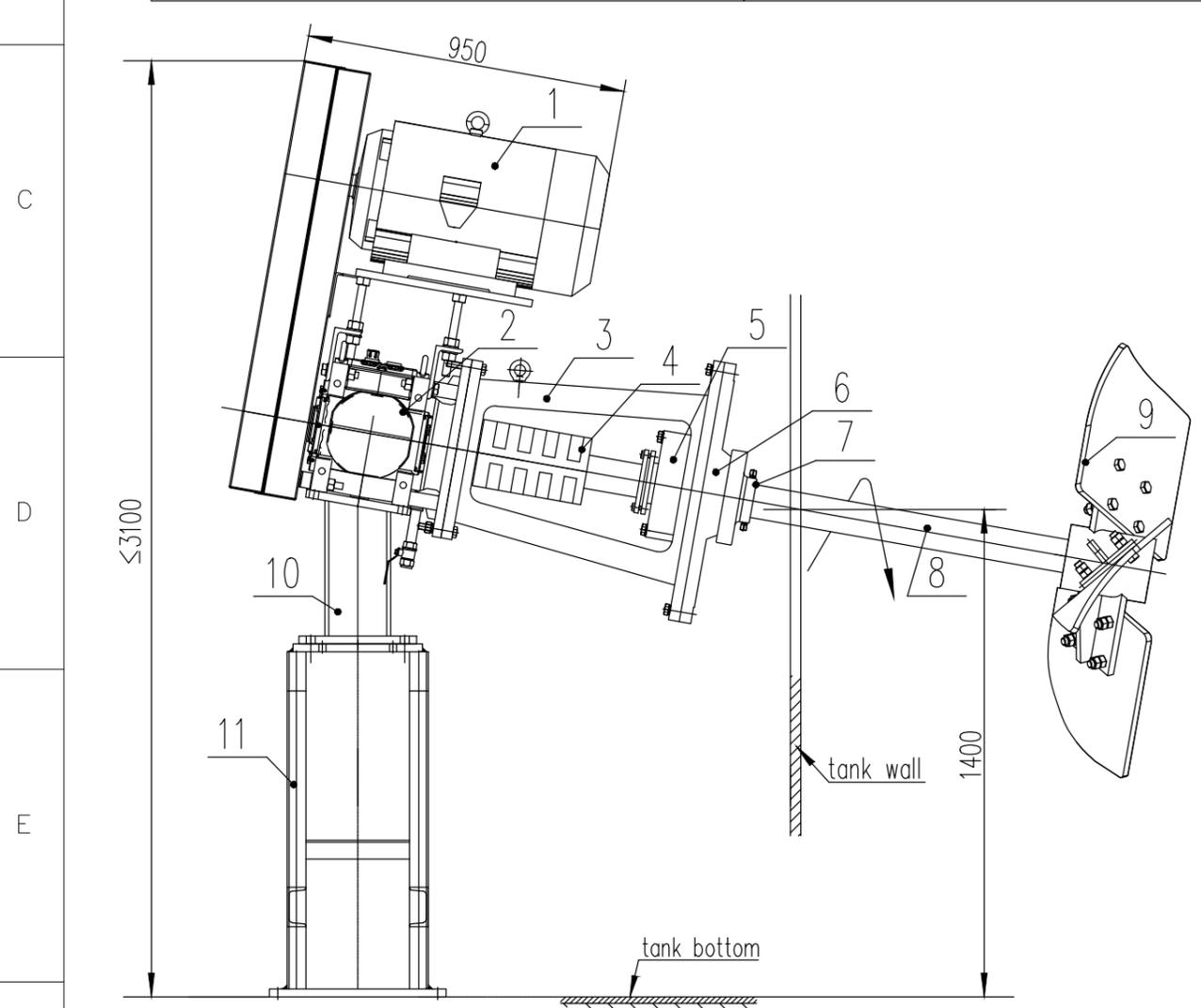
DESIGNATION -----

*Strike out whichever is not applicable

BIDDER SIGN WITH SEAL AND DATE:



Technical data	
working pressure	MPa
working temperature	
density	Kg/m ³
viscosity	CP)
solid content %	
baffle condition	
mixing purpose	
medium	
motor power	Kw
agitator speed	r/min
blade speed	m/s
volume	m ³
static loading	N
dynamic loading	N
torque	N.m
bending torque	N.m
Critical speed	n/min



NOTES:

- BOTH SHAFT AND IMPELLER BLADES SHALL BE ALLOY 926 MATERIAL.
- MECHANICAL SEAL FLUSHING WATER REQUIREMENT: VENDOR TO FURNISH CONSIDERING 2 BAR PRESSURE
- EMERGENCY (IMPELLER) FLUSHING WATER REQUIREMENT: VENDOR TO FURNISH CONSIDERING 2 BAR PRESSURE
- AGITATOR LOCATION IN THE ABSORBER IS ALREADY FIXED BY BHEL AS GIVEN IN THIS DRAWING. VENDOR SHALL DESIGN THE AGITATOR CONSISTING THE LOCATION AS SHOWN IN THIS DRAWING ONLY. AGITATOR MOUNTING NOZZLE SIZE AND LOCATION IS FIXED AND IT CANNOT BE ALTERED.
- FOR EACH TANK: 2 SETS INSTALLED AGITATOR + 1 SET WAREHOUSE SPARE SHALL BE PROVIDED.
- DURING NORMAL OPERATION OF THE ABSORBER, JAS NOZZLES WILL BLOW THE OXIDATION AIR INTO THE ABSORBER ALONG WITH SLURRY. HENCE, DURING NORMAL OPERATION JAS WILL KEEP THE ABSORBER IN SUSPENSION. AGITATOR WILL BE OPERATED ONLY DURING EMERGENCY OR SHUT DOWN CONDITION. VENDOR SHALL GUARANTEE THAT WITH TWO INSTALLED AGITATORS ARE SUFFICIENT TO PREVENT SOLID SETTLEMENT AT BOTTOM.
- FLUSH PIPE WITH FLANGE VENDOR SCOPE
- AGITATOR, FLUSH PIPE MOUNTING FASTENERS WITH ABSORBER AND FOUNDATION BOLTS ARE IN THE VENDOR SCOPE
- C276 NOZZLE ON THE ABSORBER WALL ARE IN THE BHEL'S SCOPE

Sl. No.	Description & Size	Material	Qty.	Remarks
12	Flush water pipe head	926/C276/FRP	1	
11	Support stand	A283-C	1	
10	Hold shelf	A283-C	1	
9	Impeller	926	1	
8	Mxier shaft	926	1	
7	Plug	926	1	
6	Mounting plate	A283-C/926	1	
5	Side entry agitator mechanical seal	2507	1	MAKE ?
4	Shaft coupling	A283-C	1	
3	Machine stand with safe cover	A283-C	1	
2	Gearbox	MAKE ?	1	
1	Motor IE3	NTPC APPD SOURCE	1	

VENDOR TO PROVIDE FOUNDATION PLAN

CAUTION: THE DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MARKING OF EQUIPMENT WITHOUT THE WRITTEN PERMISSION OF BHEL. FOR AGREEMENT WITH SAID COMPANY.

PROJECT: BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET: 632 406.

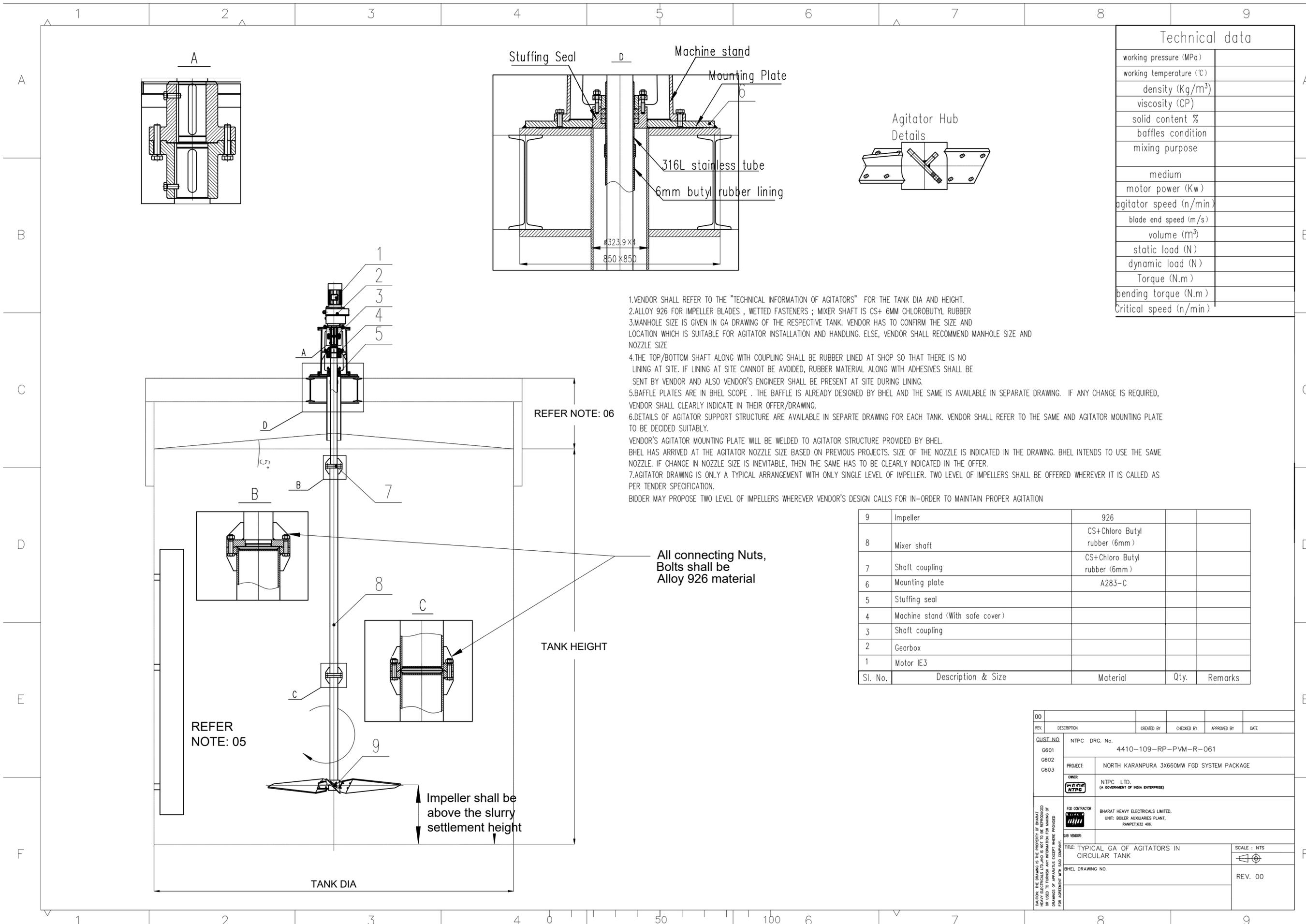
TITLE: Typical GA of Absorber agitator

BHEL DRAWING NO: 3-FW-720-02394

SUB VENDOR DRAWING NO.

