TECHNICAL SPECIFICATION

FOR

AGITATORS

CONFIDENTIAL

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

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

TECHNICAL SPECIFICATION FOR AGITATORS

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Revision – 01 Dated 09/05/2018		COMMENTS : -----	

Document Revision History:

Revision	Date	Status and Description	
01	09.05.2018	Revised Issue	Following changes incorporated a) Sl. No. 1 of TABLE -5 (Liquid Level in Tanks) - revised b) Cl. No. 24 (O & M Services for 10 Years Operation – Annual Maintenance Contract (AMC)) added
00	09.04.2018	Fresh Issue	General technical specifications

CONTENTS

General Arrangement Drawings Of Slurry Tanks And Drain Pits			
Sl.no.	Drawing Title	Drawing number	Rev.
a.	GA for Agitators for FGD Absorber Tank	FGD/ Absorber Tank /D1	00
b.	GA for all Vertical Agitators for Limestone Slurry Tank & Drain Pit tanks.	FGD/ Vertical Agitators /D2	00

PART –I

MAIN SUPPLY

1.0 PROJECT INFORMATION:

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

A) SITE CONDITIONS

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

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

B) PROJECT LOCATION AND APPROACH

a.	State/Division	**UP**
b.	District	Gautam Buddha Nagar

2.0 APPLICABLE CODES & REGULATIONS

The design of Agitators shall conform to the latest edition of International codes accepted by the Buyer according to good engineering practice.

List of codes/standards recommended: (The list is not exhaustive)

S.No	Description	Material	Design & others
1	Piping	IS, AISI, ASTM, ASME, DIN, EN, BS or Equivalent	IS, AFNOR, ANSI, API, ASME, ASTM, AWWA, BS, DIN, EN, EJMA, Manufacturer's standard
2	Machinery	IS, AISI, ASTM, ASME, DIN, EN, BS or Equivalent	IS, AFNOR, AFBMA, AGMA, ANSI,API, ASTM, AWS,BS, DIN, IEC, HI, HEI, ISO, NEC, NEMA, EN, TEMA, VDI, Manufacturer's standard

3	Instrumentation	IS, AISI, ASTM, ASME, DIN, EN, BS or Equivalent	IS, AFNOR, ANSI, API, ASME, BS, DIN, EN, IEC, IEEE, ISA, ISO, NC, Manufacturer's standard
4	Electrical	AISI, ASTM, ASME, DIN, EN, BS or Equivalent	IS, BS, VDE, IEC, EN, ANSI,IEEE, NEMA
5	Civil	IS, AISI, ASTM, ASME, DIN, EN, BS or Equivalent	IS, AFNOR, ASCE, ASNT, BS, DIN, EN, ANSI, ACI, AISC, AWS, SSPC, Manufacturer's Standard
6	Structural Steel	SA/IS2062	BS/EN 1993 (Eurocode-3) or Equivalent international codes.
7	Performance Test		ASME PTC 40, JIS, EPA, Manufacturer's standard.

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

3.0 INTENT OF SPECIFICATION

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection & performance testing at bidder's works of Agitators along with accessories which is furnished in the Flue Gas Desulphurization plant of DADRI 2 x 490 MW FGDF system. The following points may be noted.

a. There are 2 units of each 490 MW and each unit is envisaged with one FGD system. Each FGD system will be provided with 2 numbers of Agitators which are located inside the Absorber bottom Tank. These Agitators shall be Horizontal / Side Entry mounted type and shall be driven by motor. One additional Agitator will be supplied as ware house spare. All the 3 (2 Installed + 1 ware house spare) are of similar type & size & can be interchangeable.

Sl No	Description	Qty / Boiler	Total Qty
1	Absorber Agitators – Installed	2	4
2	Absorber Agitators – Ware House Spare	1	2

b. There will be a common Auxiliary Absorbent Tank for both Units. It will be provided with Side Entry Agitators with Emergency flushing arrangement. Three (3) numbers of agitators will be supplied.