SCALE: NTS

REV. 00



Technical data	
working pressure (MPa)	
working temperature (°C)	
density (Kg/m ³)	
viscosity (CP)	
solid content %	
baffles condition	
mixing purpose	
medium	
motor power (Kw)	
agitator speed (n/min)	
blade end speed (m/s)	
volume (m ³)	
static load (N)	
dynamic load (N)	
Torque (N.m)	
bending torque (N.m)	
Critical speed (n/min)	

- VENDOR SHALL REFER TO THE "TECHNICAL INFORMATION OF AGITATORS" FOR THE TANK DIA AND HEIGHT.
- ALLOY 926 FOR IMPELLER BLADES , WETTED FASTENERS ; MIXER SHAFT IS CS+ 6MM CHLOROBUTYL RUBBER
- MANHOLE SIZE IS GIVEN IN GA DRAWING OF THE RESPECTIVE TANK. VENDOR HAS TO CONFIRM THE SIZE AND LOCATION WHICH IS SUITABLE FOR AGITATOR INSTALLATION AND HANDLING. ELSE, VENDOR SHALL RECOMMEND MANHOLE SIZE AND NOZZLE SIZE
- THE TOP/BOTTOM SHAFT ALONG WITH COUPLING SHALL BE RUBBER LINED AT SHOP SO THAT THERE IS NO LINING AT SITE. IF LINING AT SITE CANNOT BE AVOIDED, RUBBER MATERIAL ALONG WITH ADHESIVES SHALL BE SENT BY VENDOR AND ALSO VENDOR'S ENGINEER SHALL BE PRESENT AT SITE DURING LINING.
- BAFFLE PLATES ARE IN BHEL SCOPE . THE BAFFLE IS ALREADY DESIGNED BY BHEL AND THE SAME IS AVAILABLE IN SEPARATE DRAWING. IF ANY CHANGE IS REQUIRED, VENDOR SHALL CLEARLY INDICATE IN THEIR OFFER/DRAWING.
- DETAILS OF AGITATOR SUPPORT STRUCTURE ARE AVAILABLE IN SEPARTE DRAWING FOR EACH TANK. VENDOR SHALL REFER TO THE SAME AND AGITATOR MOUNTING PLATE TO BE DECIDED SUITABLY.
- VENDOR'S AGITATOR MOUNTING PLATE WILL BE WELDED TO AGITATOR STRUCTURE PROVIDED BY BHEL.
- BHEL HAS ARRIVED AT THE AGITATOR NOZZLE SIZE BASED ON PREVIOUS PROJECTS. SIZE OF THE NOZZLE IS INDICATED IN THE DRAWING. BHEL INTENDS TO USE THE SAME NOZZLE. IF CHANGE IN NOZZLE SIZE IS INEVITABLE, THEN THE SAME HAS TO BE CLEARLY INDICATED IN THE OFFER.
- AGITATOR DRAWING IS ONLY A TYPICAL ARRANGEMENT WITH ONLY SINGLE LEVEL OF IMPELLER. TWO LEVEL OF IMPELLERS SHALL BE OFFERED WHEREVER IT IS CALLED AS PER TENDER SPECIFICATION.
- BIDDER MAY PROPOSE TWO LEVEL OF IMPELLERS WHEREVER VENDOR'S DESIGN CALLS FOR IN-ORDER TO MAINTAIN PROPER AGITATION

Sl. No.	Description & Size	Material	Qty.	Remarks
9	Impeller	926		
8	Mixer shaft	CS+Chloro Butyl rubber (6mm)		
7	Shaft coupling	CS+Chloro Butyl rubber (6mm)		
6	Mounting plate	A283-C		
5	Stuffing seal			
4	Machine stand (With safe cover)			
3	Shaft coupling			
2	Gearbox			
1	Motor IE3			

All connecting Nuts, Bolts shall be Alloy 926 material

TANK HEIGHT

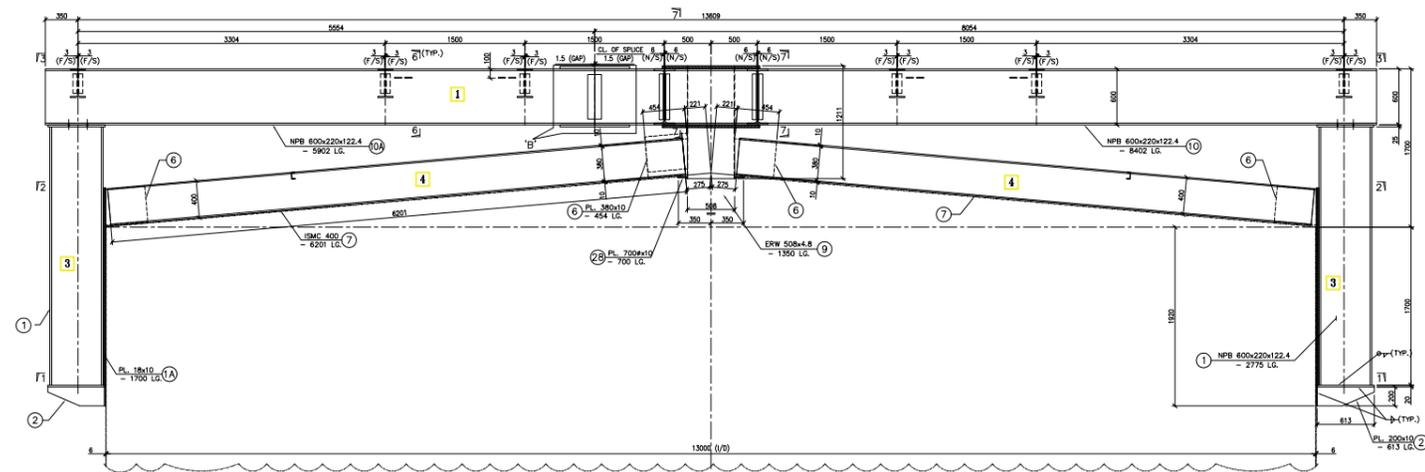
REFER NOTE: 05

Impeller shall be above the slurry settlement height

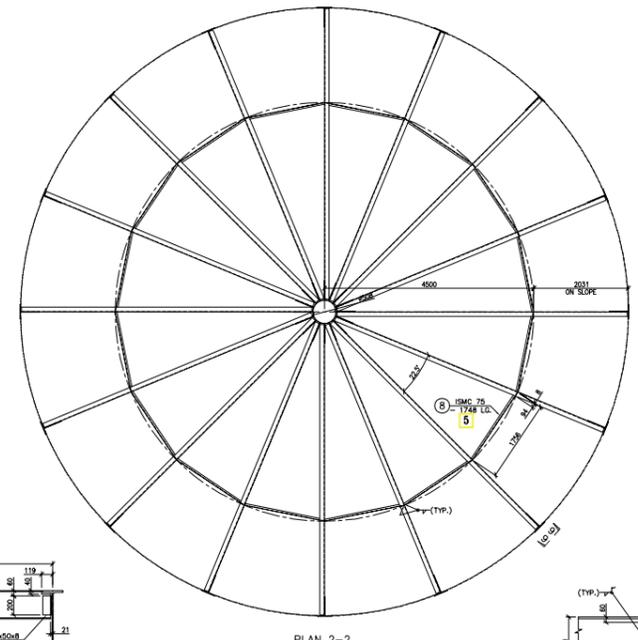
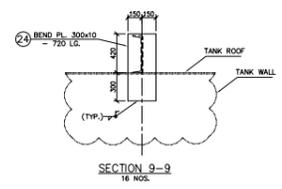
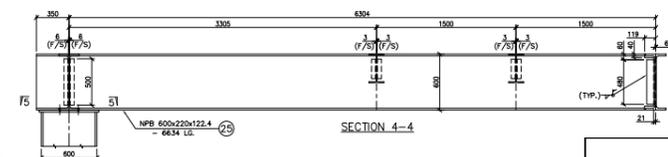
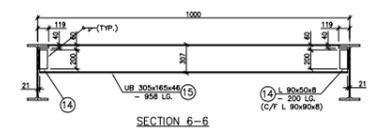
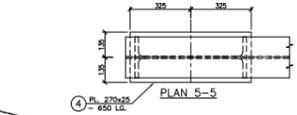
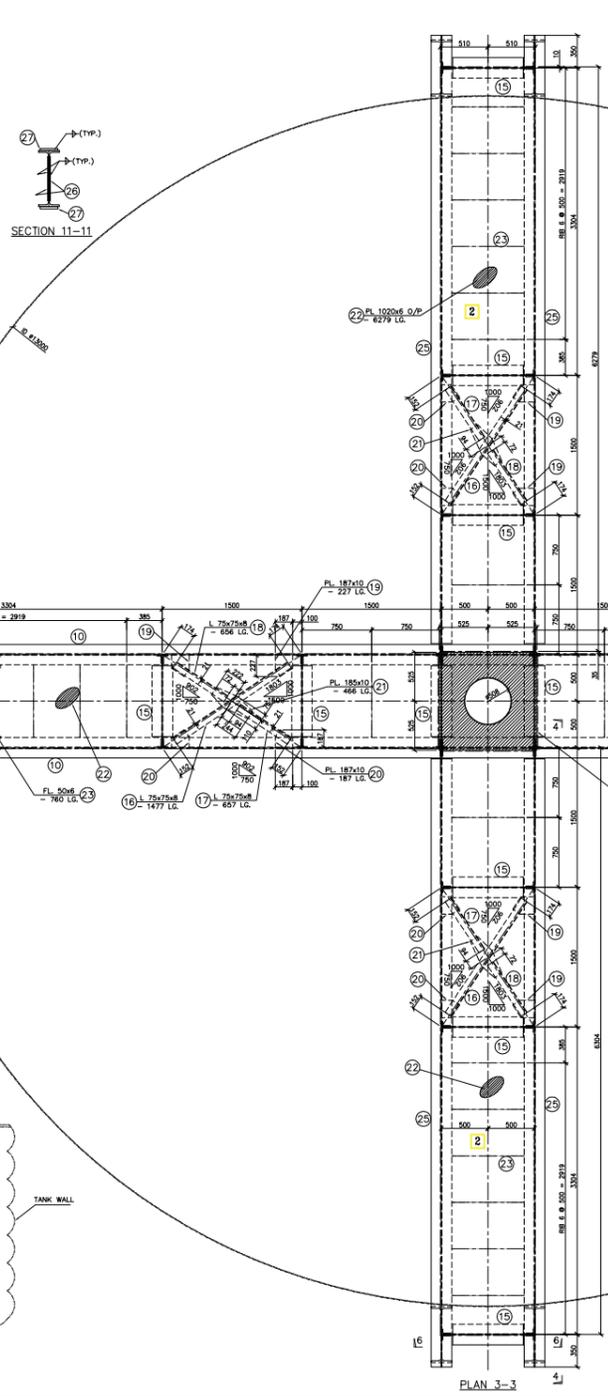
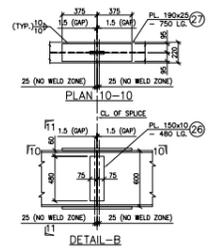
TANK DIA

REV.	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE
00					
CUST. NO. NTPC DRG. No. 4410-109-RP-PVM-R-061					
PROJECT: NORTH KARANPURA 3X660MW FGD SYSTEM PACKAGE					
OWNER: NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)					
FGD CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANPET-632 406.					
SIB VENDOR:					
TITLE: TYPICAL GA OF AGITATORS IN CIRCULAR TANK					SCALE : NTS
BHEL DRAWING NO.					REV. 00

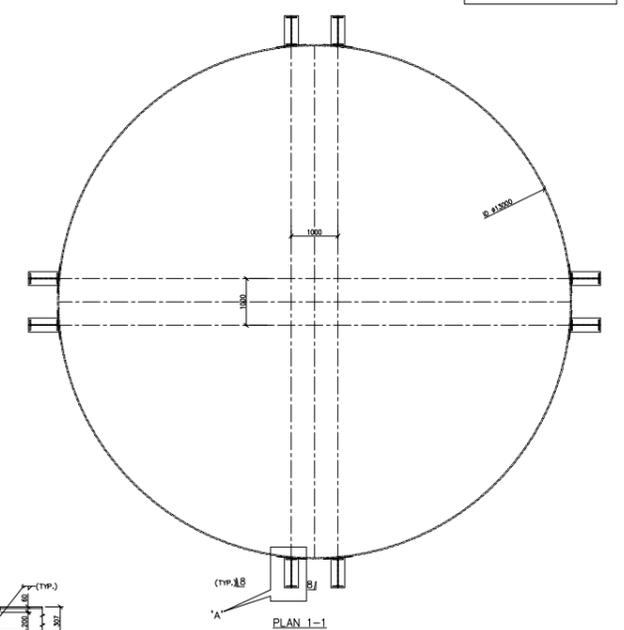
All dimensions are in millimetres
For production REF-PRG459 For painting REF-PRG458 For untd. dims.