Sl No	Description	No. of Tanks	No of Agitators / Tank.	Total no. of Agitators.
1	Auxiliary Absorbent Tank Agitators.	1	3	3

c. In addition Agitators are required for the following tanks

Agitators shall be vertical mounted type and shall be driven by motor

Sl No	Tank Description	Tank Qty	Agitator Qty
1	Primary Hydrocyclone feed tank	1	1
2	Filtrate water tank	1	1
3	Secondary Hydrocyclone feed tank	1	1
4	Waste water Tank	1	1
5	Neutralization tank	2	2
6	Limestone Slurry Storage tank	2	2
8	Absorber Area Drain Pit	2	2
9	Gypsum Dewatering Area Drain Pits	1	1
10	Ball Mill Area Drain Pit	1	1

d. 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.

e. The Bidder shall offer only proven design which meets the Provenness criteria indicated in the **Annexure-I.** 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, they are denied to participate in this tender.

f. 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-V**)".

g. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.

h. No deviation or exception shall be permitted without the written approval of the purchaser.

i. 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.

j. 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.

k. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

4.0 PROVENNESS CRITERIA:

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

5.0 TECHNICAL INFORMATION

DETAILS OF ABSORBER TANK, AUXILIARY ABSORBENT TANK, LIMESTONE SLURRY TANKS, AND DRAIN PITS FOR AGITATORS REQUIREMENT

5.1 DETAILS OF ABSORBER, SLURRY & DRAIN PIT TANKS:

TABLE - 1- ABSORBER TANK DETAILS

Sl. no	Description of Tank	Number of Tanks	Capacity of slurry m^3	Dimensions	MOC of Agitator	No of Agitators	
						Per Tank	Total
1.	Absorber Bottom Tank	2	1010	Width: 20.4 m Length: 9.9 m Height : 5.0 m	**Alloy 926** or better material for both shaft & blade. All fasteners to be of Alloy 926 or better material.	2 + 1	6
	Total						**6**
	Note: **a. Each tank shall be provided with 2 Horizontal / Side Entry Agitators & one additional one as ware house spare Agitator.**						

TABLE - 2- AUXILIARY ABSORBENT TANK

Sl. no	Description of Tank	Number of Tanks	Capacity m^3	Dimensions	MOC of Agitator	No of Agitators	
						Per Tank	Total
1.	Auxiliary Absorbent Tank	1	1300	Dia : 12 m Ht : 12 m	Agitator blades shall be made with **Alloy 926** or better material & Agitator shaft can be **rubber lined**. All fasteners used in wetted condition must be of AISI-316L.	3	3
	Total						**3**
	Note: **Agitation shall be provided to prevent settlement of slurry by Side Entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down.**						

TABLE - 3- SLURRY TANKS DETAILS

Sl. no	Description of Tank	Number of Tanks	Capacity m^3	Dimensions	MOC of Agitator	No of Agitators	
						Per Tank	Total
1.	Limestone Slurry Tanks	2	1105	Dia : 10.7 m Height : 12.8m	Agitator blades shall be made with **Alloy 926** or better material & Agitator shaft can be **rubber lined**. All fasteners used in wetted condition must be of AISI-316L	1	2
2.	Filtrate Water Tank	1	80	Dia : 4.6 m Height : 5.3 m		1	1
3.	Secondary Hydro cyclone Feed Tank	1	88	Dia : 4.6 m Height : 5.8 m		1	1
4.	Waste Water Tank	1	204	Dia : 6.1 m Height : 7.5 m		1	1
5.	Neutralization tank	2	9	Dia : 2.2 m Height : 2.8 m		1	2
6.	Primary Hydro cyclone Feed Tank	1	150	Dia : 5.5 m Height : 6.8 m		1	1
	Total						**8**
	Note: **Each tank shall be provided with one center mounted agitator.**						

TABLE -4 - Drain Pits Details

Sl. No	Description of Tank	Number of Drain Pits	Capacity m^3	Dimensions	MOC of Agitator	No of Agitators	
						Per Pit	Total
1.	Absorber Area Drain Pit	2	56 m^3	Length: 4.0 m Width : 4.0 m Height : 4.0 m	Agitator blades shall be made with **Alloy 926** or better material & Agitator shaft can be **rubber lined**. All fasteners used in wetted condition must be of AISI-316L	1	2
2.	Gypsum Dewatering Area Drain Pits	1	56 m^3	Length: 4.0 m Width : 4.0 m Height : 4.0 m		1	1
3.	Ball Mill Area Drain Pit	1	56 m^3	Length: 4.0 m Width : 4.0 m Height : 4.0 m		1	1
	Total						**4**
	Note: Each Drain Pit shall be provided with one center mounted agitator. General Arrangement drawings of the drain pits are attached along with this technical specification.						

TABLE -5 – Liquid Level in Tanks

Sl. no	Utility	Tank Dia – m	Liquid level in m	
			Minimum	Maximum
1	Lime Stone Slurry Tank	10.7	(+) 4.4	(+) 11.8
2	Auxiliary Absorbent Tank	12.0	NA	(+) 11.0
3	Filtrate Water Tank	4.6	(+)1.4	(+) 4.8
4	Primary Hydro clone Feed Tank	5.5	(+) 1.4	(+) 5.9
4	Secondary Hydro clone Feed Tank	4.6	(+) 1.2	(+) 4.8
5	Waste Water Tank	6.1	(+) 1.2	(+) 6.6
6	Lime Feed Tank	(+)1.4	Vendor to specify	(+)1.5

Sl. no	Utility	Tank Dim in (L) x (B) x (H)	Liquid level in m	
			Minimum	Maximum
7	Absorber Area Drain Sump	4m (L) x 4m(W) x 4m (H)	(+) 1.6	(+) 3.3
8	Gypsum Area Drain Sump	4m (L) x 4m(W) x 4m (H)	(+) 1.6	(+) 3.3
9	Limestone Area Area Drain Sump	4m (L) x 4m(W) x 4m (H)	(+) 1.6	(+) 3.3

5.2 PROCESS PARAMETERS DETAILS:

TABLE – 6 PROCESS PARAMETERS FOR ABSORBER TANKS

Sl. no	Item	Absorber Tank
1.	Maximum solid particle size	200 mesh (75 micron)
2.	Normal solid particle size	325mesh (20 micron) 50 % pass
3.	Solid to be handled	Gypsum along Lime Stone and other impurities
4.	Sp Gravity of Slurry	1.213
5.	Hardness of particle	5-7 (Mho scale)
6.	Concentration of slurry	30% by weight
7.	Sp Gravity of Lime Stone	2.32 (Avg)
8.	Sp gravity of heaviest particles (Columbium and Iron oxide)	5.9
9.	Concentration of Chlorine	20000ppm
10.	Viscosity of Slurry	10cp
11.	Operating temp of Slurry	59-70 deg C

TABLE – 7 PROCESS PARAMETERS FOR SLURRY TANKS

Sl. no	Item	Aux Absorber Tank & Primary hydrocyclone feed tank	Lime Stone Slurry Tank	Sec. Hydro cyclone & Filtrate Water Tank	Waste water Tank	Lime feed Tank
12.	Maximum solid particle size	200 mesh (75 micron)	150 mesh (104 micron)	325 mesh (43micron)	200 mesh (75micron)	325 mesh (43micron)
13.	Normal solid particle size	325mesh (20 micron) 50 % pass	325 Mesh (43micron)	500 mesh (25 micron) to 1250 (10 micron)	325 mesh (43 micron) and fine particles	325 mesh (43micron)
14.	Solid to be handled	Gypsum along Lime Stone and other impurities	Lime Stone and other impurities	Gypsum	Lime stone or Gypsum or mixture of two	Hydrated Lime
15.	Sp Gravity of Slurry	1.213	1.215	1.110	1.022	1.087
16.	Hardness of particle	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)
17.	Concentration of slurry	30% by weight	30% by weight	16.6% by weight	3 % by weight	12% By weight
18.	Sp Gravity of Lime Stone	2.32 (Avg)	2.71	2.32 (Avg)	2.51 (Avg)	2.51 (Avg)
19.	Sp gravity of heaviest particles (Columbium and Iron oxide)	5.9	5.9	5.9	5.9	5.9
20.	Concentration of Chlorine	20000ppm	33.7 ppm	20000ppm	20000ppm (max)	<100 ppm
21.	Viscosity of Slurry	10cp	30cp	4 cp	3 cp	8-15 cp
22.	Operating temp of Slurry	59-70 deg C	43-70 deg C	59-70 deg C	59-70 deg C	45 deg C