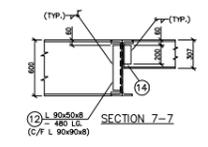
1. NO. AXILIARY OBSBERT TANK SUPPORT RECD AS DRN MKD. 13000/AOT-1



PLAN 2-2



PLAN 1-1



SL. NO	SECTION	TOTAL WEIGHT (KG)	MATERIAL SPECIFICATION
1	NPB 600x220x122.4	9496.91	IS: 2062-2006 GR-A
2	UB 305x165x46	618.29	IS: 2062-2006 GR-A
3	ISMC 400	4970.72	IS: 2062-2006 GR-A
4	ISMC 75	198.55	IS: 2062-2006 GR-A
5	L 90x90x8	179.71	IS: 2062-2006 GR-A
6	L 75x75x8	99.32	IS: 2062-2006 GR-A
7	ERW 508x4.8	84.02	IS: 2062-2006 GR-A
8	PL 40 THK.	692.37	IS: 2062-2006 GR-A
9	PL 25 THK.	331.47	IS: 2062-2006 GR-A
10	PL 20 THK.	489.09	IS: 2062-2006 GR-A
11	PL 10 THK.	1754.41	IS: 2062-2006 GR-A
12	PL 6 THK.	50.11	IS: 2062-2006 GR-A
13	CHQD PL 6 O/P	1362.89	IS: 2062-2006 GR-A
TOTAL WEIGHT=		20297.87	

BILL OF MATERIALS

SECTION MKD.	PART MKD.	ITEM N.O.	SECTION	LENGTH	Qty FOR ONE ASSEMBLY	UNIT WT. (Kgs.)	WEIGHT FOR ONE ASSEMBLY (Kgs.)	NOS. OF ASSEMBLY	QTY. FOR TOTAL ASSEMBLY	WEIGHT FOR TOTAL ASSEMBLY (Kgs.)	ERE. MKD. WT.(Kgs.)	REMARKS				
13000/AOT-1	1	8	PL 380x10	454	16	78.50	216.89	16	216.89							
		9	ERW 508x4.8	1211	1	69.38	84.02	1	84.02							
		10	NPB 600x220x122.4	8402	2	122.4	2056.81	2	2056.81							
		10A	NPB 600x220x122.4	5902	2	122.4	1444.81	2	1444.81							
		11	PL 1050x40	1050	2	314.00	692.37	2	692.37							
		14	L 90x50x8	200	32	10.80	69.12	32	69.12					(C/F L90x90x8)		
		15	UB 305x165x46	958	6	46.10	353.31	6	353.31							
		16	L 75x75x8	1477	2	8.90	26.29	2	26.29							
		17	L 75x75x8	657	2	8.90	11.69	2	11.69							
		18	L 75x75x8	656	2	8.90	11.68	2	11.68							
		19	PL 187x10	227	4	78.50	13.33	4	13.33							
		20	PL 187x10	187	4	78.50	10.98	4	10.98							
		21	PL 185x10	466	2	78.50	13.53	2	13.53							
		22	CHQD PL 1020x8 O/P	6279	2	53.20	681.46	2	681.46							
		23	PL 50x8	760	14	47.10	25.06	14	25.06							
		28	PL 150x10	480	2	78.50	11.30	2	11.30							
		27	PL 190x25	750	2	198.26	55.93	2	55.93							
		28	PL 700x10	700	1	78.50	38.47	1	38.47							
		13000/AOT-1	2	12	L 90x50x8	480	8	10.80	41.47	8	41.47				(C/F L90x90x8)	
				13	NOT USED											
				14	L 90x50x8	200	32	10.80	69.12	32	69.12				(C/F L90x90x8)	
				15	UB 305x165x46	958	6	46.10	264.96	6	264.96					
				16	L 75x75x8	1477	2	8.90	26.29	2	26.29					
				17	L 75x75x8	657	2	8.90	11.69	2	11.69					
				18	L 75x75x8	656	2	8.90	11.68	2	11.68					
				19	PL 187x10	227	4	78.50	13.33	4	13.33					
				20	PL 187x10	187	4	78.50	10.98	4	10.98					
				21	PL 185x10	466	2	78.50	13.53	2	13.53					
22	CHQD PL 1020x8 O/P			6279	2	53.20	681.46	2	681.46							
23	PL 50x8			760	14	47.10	25.06	14	25.06							
25	NPB 600x220x122.4			8634	4	122.4	3248.01	4	3248.01							
13000/AOT-1	3			1	NPB 600x220x122.4	2775	8	122.4	2717.28	8	2717.28					
				1A	PL 18x10	1700	8	78.50	19.22	8	19.22					
				2	PL 200x10	634	8	78.50	79.63	8	79.63					
				3	PL 600x20	649	8	157.00	489.09	8	489.09					
				4	PL 270x25	650	8	198.26	275.54	8	275.54					
13000/AOT-1	4			5	PL 620x10	2120	8	78.50	825.44	8	825.44					
				6	PL 380x10	454	16	78.50	216.89	16	216.89					
				7	ISMC 400	8201	16	50.10	4970.72	16	4970.72					
				24	PL 300x10	720	16	78.50	271.30	16	271.30					
				13000/AOT-1	5	8	ISMC 75	1738	16	7.14	198.55	16	198.55			
TOTAL WEIGHT=						20297.87	1	20297.87	20297.87							

TOTAL WEIGHT 20297.87 KG. = 20.298 T.

NOTES:-
1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN MM.
2. STANDARD FABRICATION NOTES DWG NO:4-00-000-32487 SHALL BE REFERRED FOR RELEVANT DETAILS.

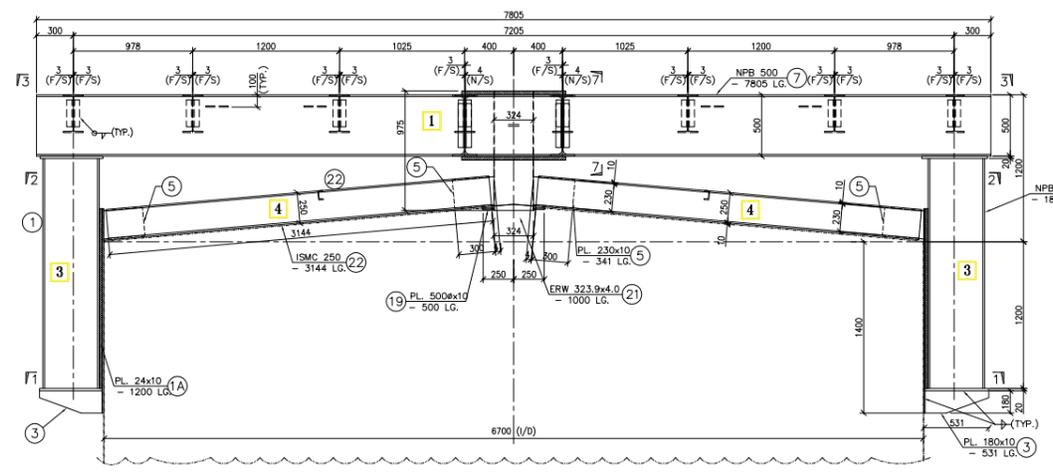
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT
BHARAT HEAVY ELECTRICALS LTD.
UNIT: BOILER AUXILIARIES PLANT, MANIPET - 532 406.

DEPT: UNCLD.DPM
SCALE: 1:20
DATE: 12/18/15

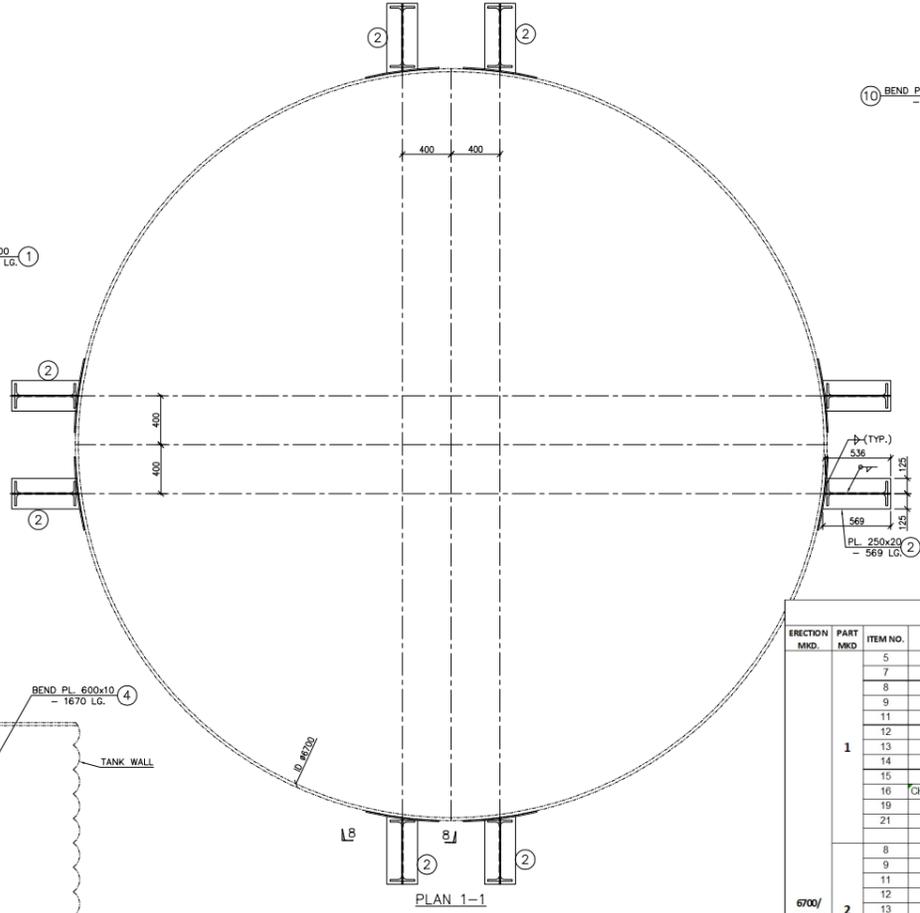
DRWING NO: 0-W-721-01303

REV: 00

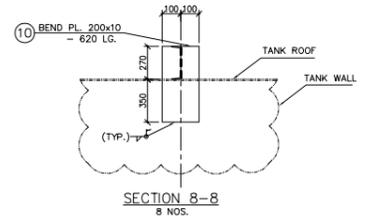
All dimensions are in millimetres
 For production
 REF - PBA-599 For painting
 REF - PBA-588 For anti. zinc



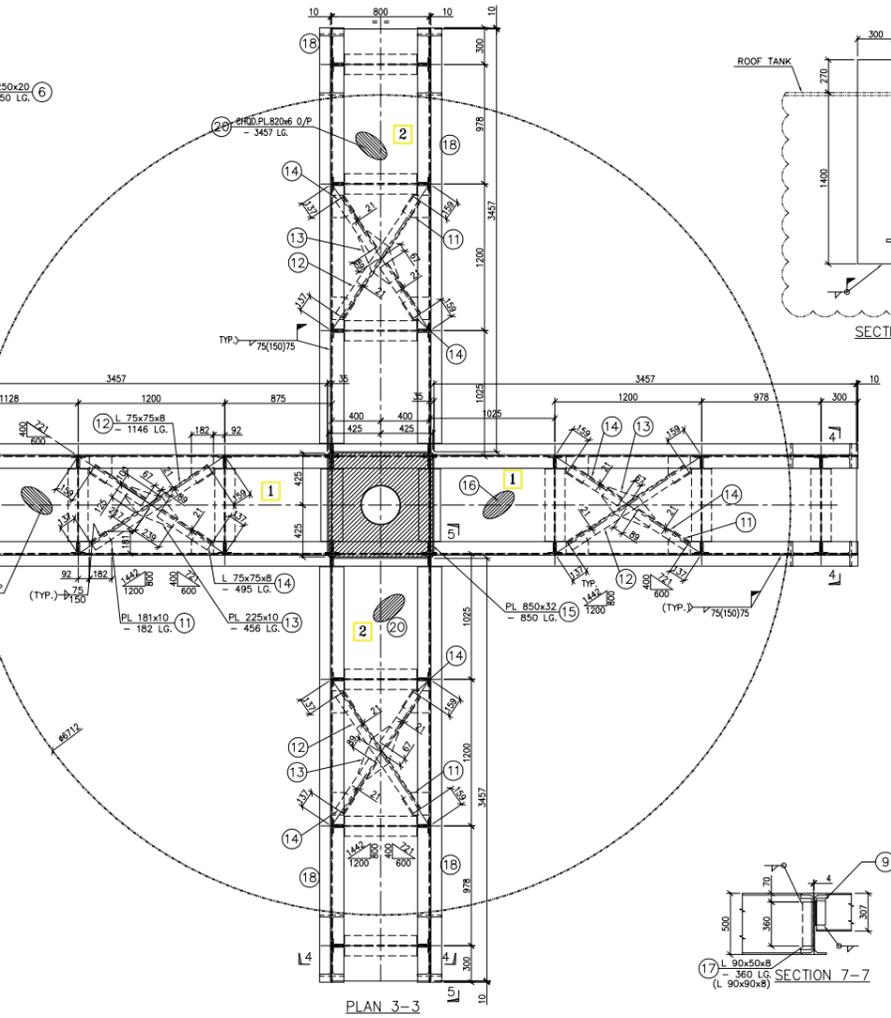
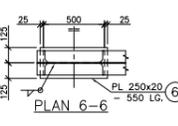
1 NO. SECONDARY HYDROCYCLONE FEED TANK SUPPORT REQD AS DRN MKD 6700/SHFT-1