TABLE -8 PROCESS PARAMETERS FOR DRAIN PITS

Sl. No.	Description	Drain pits
1.	Maximum solid particle size	Limestone
2.	Maximum solid particle size	200 mesh (75 micron)
3.	Normal solid particle size, d 50	325 mesh (43 micron) and fine particles
4.	Solid to be handled	Limestone and Gypsum Slurry
5.		
6.	Concentration of slurry	30% by weight
7.	Sp. Gravity of Lime Stone	1.213
8.	Concentration of Chlorine	20,000 ppm (max)
9.	Viscosity of Slurry	10 cp
10.	Maximum operating temperature of Slurry	59-70 C

5.3 POWER SUPPLY DETAILS:

1.	**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.
	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.	

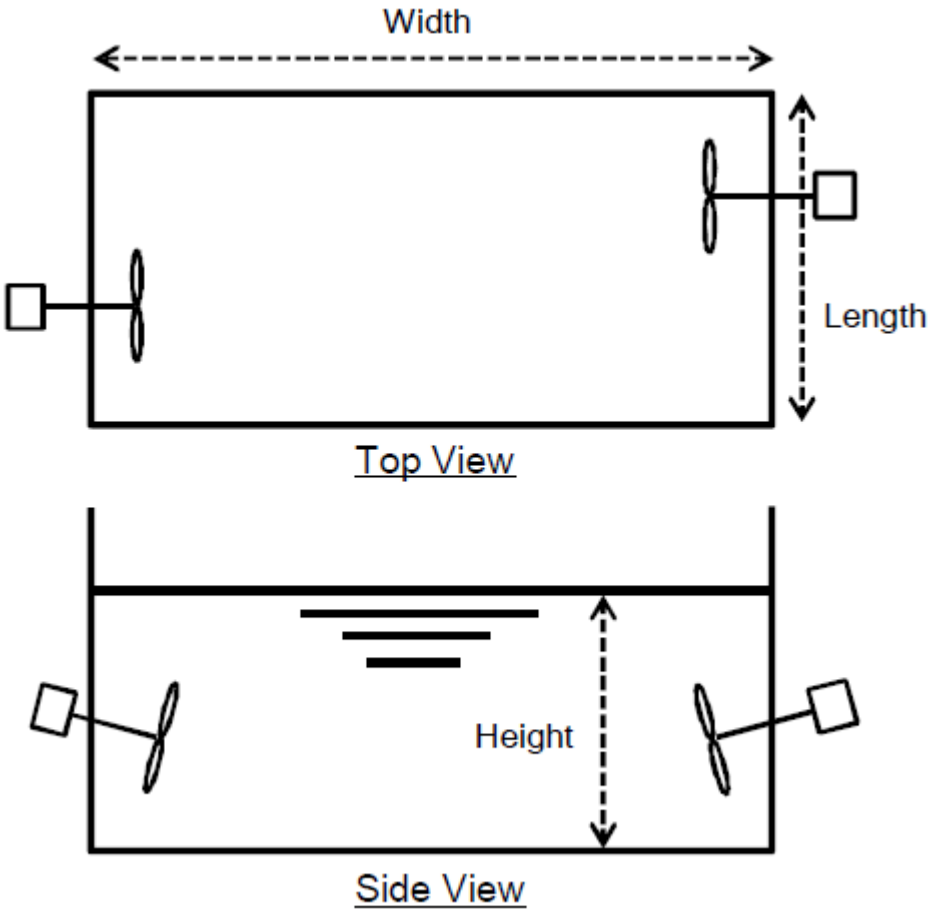
5.4 AGITATOR ARRANGEMENTS:

(1) Absorber Agitators:

a. The absorber agitators are Side Mounted / Horizontal type. The Dimensions of Each Absorber bottom tank as per Table 1 of Clause 5.1.
Dimensions: Width: 20.4 m x Length: 9.9 m x Height: 5.0 m.

The arrangement of Agitators in Absorber as per Sketch-1 shown below.

SKETCH - 1



(2) Aux Absorbent Tank Agitators:

These Agitators will operate continuously when Limestone / Gypsum Slurry is evacuated from Absorber for any Absorber maintenance work. The Aux Absorbent Tank details as per Clause no: 5.1 Table -2.

(3) Slurry Tank Agitators:

These Agitators will operate continuously for FGD system operation. The Slurry Tanks details as per Clause no: 5.1 Table -3.

(4) Drain Pit Tank Agitators:

These Agitators will operate continuously for FGD system operation. The Drain Pit Tank details as per Clause no: 5.1 Table -4.

6.0 SCOPE OF SUPPLY

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

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

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

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

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

A) <u>ABSORBER TANK AGITATORS:</u>

Sl. No	Scope
1.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)

Sl. No	Scope	
	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 with gearbox arrangement
	x.	Supporting arrangement of Side Entry Agitator on Absorber Wall.
	xi.	Painting and Rust Prevention during shipment and construction
	xii.	Supervision of Erection & commissioning at site
	xiii.	Special tools & tackles as applicable
	xiv.	Start-up spares as applicable
	xv.	Installation, operation and maintenance manuals
	xvi.	Any other items required for completeness of the equipment except the items covered in the exclusions.

B) **AUXILIARY Absorbent TANK AGITATORS**:

Sl. No	Scope	
2.	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 with gearbox arrangement
	x.	Supporting arrangement of Side Entry Agitator on Tank Wall.
	xi.	Emergency Flush Start System.
	xii.	Painting and Rust Prevention during shipment and construction
	xiii.	Supervision of Erection & commissioning at site
	xiv.	Special tools & tackles as applicable
	xv.	Start-up spares as applicable
	xvi.	Installation, operation and maintenance manuals
	xvii.	Any other items required for completeness of the equipment except the items covered in the exclusions.

C) SLURRY TANK & DRAIN PIT TANK AGITATORS:

Sl. No	Scope
3.	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 with gearbox arrangement
	x. Mating Flange for Supporting on Slurry Tank Roof
	xi. Painting and Rust Prevention during shipment and construction
	xii. Supervision of Erection & commissioning at site
	xiii. Special tools & tackles as applicable
	xiv. Start-up spares as applicable
	xv. Installation, operation and maintenance manuals
	xvi. Any other items required for completeness of the equipment except the items covered in the exclusions.

6.1	TECHNICAL REQUIREMENTS
1.	It shall be noted that all Agitators are meant for keeping the solid particles in suspended mode in liquid with “Full off-Bottom Suspension” of solid particles to 98% of liquid column to virtually “Uniform Solid Concentration”. No chemical reaction will takes place.
2.	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators .If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.
3.	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”.
4.	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.
5.	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.
6.	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated as per Table No: 5 of Clause 5.1
7.	Agitator must have low-pitch propeller with low solidity ratio and Power Number of 0.3-0.35. The Maximum Input Power at motor terminal shall be considered as a guaranteed parameter under "Schedule of Guaranteed Parameters" in ANNEXURE -II 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 10%margin at maximum liquid level, taking into account frequency variation.
8.	In case Bidder provides a Vertical Agitator with **hub design** the same has to be of **Alloy 926** or better material**.**
6.2	**CONSTRUCTIONAL FEATURES**
A)	**BLADE AND HUB OF PROPELLER**
I)	The blades of the agitators shall be of Alloy 926 or better material.
II	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.
III	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.
IV	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
B)	**SEAL**
1.	**Horizontal / Side Entry Agitators for Absorber Tank & Aux Absorbent Tank**
I.	Agitators should be provided with Single Stage mechanical seal. the mechanical seal should be as per ISO-21049 / API 682
II.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
IV.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
V.	All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
VI.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.