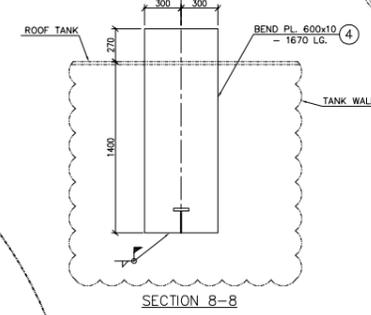
PLAN 1-1



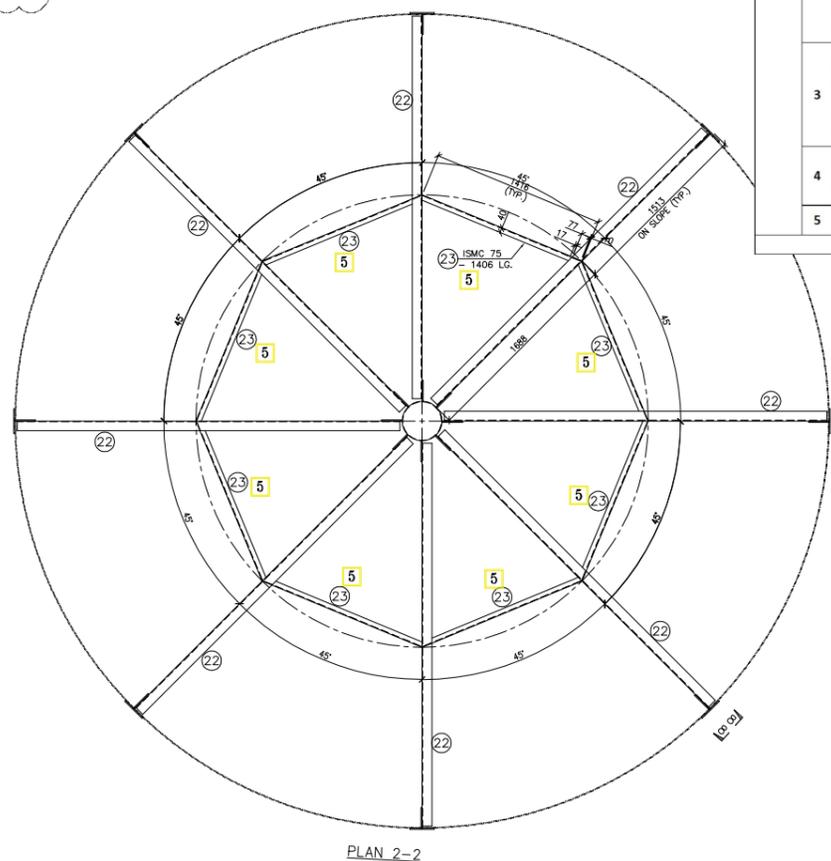
SECTION 8-8
8 NOS.



PLAN 3-3



SECTION 8-8



PLAN 2-2

BILL OF MATERIALS												
ERECTN MKD.	PART MKD.	ITEM NO.	SECTION	LENGTH	Qty FOR ONE ASSEMBLY	UNIT WT. (Kg.)	WEIGHT FOR ONE ASSEMBLY (Kg.)	NOS. OF ASSEMBLY	QTY. FOR TOTAL ASSEMBLY	WEIGHT FOR TOTAL ASSEMBLY (Kg.)	EREC. MKD. WT.(Kg.)	REMARKS
		5	PL 230x10	341	8	78.50	49.25	8	49.25			
		7	NPB500	7805	2	90.70	1415.83	2	1415.83			
		8	UB 305x165x46	762	8	46.10	281.03	8	281.03			
		9	L 90x90x8	200	32	10.80	69.12	32	69.12			(C/F L90x90x8)
		11	PL 181x10	182	8	78.50	20.69	8	20.69			
		12	L 75x75x8	1146	2	8.90	20.40	2	20.40			
		13	PL 225x10	456	2	78.50	16.11	2	16.11			
		14	L 75x75x8	495	4	8.90	17.62	4	17.62			
		15	PL 850x32	850	2	251.20	362.98	2	362.98			
		16	CHQD PL 820x6 O/P	3457	2	53.20	301.62	2	301.62			
		19	PL 500x10	500	1	78.50	19.63	1	19.63			
		21	ERW 323.9x4.0	975	1	31.80	31.01	1	31.01			
		8	UB 305x165x46	762	6	46.10	210.77	6	210.77			
		9	L 90x90x8	200	24	10.80	51.84	24	51.84			(C/F L90x90x8)
		11	PL 181x10	182	8	78.50	20.69	8	20.69			
		12	L 75x75x8	1146	2	8.90	20.40	2	20.40			
		13	PL 225x10	456	2	78.50	16.11	2	16.11			
		14	L 75x75x8	495	4	8.90	17.62	4	17.62			
		17	L 90x90x8	360	8	10.80	31.10	8	31.10			(C/F L90x90x8)
		18	NPB500	3484	4	90.70	1264.00	4	1264.00			
		20	CHQD PL 820x6 O/P	3457	2	53.20	301.62	2	301.62			
		1	NPB500	1680	8	90.70	1364.13	8	1364.13			
		1A	PL 24x10	1200	8	78.50	18.09	8	18.09			
		2	PL 250x20	569	8	157.00	178.67	8	178.67			
		3	PL 180x10	531	8	78.50	60.02	8	60.02			
		4	PL 600x10	1670	8	78.50	629.26	8	629.26			
		6	PL 250x20	550	8	157.00	172.70	8	172.70			
		5	PL 230x10	341	8	78.50	49.25	8	49.25			
		10	PL 200x10	620	8	78.50	77.87	8	77.87			
		22	ISMC 250	3546	8	30.60	868.06	8	868.06			
		23	ISMC 75	1626	8	7.14	92.88	8	92.88			
							8050.34	1	8050.34		8050.34	

TOTAL WEIGHT 8050.34 KG = 8.05 T.

ABSTRACT			
SL.NO	SECTION	TOTAL WEIGHT (KG)	MATERIAL SPECIFICATION
1	NPB500	4043.95	IS: 2062-2006 GR-A
2	UB 305x165x46	491.79	IS: 2062-2006 GR-A
3	ISMC 250	868.06	IS: 2062-2006 GR-A
4	ISMC 75	92.88	IS: 2062-2006 GR-A
5	L 90x90x8	152.06	IS: 2062-2006 GR-A
6	L 75x75x8	76.04	IS: 2062-2006 GR-A
7	ERW 323.9x4.0	31.01	IS: 2062-2006 GR-A
8	PL 32 THK.	362.98	IS: 2062-2006 GR-A
9	PL 20 THK.	351.37	IS: 2062-2006 GR-A
10	PL 10 THK.	976.96	IS: 2062-2006 GR-A
11	CHQD PL 6 O/P	603.23	IS: 2062-2006 GR-A
TOTAL WEIGHT=		8050.34	

NOTES:-
 1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN MM.
 2. STANDARD FABRICATION NOTES DWG NO:4-00-000-32487 SHALL BE REFERRED FOR RELEVANT DETAILS.

REV	DATE	ALTERED	CHECKED	SCALE	WEIGHT	NO. OF SHEETS	NO. OF SHEETS
				1:1		1	1

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

SHARAT HEAVY ELECTRICALS LTD.
 UNIT: BOILER AUXILIARIES PLANT.
 RAIPUR - 632 406.

DEPT: ASST. ENGR. IN-CHARGE
 CODE: 01
 TITLE: NTPC-NORTH KARANPURA (3X660MW) AGITATOR SUPPORT FOR SECONDARY HYDROCYCLONE FEED TANK

SCALE: 1:1

WEIGHT: 8050.34

NO. OF SHEETS: 1

NO. OF SHEETS: 1

DATE: 10/11/21

APPD: GANESH

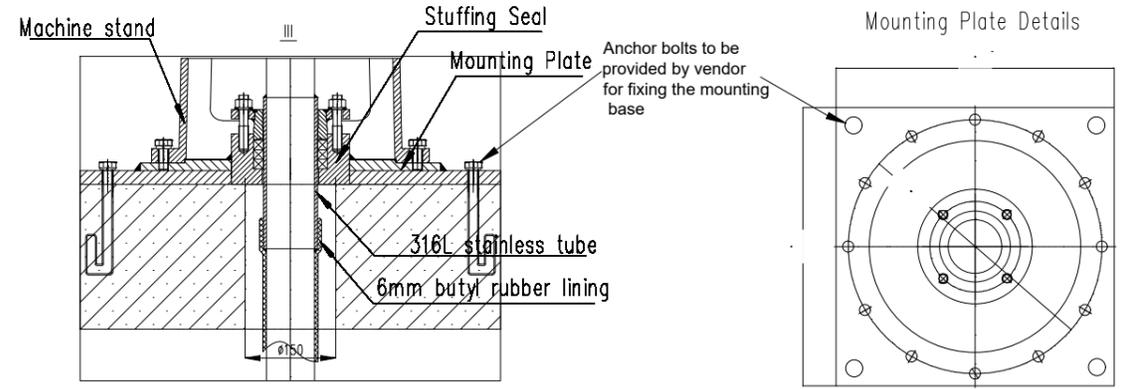
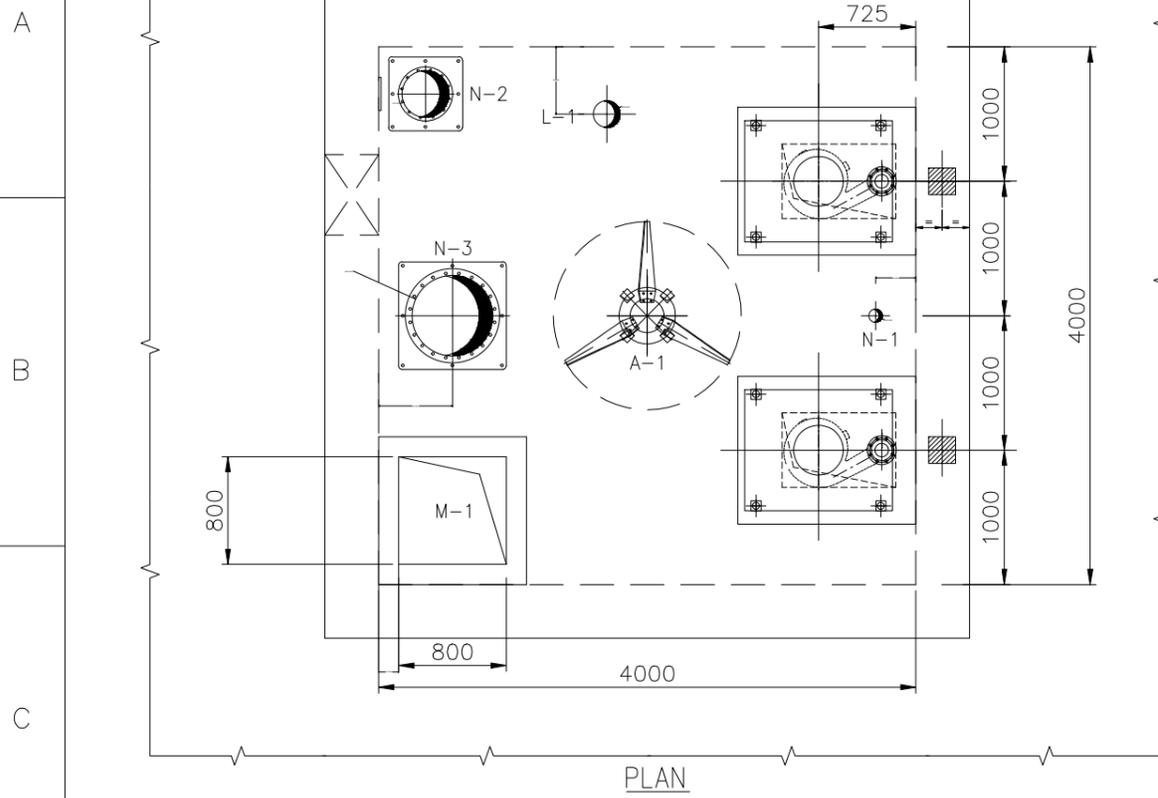
REF. TO ASSY/DWG: SME-NTPC-NC-AS-FAB-005

CARD CODE: U 01

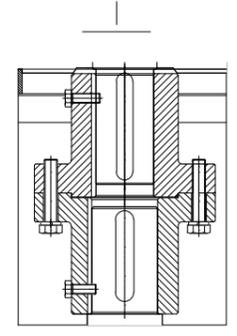
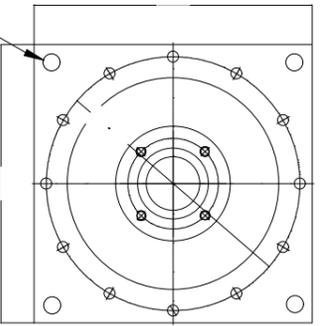
DRAWING NO: 0-FW-721-01306

REV: 00

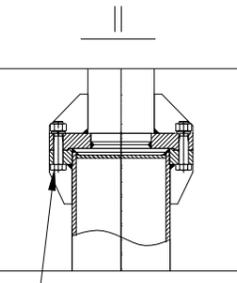
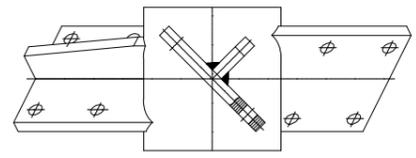
601401/2021/BAP-9762_FGD



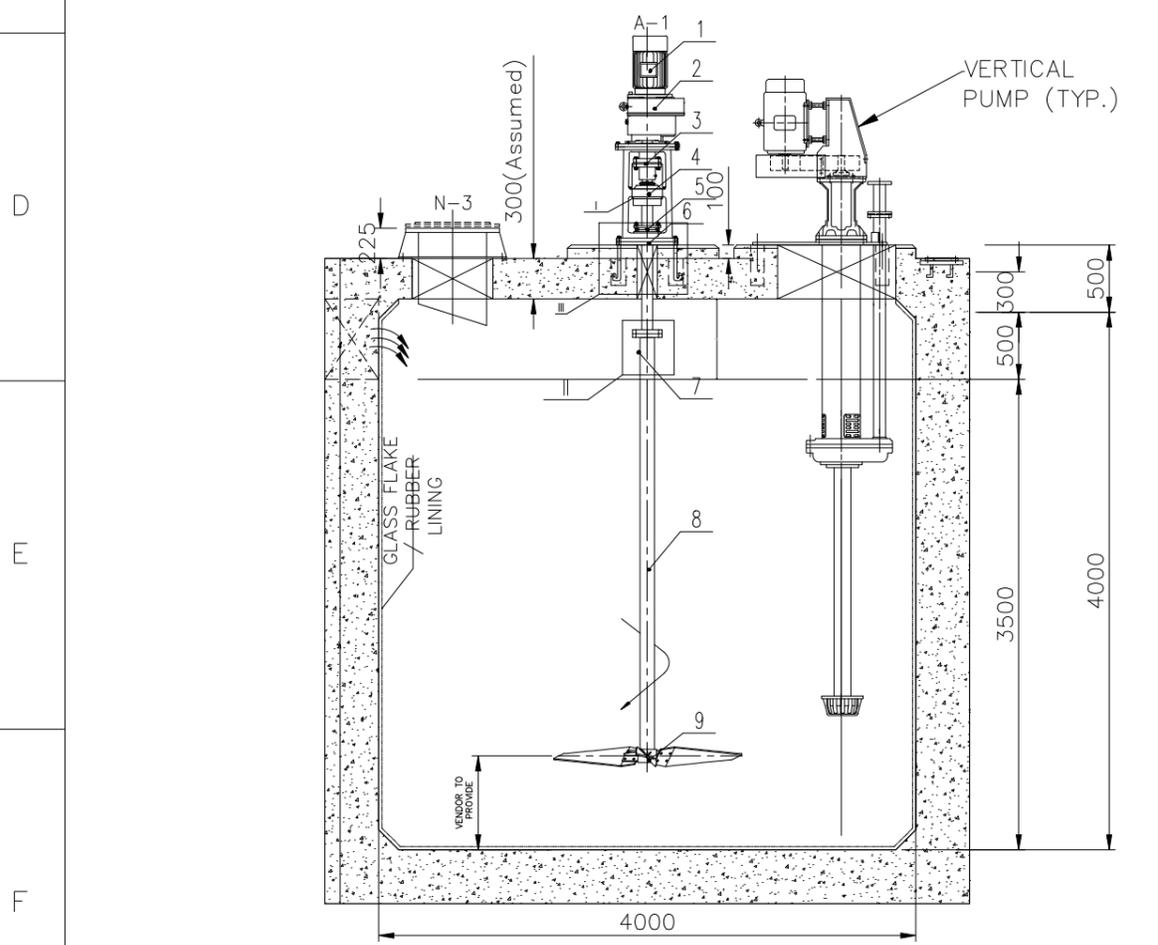
Mounting Plate Details



Agitator Hub Details



All connecting Nuts, Bolts shall be Alloy 926 material



Technical data	
working pressure (MPa)	
working temperature (°C)	
density (Kg/m ³)	
viscosity (CP)	
solid content %	
baffles condition	
mixing purpose	off-bottom suspension
medium	Limestone/ Gypsum slurry
motor power (Kw)	
agitator speed (n/min)	
blade end speed (m/s)	
volume (m ³)	
static load (N)	
dynamic load (N)	
torque (N.m)	
bending torque (N.m)	
Critical speed (n/min)	

Sl. No.	Description & Size	Material	Qty.	Remarks
9	Impeller	926		
8	Mixer shaft	CS+Chloro Butyl rubber (6mm)		
7	Shaft coupling	CS+Chloro Butyl rubber (6mm)		
6	Mounting plate			
5	Stuffing seal			
4	Machine stand (with safe cover)			
3	Shaft coupling			
2	Gearbox			
1	Motor IE3			

Notes:

1. Top of the Sump is made of Concrete. Vendor has to provide anchor bolts for fixing on the top of Concrete. If any other mounting arrangement is suggested, vendor has to provide all the material to fix on the concrete,
2. Alloy 926 for impeller blades, wetted fasteners ; Shaft is CS+6 mm Chlorobutyl rubber.
3. BHEL has designed the sump with a Manhole size : 800X800 mm. If vendor requires any change, Vendor to inform clearly in their technical offer. Agitator opening is $\phi 150$ mm. If any change is required for easy installation & handling purpose, the same shall be clearly indicated in the technical offer.
4. The top/bottom shaft along with coupling shall be Rubber Lined at Shop so that there is no lining at Site. if lining at Site cannot be avoided, rubber material along with adhesives shall be sent by vendor and Vendor's Engineer shall be present at Site during Lining.

00					
REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE
CUST. NO.	NTPC DRG. NO. 4410-109-RP-PVM-R-061				
G601	PROJECT: NORTH KARANPURA 3X660MW FGD SYSTEM PACKAGE				
G602	OWNER: NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)				
G603	FGD CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.				
SUB VENDOR:					
TITLE: GA of drain sump agitator (typical)					
BHEL DRAWING NO: 3-FW-720-02401					
SUB VENDOR DRAWING NO.					
SCALE : NTS					REV. 00

	QUALIFYING REQUIREMENTS FOR AGITATORS OF NTPC North Karanpura (3X660 MW)
AGITATORS:QR-3K:NKSTPP:REV00	

ANNEXURE- 3K : Qualifying Requirements for Agitators

The following terminology shall be followed for 3K Document:

- a) Bidder means BHEL
- b) Bidder's sub-vendor means Agitator Manufacturer.
- c) Employer or owner means NTPC

Agitator Vendor shall meet the below qualification requirement of NTPC .

NTPC CLAUSE NO	DESCRIPTION			
4.01.01	The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipments, auxiliaries, systems and bought out items as per criteria stipulated below			
4.01.02	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 designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on 30 th of January, 2019.			
Type and Rating for Qualification				
	Name of Equipment	Type of Equipment	Application	Equipment Rating
	Agitators	Vertical/ Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application
4.01.04	<p>A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.02 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create / have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment (s).</p> <p>Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.</p> <p>In addition, the Bidder along with the Indian Joint Venture Company/ Subsidiary Company, qualified equipment manufacturers and its holding/ subsidiary Company, as applicable, shall</p>			


QUALIFYING REQUIREMENTS FOR AGITATORS OF NTPC North Karanpura (3X660 MW)
AGITATORS:QR-3K:NKSTPP:REV00

	furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved subvendor for a particular equipment. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 10 Million (Indian Rupees ten Million only) for each equipment.
4.01.07	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.02(f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor 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.
04.01.09	Before taking up the manufacturing of such equipment(s) as per clause 4.01.03, 4.01.04,4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.
04.01.10	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.
04.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 4.01.01 : Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.
	REMARKS: 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(NTPC) and the above conditions for qualification criteria may be relaxed subject to the end-customer's approval for the vendors participating in this enquiry

**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE
FOR
NORTHKARANPURA STPP (3X660 MW)
BIDDING DOCUMENT NO. CS-4410-109-2**

Bidder's Name and Address:

To
Contract Services-II
NTPC Limited
Noida-201301

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

Equipment Name	Sub-Vendor Name	Collaborator's Name, if applicable	Seeking Qualification as per clause..... Sub-Section-I, Part-A of Section-VI
Booster Fans			*4.01.01 /*4.01.02 /*4.01.03/*4.01.04
*Slurry Recirculation Pumps			*4.01.01 /*4.01.02 /*4.01.04 /*4.01.08
Oxidation Blowers			*4.01.01 /*4.01.02 /*4.01.04 /*4.01.05
Wet limestone Grinding mills			*4.01.01 /*4.01.02/4.01.04/*4.01.06/
Slurry Pumps			*4.01.01/*4.01.02/*4.01.04/*4.01.08
Agitators			*4.01.01 /*4.01.02/*4.01.04 /*4.01.07
Vacuum Belt filters			*4.01.01 /*4.01.02/*4.01.04

Note : *Strike-off whichever is not applicable.

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

Signature of authorized signatory.....

2. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e manufacturer of such equipments for at least 500 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall also be furnished.
3. If the qualification sought as per the clause 4.01.04, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipments in India shall be furnished individually for each equipment by the bidder such as,
- i) Copy of document of incorporation of JV/Subsidiary company in India
 - ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI.
 - iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

Further, the details of collaborator or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 4.01.02, sub-section-I-A, Part-A of Section-VI shall be filled by the Bidder in the format A to G (format given at 1.00.00). In addition to that, the sub vendor along with the Indian JV company/subsidiary company, qualified equipment manufacturer and its holding company/subsidiary company as applicable shall furnish the DJU.

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

1.00.00 (Applicable for Bidder/his sub vendors seeking qualification as per clause no. 4.01.02, Sub section-I, Part-A of Section-VI. Bidder shall furnish the required data only for those equipments / auxiliaries which are proposed to be sourced under this route.)

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems and Bought Out Items such as Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum belt filters which have been designed (either by self manufacturer or under valid ongoing collaboration and technology transfer agreement), *manufactured/ *got manufactured and supplied by us /Manufacturer (or manufactured/ got manufactured & supplied by our proposed sub-vendors) and these are in successful operation in at least one (1) plant for a period not less than one year reckoned

Signature of authorized signatory.....

as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder. The details of type and minimum equipment rating of such equipment are given below :

- F. **Agitators:** We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement),*manufactured/*got manufactured and supplied at least one (1) number of Agitators with rating not less than that supplied for 500 MW or higher size unit for similar application, Vertical/Horizontal type working in Wet Limestone based FGD application in Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below::

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether 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:	
10.	Agitators supplied forMW unit size

Signature of authorized signatory.....

Sl. No.	Description	Reference Work
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 consideration for approval but not later than six months to award date of contract to the Main bidder	-*Yes/*No
12.	Flue gas Desulphurization system 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

* Strike off whichever is not applicable.

Signature of authorized signatory.....

***2.00.00** **Applicable for Bidder/its sub vendor seeking provenness criteria as per clause no. 4.01.02 & 4.01.03, Sub section-I, Part-A of Section-VI.**

2.01.00 We, hereby confirm that we/our sub-vendor are a regular manufacturer of ~~Booster Fan for units of atleast 500MW rating and the details in this regard on provenness criteria as per clause 4.01.02, sub-section-I, Part-A, Section-VI are hereby furnished below:~~

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

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

2.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the aforesaid equipment as per 2.01.00 above who meets the requirement stipulated at clause ~~4.01.02, sub-section-I, Part-A, Section-VI are enclosed at Annexure-..... to this Attachment. The data in respect of provenness criteria for these equipment which are in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below. We further confirm that we/ our sub vendor(s) have created manufacturing and testing facilities at our/ their works as per collaborator's/ Licensor's design, manufacturing & quality control system for these equipment(s)/ Auxiliary(ies).~~

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

***3.00.00** **Applicable for JV Company/Subsidiary Company meeting provenness criteria as per clause no. 4.01.04, Sub section-IA, Part-A of Section-VI.**

3.01.00 We, hereby confirm that JV company/ Subsidiary company (Strike off whichever is not applicable) formed for manufacturing and supply of equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry Pumps, *Agitators, *vacuum belt filters) has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02 of sub-section-I, Part-A, Section VI of bidding documents (or the technology provider of the qualified equipment manufacturer). Further, in such a case, such qualified equipment manufacturers is having, directly or indirectly through its holding company/subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture / Subsidiary or up to the end of defect liability period of the contract, whichever is later. Before taking up the manufacturing of such equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry

Signature of authorized signatory.....

Pumps,*Agitators, vacuum belt filters), we/ our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

We further confirm that details in respect of collaboration / valid licencing agreement for the aforesaid equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry Pumps, *Agitators, vacuum belt filters) who meets the requirement stipulated at clause **4.01.02**, sub-section-I, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment.

In addition, the Bidder along with its sub-vendors, as per 3.01.00 above (if applicable) and the qualified Oxidation Blower manufacturer and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed at **Attachment-3K**

***4.00.00 Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.05, Sub section-I, Part-A of Section-VI.**

4.01.00 We, hereby confirm that *we/*our sub-vendors is a manufacturer of Blowers/compressors for minimum 50 NM³/min capacity. (Details of references enclosed at Annexure)

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

4.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Oxidation Blower between *us/*our sub-vendors, as per 4.01.00 above, and with qualified Oxidation Blower manufacturer, who meets the requirement stipulated at clause **4.01.02**, sub-section-I, Part-A, Section-VI are enclosed as per **Annexure-.....** to this Attachment. The data in respect of provenness criteria for the qualified Oxidation Blower manufacturer, which are in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below. We further confirm that we/ our sub vendor(s) have created manufacturing and testing facilities at our/ their works as per collaborator's/ Licensor's design, manufacturing & quality control system for the Oxidation Blowers.

We further confirm that before taking up the manufacturing of such Oxidation Blower *we/ *our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

Signature of authorized signatory.....

We further confirm that details in respect of collaboration / valid licencing agreement for the Oxidation Blowers who meets the requirement stipulated at clause **4.01.02**, sub-section-I, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment. In addition, the Bidder along with our sub-vendors, as per 4.01.00 above (if applicable) and the qualified Oxidation Blower manufacturer and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed at **Attachment-3K**.

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

***5.00.00** **Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.06, Sub section-I, Part-A of Section-VI.**

5.01.00 We, hereby confirm that *we/*our sub-vendors is a manufacturer of Dry Grinding Mills for minimum 20 T/h capacity. (Details of references enclosed at Annexure)

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

5.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Wet Grinding Mills between *us/*our sub-vendors, as per 5.01.00 above, and with qualified Wet Grinding Mill manufacturer, who meets the requirement stipulated at clause **4.01.02**, sub-section-I, Part-A, Section-VI are enclosed at **Annexure-.....** to this Attachment. The data in respect of proveneness criteria for the qualified Wet Grinding Mill manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.

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

We further confirm that before taking up the manufacturing of such Wet Grinding Mill *we/ *our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

In addition, the Bidder along with our sub-vendors, as per 5.01.00 above (if applicable) and the qualified Wet Grinding Mill manufacturer and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed at **Attachment-3K**.

Signature of authorized signatory.....

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

***6.00.00** **Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.07, Sub section-I, Part-A of Section-VI.**

6.01.00 We, hereby confirm that **we/*our* sub-vendors is a manufacturer of a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry. (Details of references enclosed at Annexure

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

6.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Agitator between **us/*our* sub-vendors, as per 6.01.00 above, and with qualified Agitator manufacturer, who meets the requirement stipulated at clause **4.01.02**, sub-section-I, Part-A, Section-VI are enclosed at **Annexure-.....** to this Attachment. The data in respect of proveneness criteria for the qualified Agitator manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.

We further confirm that before taking up the manufacturing of such Agitator, **we/ *our* sub vendor(s) **will create /*have created* manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

In addition, the Bidder along with our sub-vendors, as per 6.01.00 above (if applicable) and the qualified Agitators manufacturer and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed at **Attachment-3K**.

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

Signature of authorized signatory.....

***7.00.00** **Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.08, Sub section-I, Part-A of Section-VI.**

7.01.00 We, hereby confirm that ~~*we/*our sub-vendors is a manufacturer of a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.02 (e), sub-section-I, Part-A, Section-VI. (Details of references enclosed at Annexure~~)

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

7.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Slurry Recirculation Pumps, between ~~*us/*our sub-vendors, as per 7.01.00 above, and with qualified Slurry Recirculation Pump manufacturer, who meets the requirement stipulated at clause 4.01.02(b), sub-section-I, Part-A, Section-VI are enclosed at Annexure-..... to this Attachment. The data in respect of proveneness criteria for the qualified Slurry Recirculation Pump manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.~~

~~We further confirm that before taking up the manufacturing of such Slurry Recirculation Pumps, *we/ *our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.~~

~~In addition, the Bidder along with our sub-vendors, as per 7.01.00 above (if applicable) and the qualified Lime stone slurry recirculation pump manufacturer and its holding/ subsidiary Company, as applicable, shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed at Attachment-3K.~~

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

Signature of authorized signatory.....

**FORM OF DEED OF JOINT UNDERTAKING TO BE PROVIDED
FOR *BOOSTER FANS/*SLURRY RECIRCULATION PUMPS/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY
PUMPS/*AGITATORS/*VACUUM BELT FILTERS (TO BE FILLED SEPARATELY FOR EACH APPLICABLE EQUIPMENT)
AS PER CLAUSE 4.01.04 OF SUB-SECTION-I, PART A, SECTION VI**

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

DEED OF JOINT UNDERTAKING TO BE EXECUTED BY THE BIDDER/CONTRACTOR, INDIAN JV/SUBSIDIARY COMPANY MEETING THE REQUIREMENTS SPECIFIED AT CLAUSE NO. 4.01.04 OF SUB-SECTION-I, PART A, SECTION VI AND THE QUALIFIED EQUIPMENT MANUFACTURER & ITS *HOLDING/*SUBSIDIARY COMPANY(IES), AS APPLICABLE, MEETING THE REQUIREMENTS AS PER CLAUSE 4.01.02 OF SUB-SECTION-I, PART A, SECTION VI FOR *BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS IN WHICH EXECUTANT OF THE DJUs ARE JOINTLY AND SEVERALLY LIABLE FOR THE SUCCESSFUL PERFORMANCE OF THE *BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS

The DEED OF UNDERTAKING executed thisday ofTwo thousandby M/s a Company incorporated underhaving its Registered Office at (hereinafter called the "Bidder/Contractor", which expression shall include its successors, administrators, executors and permitted assigns) AND

**M/s, a JV / SUBSIDIARY COMPANY as per the requirement of clause 4.01.04 of sub-section-I, Part-A, Section-VI, incorporated under having its Registered Office at (hereinafter called the " Indian JV/ SUBSIDIARY Manufacturing Company"), which expression shall include its successors, administrators, executors and permitted assigns) AND

M/shaving its Registered Office at (hereinafter called the "Qualified Equipment Manufacturer", which expression shall include its successors, administrators, executors and permitted assigns) AND

*M/sA Company registered underhaving its Registered Office at , hereinafter called holding/ subsidiary company of the qualified equipment manufacturer in favour of NTPC Limited, A Government of India Enterprise, incorporated under the Companies Act, 1956, having its Registered Office at NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi-110003 INDIA (hereinafter called "NTPC" or "Employer" which expression shall include its successors, administrators, executors and assigns).

Signature of authorized signatory.....

WHEREAS, the Employer invited Bids for design, engineering, manufacture, supply, transportation to site, construction, installation, testing, commissioning and conductance of guarantee tests for the **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS vide clause 4.01.04 of Sub-Section-I, Part A, Section VI of bidding documents, it has been specified that a Qualified Indian Manufacturing Company can also manufacture equipment listed at clause no. 4.01.02 (...) of Sub-Section-I, Part A, Section VI for which it is qualified, provided that it has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of ***BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS** in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02(...) of Sub-Section-I, Part-A, Section-VI of bidding documents. Before taking up the manufacturing of ***BOOSTER FANS/*SLURRY RECIRCULATION PUMP/*OXIDATION BLOWERS/*WET LIMESTONE GRINDING MILLS/*SLURRY PUMPS/*AGITATORS/*VACUUM BELT FILTERS**, the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/ licensor's design, manufacturing and quality control system for Wet limestone Grinding mill. In addition, the Bidder/Contractor along with the Qualified Indian JV/SUBSIDIARY Manufacturing Company, qualified equipment manufacturers and its holding/subsidiary company shall furnish DJU for each equipment in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment.

WHEREAS M/s (Bidder/Contractor) has submitted its proposal in response to the aforesaid Invitation for Bid by the Employer bearing No. dated for **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS M/s (Indian JV/SUBSIDIARY Company) meets the requirement of clause 4.01.04 of sub-section-I, Part-A, Section-VI and has a valid ongoing collaboration*/licensing* agreement for design, engineering, manufacturing of(Name Of Equipment) in India with M/swho meets the requirements stipulated at clause 4.01.02(a)*/(b)*/(c)*/(d)*/(e)*/(f)*/(g)* of Sub-Section-I, Part A, Section-VI of bidding documents.

AND WHEREAS M/s (Qualified Equipment Manufacturer) meets the requirements of clause 4.01.02 of sub-section-I, Part-A, Section-VI for(Name Of Equipment)

AND WHEREAS M/s..... directly*/indirectly through its holding/subsidiary company M/s* have atleast 26% equity participation in the Indian JV/SUBSIDIARY Company which shall be maintained for a lock in period of seven (7) years from the date of incorporation of the Indian JV/ SUBSIDIARY Company or upto the end of defect liability of the contract whichever is later.

Signature of authorized signatory.....

AND WHEREAS the Bidder/Contractor along with the *Qualified Indian Manufacturing Company , Qualified Equipment Manufacturers alongwith its holding/subsidiary company are required to jointly execute and furnish prior to the placement of order for..... (Name of equipment), an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Employer for successful performance of the (Name of Equipment) for **North Karanpura STPP (3X660MW) Project** fully meeting the stipulated technical requirements, guaranteed parameters and characteristics as per the Bidding Documents, in the event the bid is accepted by the Employer resulting into a Contract.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. We the Qualified Equipment Manufacturer and the Indian JV/SUBSIDIARY Company and the Bidder/Contractor, do hereby declare and undertake that we shall be jointly and severally responsible to the Employer for the successful performance of the (Name of Equipment).
2. In case of any breach of the Contract committed by the Indian JV/SUBSIDIARY, we the Bidder/Contractor and Qualified Equipment Manufacturer do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the (Name of Equipment) and undertake to carryout all the obligations and responsibilities under this Deed of Joint Undertaking in order to discharge the Indian JV/SUBSIDIARY Company obligations stipulated under the Contract. Further, if the Employer sustains any loss or damage on account of any breach of the Contract for the (Name of Equipment), we the Bidder/Contractor and Qualified Equipment Manufacturer jointly and severally undertake to promptly indemnify and pay such loss/damages caused to the Employer on its written demand without any demur, reservation, Contest or protest in any manner whatsoever. This is without prejudice to any rights of the Employer against the Contractor/ his Sub-Vendor under the Contract and/or guarantees. It shall not be necessary or obligatory for the Employer to first proceed against the Indian JV/SUBSIDIARY Company / Bidder/Contractor before proceeding against the Qualified Equipment Manufacturer nor any extension of time or any relaxation given by the Employer to the Qualified Indian Manufacturing Company / **Bidder/Contractor shall prejudice any rights of the Employer under this Deed of Joint Undertaking to proceed against the Qualified Equipment Manufacturer.
3. The liability of the Contractor, his sub-vendor and Associate/Collaborator shall be limited to an amount equal to 100% of the value of the contract** between the contractor and the sub supplier for the equipment.
4. Without prejudice to the generality of the Undertaking in paragraph 1 above, the manner of achieving the objective set forth in paragraph 1 above shall be as follows:
 - (a) We the Qualified Equipment Manufacturer shall ensure that complete design, manufacturing, quality assurance and installation of the (Name of Equipment) is carried out inline with our manufacturing & quality drawings and

Signature of authorized signatory.....

procedures and shall be fully responsible for its compliance so as to ensure satisfactory, reliable, safe and trouble free performance of (Name of Equipment).

Further, we, the Qualified Equipment Manufacturer shall extend our quality surveillance/ supervision/ quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Qualified Indian Manufacturing Company's works and/ or at Employer's project site.

Further, the Qualified Equipment Manufacturer shall depute their technical experts from time to time to the Indian JV/SUBSIDIARY Manufacturing Company's works/ Employer's project site as required by the Employer and agreed to by Indian JV/SUBSIDIARY Manufacturing Company to facilitate the successful performance of the (Name of Equipment) as stipulated in the aforesaid Contract.

Further, the Qualified Equipment Manufacturer shall ensure proper design, manufacture, installation, testing and successful performance of the (Name of Equipment) under the said Contract in accordance with stipulations of Bidding Documents and if necessary, the Qualified Equipment Manufacturer shall advise the Indian JV/SUBSIDIARY Manufacturing Company suitable modifications of design and implement necessary corrective measures to discharge the obligations under the contract.

- (b) In the event Indian JV/SUBSIDIARY Manufacturing Company /Contractor fail to demonstrate that the (Name of Equipment) meets the guaranteed parameters and demonstration parameters as specified in the contract, the Qualified Equipment Manufacturer shall promptly carry out all the corrective measures related to engineering services at their own expense and shall promptly provide corrected design to the Employer.
- (c) Implementation of the corrected design and all other necessary repairs, replacements, rectification or modifications to the (Name of Equipment) and payment of financial liabilities and penalties and fulfillment of all other contractual obligations as provided under the contract shall be the joint and severally responsibility of the Contractor and Indian JV/SUBSIDIARY Manufacturing Company and Qualified Equipment Manufacturer.

5. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Indian JV/SUBSIDIARY Manufacturing Company do hereby undertake and confirm that this Undertaking shall be irrevocable and shall not be revoked till ninety (90) days after the end of the defect liability period of the equipment covered under the Contract and further stipulate that the Undertaking herein contained shall terminate after ninety (90) days of satisfactory completion of such defect liability period. In case of delay in completion of defect liability period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. We further agree that this Undertaking shall be

Signature of authorized signatory.....

.....
(Signature Name) (Signature of the Authorised Representative)

.....
(Official Address) Name
Designation
Common Seal of the Company

1. WITNESS For M/s
(Indian JV/SUSIDIARY Company)

.....
(Signature Name) (Signature of the Authorised Representative)

.....
(Official Address) Name.....
Designation
Company

1. WITNESS For M/s
(Qualified Equipment Manufacturer)

.....
(Signature Name) (Signature of the Authorised Representative)

Signature of authorized signatory.....

.....
(Official Address)

Name.....

Designation

Common Seal of the
Company

1. WITNESS

For M/s
(Holding/subsidiary company to Qualified Equipment Manufacturer)

.....
(Signature Name)

(Signature of the Authorised
Representative)

.....
(Official Address)

Name.....

Designation

Common Seal of the

Company

Note : Power of Attorney of the persons signing the said Deed of Joint Undertaking is to be furnished.

* Contractor/Sub-Vendor shall strike out, whichever is not applicable

** copy of priced purchase order for the equipment/system shall be furnished by the Bidder.

Signature of authorized signatory.....

**FORM OF DEED OF JOINT UNDERTAKING TO BE PROVIDED
FOR AGITATORS
AS PER CLAUSE 4.01.07 OF SUB-SECTION-I, PART A, SECTION VI
(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)**

DEED OF JOINT UNDERTAKING TO BE EXECUTED BY THE BIDDER/CONTRACTOR, QUALIFIED INDIAN MANUFACTURING COMPANY MEETING THE REQUIREMENTS SPECIFIED AT CLAUSE NO. 4.01.07 OF SUB-SECTION-I, PART A, SECTION VI ALONGWITH QUALIFIED EQUIPMENT MANUFACTURER OF AGITATORS MEETING THE REQUIREMENTS AS PER CLAUSE 4.01.02 (f) OF SUB-SECTION-I, PART A, SECTION VI FOR SUCCESSFUL PERFORMANCE OF AGITATORS IN WHICH EXECUTANT OF THE DJU ARE JOINTLY AND SEVERALLY LIABLE FOR THE SUCCESSFUL PERFORMANCE OF THE AGITATORS

The DEED OF UNDERTAKING executed thisday ofTwo thousandby M/sa Company incorporated underhaving its Registered Office at (hereinafter called the "Bidder/Contractor", which expression shall include its successors, administrators, executors and permitted assigns) AND

M/s, a **AGITATORS manufacturer as per the requirement of clause 4.01.07 of sub-section-I, Part-A, Section-VI, incorporated under having its Registered Office at (hereinafter called the "Qualified Indian Manufacturing Company"), which expression shall include its successors, administrators, executors and permitted assigns) AND

M/s a **AGITATORS** manufacturer meeting the requirements of clause 4.01.02 (f) of sub-section-I, Part-A, Section-VI incorporated underhaving its Registered Office at (hereinafter called the "Qualified Equipment Manufacturer", which expression shall include its successors, administrators, executors and permitted assigns) AND

in favour of NTPC Limited, A Government of India Enterprise, incorporated under the Companies Act, 1956, having its Registered Office at NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi-110003 INDIA (hereinafter called "NTPC" or "Employer" which expression shall include its successors, administrators, executors and assigns).

WHEREAS, the Employer invited Bids for design, engineering, manufacture, supply, transportation to site, construction, installation, testing, commissioning and conductance of guarantee tests for the **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS vide clause 4.01.07 of Sub-Section-I, Part A, Section VI of bidding documents, it has been specified that a Qualified Indian Manufacturing Company can also manufacture equipment listed at clause no. 4.01.02 (f) of Sub-Section-I, Part A, Section VI for which it is qualified, provided that it has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of

Signature of authorized signatory.....

AGITATORS in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.02(f) of Sub-Section-I, Part-A, Section-VI of bidding documents. Before taking up the manufacturing of **AGITATORS**, the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/ licensor's design, manufacturing and quality control system for Wet limestone Grinding mill. In addition, the Bidder/Contractor along with the Qualified Indian Manufacturing Company, qualified equipment manufacturers shall furnish DJU for each equipment in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment.

WHEREAS M/s (Bidder/Contractor) has submitted its proposal in response to the aforesaid Invitation for Bid by the Employer bearing No. dated for **Flue Gas Desulphurisation (FGD) System Package for North Karanpura STPP (3X660MW)** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-4410-109-2**.

AND WHEREAS M/s (Qualified Indian Manufacturing Company) meets the requirement of clause 4.01.07 of sub-section-I, Part-A, Section-VI and has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of(Name Of Equipment) in India with M/s who meets the requirements stipulated at clause 4.01.02(f) of Sub-Section-I, Part A, Section-VI of bidding documents.

AND WHEREAS M/s (Qualified Equipment Manufacturer) meets the requirements of clause 4.01.02 of sub-section-I, Part-A, Section-VI for(Name Of Equipment).

AND WHEREAS the Bidder/Contractor along with the *Qualified Indian Manufacturing Company , Qualified Equipment Manufacturers, are required to jointly execute and furnish prior to the placement of order for..... (Name of equipment), an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Employer for successful performance of the (Name of Equipment) for **North Karanpura STPP (3X660MW) Project** fully meeting the stipulated technical requirements, guaranteed parameters and characteristics as per the Bidding Documents, in the event the bid is accepted by the Employer resulting into a Contract.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. We the Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company and the Bidder/Contractor, do hereby declare and undertake that we shall be jointly and severally responsible to the Employer for the successful performance of the (Name of Equipment).
2. In case of any breach of the Contract committed by the Qualified Indian Manufacturing Company, we the Bidder/Contractor and Qualified Equipment Manufacturer do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of the (Name of Equipment) and undertake to carryout all the obligations and responsibilities under this Deed of Joint Undertaking in order to discharge the Qualified Indian Manufacturing Company obligations stipulated under the Contract. Further, if

Signature of authorized signatory.....

the Employer sustains any loss or damage on account of any breach of the Contract for the (Name of Equipment), we the Bidder/Contractor and Qualified Equipment Manufacturer jointly and severally undertake to promptly indemnify and pay such loss/damages caused to the Employer on its written demand without any demur, reservation, Contest or protest in any manner whatsoever. This is without prejudice to any rights of the Employer against the Contractor/ his Sub-Vendor under the Contract and/or guarantees. It shall not be necessary or obligatory for the Employer to first proceed against the Indian Qualified Indian Manufacturing Company / Bidder/Contractor before proceeding against the Qualified Equipment Manufacturer nor any extension of time or any relaxation given by the Employer to the Qualified Indian Manufacturing Company / **Bidder/Contractor shall prejudice any rights of the Employer under this Deed of Joint Undertaking to proceed against the Qualified Equipment Manufacturer.

3. The liability of the Contractor, his sub-vendor and Associate/Collaborator shall be limited to an amount equal to 100% of the value of the contract** between the contractor and the sub supplier for the equipment.

4. Without prejudice to the generality of the Undertaking in paragraph 1 above, the manner of achieving the objective set forth in paragraph 1 above shall be as follows:

(a) We the Qualified Equipment Manufacturer shall ensure that complete design, manufacturing, quality assurance and installation of the (Name of Equipment) is carried out inline with our manufacturing & quality drawings and procedures and shall be fully responsible for its compliance so as to ensure satisfactory, reliable, safe and trouble free performance of (Name of Equipment).

Further, we, the Qualified Equipment Manufacturer shall extend our quality surveillance/ supervision/ quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Qualified Indian Manufacturing Company's works and/ or at Employer's project site.

Further, the Qualified Equipment Manufacturer shall depute their technical experts from time to time to the Qualified Indian Manufacturing Company's works/ Employer's project site as required by the Employer and agreed to by Qualified Indian Manufacturing Company to facilitate the successful performance of the (Name of Equipment) as stipulated in the aforesaid Contract.

Further, the Qualified Equipment Manufacturer shall ensure proper design, manufacture, installation, testing and successful performance of the (Name of Equipment) under the said Contract in accordance with stipulations of Bidding Documents and if necessary, the Qualified Equipment Manufacturer shall advise the Qualified Indian Manufacturing Company suitable modifications of design and implement necessary corrective measures to discharge the obligations under the contract.

Signature of authorized signatory.....

- (b) In the event Qualified Manufacturing Company /Contractor fail to demonstrate that the (Name of Equipment) meets the guaranteed parameters and demonstration parameters as specified in the contract, the Qualified Equipment Manufacturer shall promptly carry out all the corrective measures related to engineering services at their own expense and shall promptly provide corrected design to the Employer.
- (c) Implementation of the corrected design and all other necessary repairs, replacements, rectification or modifications to the (Name of Equipment) and payment of financial liabilities and penalties and fulfillment of all other contractual obligations as provided under the contract shall be the joint and severally responsibility of the Contractor and Qualified Indian Manufacturing Company and Qualified Equipment Manufacturer.
5. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company do hereby undertake and confirm that this Undertaking shall be irrevocable and shall not be revoked till ninety (90) days after the end of the defect liability period of the equipment covered under the Contract and further stipulate that the Undertaking herein contained shall terminate after ninety (90) days of satisfactory completion of such defect liability period. In case of delay in completion of defect liability period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. We further agree that this Undertaking shall be without any prejudice to the various liabilities of the Contractor including Contract Performance Security as well as other obligations of the Contractor in terms of the Contract.
6. The Bidder/Contractor and Qualified Equipment Manufacturer will be fully responsible for the quality of all the equipment/main assemblies/components manufactured at their works or at their Vendors' works or constructed at site, and their repair or replacement, if necessary, for incorporation in the Plant and timely delivery thereof to meet the completion schedule under the Contract.
7. In case of Award, in addition to the Contract Performance Security for the Contract, the Qualified Equipment Manufacturer and Qualified Indian manufacturing company shall furnish 'as security' an on demand Performance Bank Guarantee in favour of the Employer as per provisions of the bidding documents. The value of such Bank Guarantee shall be equal to **INR 1.5 Million for each (Indian Rupees One and half Million)** and it shall be guarantee towards the faithful performance /compliance of this Deed of Joint Undertaking in accordance with the terms and conditions specified herein. The bank guarantee shall be unconditional, irrevocable and valid till ninety (90) days beyond the end of defect liability period of the last equipment covered under the Contract. In case of delay in completion of the defect liability period, the validity of this Bank Guarantee shall be extended by the period of such delay. The guarantee amount shall be promptly paid to the Employer on demand without any demur, reservation, protest or contest.

Signature of authorized signatory.....

- 8. Any dispute that may arise in connection with this Deed of Joint Undertaking shall be settled as per arbitration procedure/rules mentioned in the Contract Documents. This Deed of Joint Undertaking shall be construed and interpreted in accordance with the Laws of India and the Courts of Delhi shall have exclusive jurisdiction.
- 9. We, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company shall form an integral part of the Contracts from the date of signing of this Deed of Joint Undertaking. We further agree that this Deed of Joint Undertaking shall continue to be enforceable till its validity.
- 10. That this Deed of Joint Undertaking shall be operative from the effective date of signing of this Deed of Joint Undertaking.

IN WITNESS WHEREOF, the Bidder/Contractor and Qualified Equipment Manufacturer and the Qualified Indian Manufacturing Company through their authorised representatives, have executed these presents and affixed common seal of their respective companies, on the day, month and year first mentioned above.

1. WITNESS For M/s
(Bidder/Contractor)
.....
(Signature Name) (Signature of the Authorised
Representative)
.....
(Official Address) Name

Designation
Common Seal of the
Company

1. WITNESS For M/s
(Qualified Indian Manufacturing Company)
.....
(Signature of the Authorised

Signature of authorized signatory.....

(Signature Name)
Representative)

.....
(Official Address)

Designation

Company

Name.....

Common Seal of the

1. WITNESS

For M/s
(Qualified Equipment Manufacturer)

.....
(Signature Name)

(Signature of the Authorised
Representative)

.....
(Official Address)

Name.....

Designation

Common Seal of the
Company

Note : Power of Attorney of the persons signing the said Deed of Joint Undertaking is to be furnished.

* Contractor/Sub-Vendor shall strike out, whichever is not applicable

** copy of priced purchase order for the equipment/system shall be furnished by the Bidder.

Signature of authorized signatory.....

MANDATORY SPARES FOR AGITATORS OF NORTH KARANPURA(UNPRICED FORMAT)-TO BE FILLED AND SUBMITTED

S.No	MATERIAL CODE	DESCRIPTION	QUANTITY	UNIT	MODEL NO	QUOTED/ NOT QUOTED	REMARKS(IF NOT QUOTED, VENDOR TO GIVE THE REASON)
1	RFW115130001	Impeller Assembly for ABSORBER AGITATOR (each type and size)	2	ST			
2	RFW115130002	Bearing Assembly for ABSORBER AGITATOR (each model/bearing no)	3	ST			
3	RFW115130003	Motor for ABSORBER AGITATOR	1	ST			
4	RFW115130004	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for ABSORBER AGITATOR (each type and size)	3	ST			
5	RFW115130005	Gear Box Assembly (If Applicable) for ABSORBER AGITATOR	2	ST			
6	RFW115130006	Impeller Assembly for AUXILIARY ABSORBENT AGITATOR (each type and size)	2	ST			
7	RFW115130007	Bearing Assembly for AUXILIARY ABSORBENT AGITATOR (each model/bearing no)	3	ST			
8	RFW115130008	Motor for AUXILIARY ABSORBENT AGITATOR	1	ST			
9	RFW115130009	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for AUXILIARY ABSORBENT AGITATOR (each type and size)	3	ST			
10	RFW115130010	Gear Box Assembly (If Applicable) for AUXILIARY ABSORBENT AGITATOR	2	ST			
11	RFW115130011	Impeller Assembly for FILTRATE WATER AGITATOR (each type and size)	2	ST			
12	RFW115130012	Bearing Assembly for FILTRATE WATER AGITATOR (each model/bearing no)	3	ST			
13	RFW115130013	Motor for FILTRATE WATER AGITATOR	1	ST			
14	RFW115130014	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for FILTRATE WATER AGITATOR (each type and size)	3	ST			
15	RFW115130015	Gear Box Assembly (If Applicable) for FILTRATE WATER AGITATOR	2	ST			
16	RFW115130016	Impeller Assembly for SECONDARY HYDROCYCLONE FEED TANK AGITATOR (each type and size)	2	ST			
17	RFW115130017	Bearing Assembly for SECONDARY HYDROCYCLONE FEED TANK AGITATOR (each model/bearing no)	3	ST			
18	RFW115130018	Motor for SECONDARY HYDROCYCLONE FEED TANK AGITATOR	1	ST			
19	RFW115130019	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for SECONDARY HYDROCYCLONE FEED TANK AGITATOR (each type and size)	3	ST			
20	RFW115130020	Gear Box Assembly (If Applicable) for SECONDARY HYDROCYCLONE FEED TANK AGITATOR	2	ST			
21	RFW115130021	Impeller Assembly for WASTE WATER TANK AGITATOR (each type and size)	2	ST			
22	RFW115130022	Bearing Assembly for WASTE WATER TANK AGITATOR (each model/bearing no)	3	ST			
23	RFW115130023	Motor for WASTE WATER TANK AGITATOR	1	ST			
24	RFW115130024	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for WASTE WATER TANK AGITATOR (each type and size)	3	ST			
25	RFW115130025	Gear Box Assembly (If Applicable) for WASTE WATER TANK AGITATOR	2	ST			
26	RFW115130026	Impeller Assembly for LIMESTONE SLURRY STORAGE TANK AGITATOR (each type and size)	2	ST			
27	RFW115130027	Bearing Assembly for LIMESTONE SLURRY STORAGE TANK AGITATOR (each model/bearing no)	3	ST			
28	RFW115130028	Motor for LIMESTONE SLURRY STORAGE TANK AGITATOR	1	ST			
29	RFW115130029	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for LIMESTONE SLURRY STORAGE TANK AGITATOR (each type and size)	3	ST			
30	RFW115130030	Gear Box Assembly (If Applicable) for LIMESTONE SLURRY STORAGE TANK AGITATOR	2	ST			
31	RFW115130031	Impeller Assembly for PRIMARY HYDROCYCLONE FEED TANK AGITATOR (each type and size)	2	ST			
32	RFW115130032	Bearing Assembly for PRIMARY HYDROCYCLONE FEED TANK AGITATOR (each model/bearing no)	3	ST			
33	RFW115130033	Motor for PRIMARY HYDROCYCLONE FEED TANK AGITATOR	1	ST			
34	RFW115130034	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for PRIMARY HYDROCYCLONE FEED TANK AGITATOR (each type and size)	3	ST			
35	RFW115130035	Gear Box Assembly (If Applicable) for PRIMARY HYDROCYCLONE FEED TANK AGITATOR	2	ST			
36	RFW115130036	Impeller Assembly for ABSORBER AREA DRAIN SUMP AGITATOR (each type and size)	2	ST			
37	RFW115130037	Bearing Assembly for ABSORBER AREA DRAIN SUMP AGITATOR (each model/bearing no)	3	ST			
38	RFW115130038	Motor for ABSORBER AREA DRAIN SUMP AGITATOR	1	ST			
39	RFW115130039	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for ABSORBER AREA DRAIN SUMP AGITATOR (each type and size)	3	ST			
40	RFW115130040	Gear Box Assembly (If Applicable) for ABSORBER AREA DRAIN SUMP AGITATOR	2	ST			
41	RFW115130041	Impeller Assembly for GYPSUM AREA DRAIN SUMP AGITATOR (each type and size)	2	ST			
42	RFW115130042	Bearing Assembly for GYPSUM AREA DRAIN SUMP AGITATOR (each model/bearing no)	3	ST			
43	RFW115130043	Motor for GYPSUM AREA DRAIN SUMP AGITATOR	1	ST			
44	RFW115130044	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for GYPSUM AREA DRAIN SUMP AGITATOR (each type and size)	3	ST			
45	RFW115130045	Gear Box Assembly (If Applicable) for GYPSUM AREA DRAIN SUMP AGITATOR	2	ST			
46	RFW115130046	Impeller Assembly for LIMESTONE AREA DRAIN SUMP AGITATOR (each type and size)	2	ST			
47	RFW115130047	Bearing Assembly for LIMESTONE AREA DRAIN SUMP AGITATOR (each model/bearing no)	3	ST			
48	RFW115130048	Motor for LIMESTONE AREA DRAIN SUMP AGITATOR	1	ST			
49	RFW115130049	Belt & Pulley or Coupling Between Motor & Gearbox (If applicable) for LIMESTONE AREA DRAIN SUMP AGITATOR (each type and size)	3	ST			
50	RFW115130050	Gear Box Assembly (If Applicable) for LIMESTONE AREA DRAIN SUMP AGITATOR	2	ST			
	Note:	Vendor has to quote all spares along with model nos as tabulated above for all the agitators.If spares for two or more agitators are of same type and size, then BHEL will decide required quantity of spares and order shall be only for each type and size.					