VII.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.
VIII.	Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.
IX.	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer the best seal that is suitable for the offered Agitator
X.	Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
XI.	The sub-vendor of the seal shall be approved by NTPC during contract execution.
2.	**Vertical Agitators for Slurry Tanks & Drain Pit Tanks**
I	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.
C)	**SHAFT**
	MOC of Shaft as per Clause 5.1 Table 1-4 suitable to the service. Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed.
D)	**BEARING & BEARING HOUSING IN GEAR BOX**
	Bearing shall be of rolling type radial and thrust bearing (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.
	Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hr (minimum).
	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant–level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) numberG1/2" 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 NTPC). Hence, it is expected that manufacturer to submit quality plan (QAP) along with the offer. The same shall be followed at post order stage also. QAP should be as per the best practice followed internationally to avoid any conflict of interest.
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: 5.3.
3	It should meet Motor specification as per Clause No: 22, reference documents.
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. An auxiliary slow drive provision shall be provided in the Gear Box so that slurry is always kept in dynamic condition to avoid settling of slurry at bottom, in the event of Agitator is not operating at its rated speed. Rating of at Gear box shall be at least 1.5 times the rated torque of Agitator.
H)	**COUPLING & COUPLING GUARD**
I.	Coupling and coupling guard should be supplied between driver and driven equipment.
II.	Coupling should be designed taking into consideration adequate service factor.
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer length shall be of sufficient length so than Motor and Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940.

VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.
I)	**PLATE AND FASTENING BOLTS**
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.
II.	Base plate must have provision of leveling on its intended mounting place. Sole plate is not in the scope of supply of Agitator manufacturer. It should be noted that Sole plate will be rubber lined to prevent any leakage of corrosive gases
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as 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 AISI-316L so that even if it comes in contact with liquid by swelling of rubber, thread remains unaffected. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.
K)	**ABSORBER AGITATORS:**
I.	All Agitators shall be designed for continuous operation.
II.	The Absorber Agitators shall be of Horizontal / Side Entry type.
III.	The Material of Construction (MOC) of Agitators shall be Alloy 926 or better material as per Clause No: 5.1 Table-1
IV.	It should be of Flange mounted type.
V.	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 condition. The maximum tip speed to be limited to bidder's proven practice.
VI.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide details of Nozzle size during contract stage.
VII.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.
VIII.	**The following information to be provided along with the bid:** **a) Impeller Diameter** **b) Impeller Speed**

	c) Agitator Pumping Capacity (m^3/min) **d) Volume per Agitator:**
L)	**AUXILIARY ABSORBENT TANK AGITATORS:**
I.	All Agitators shall be designed for continuous operation.
II.	The Absorber Agitators shall be of Horizontal / Side Entry type.
III.	The Material of Construction (MOC) of Agitators: Agitator blades shall be made with **Alloy 926** or better material & Agitator shaft can be **rubber lined** as per Clause No: 5.1 Table-2.
IV.	It should be of Flange mounted type.
V.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide details of Nozzle size during contract stage.
VI.	It should be provided with a Emergency Flush Start System.
VII.	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 condition. The maximum tip speed to be limited to bidders proven practice.
VIII.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.
IX.	**The following information to be provided along with the bid:** **e) Impeller Diameter** **f) Impeller Speed** **g) Agitator Pumping Capacity (m^3/min)** **h) Volume per Agitator:**
M)	**SLURRY TANK & DRAIN PIT Tank AGITATORS:**
I.	All Agitators shall be designed for continuous operation.
II.	The Absorber Agitators shall be of Horizontal / Side Entry type.
III.	The Material of Construction (MOC) of Agitators: Agitator blades shall be made with **Alloy 926** or better material & Agitator shaft can be **rubber lined** as per Clause No: 5.1 Table-3 & 4.
IV.	It should be roof mounted.
V.	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.
VI.	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.
VII.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top. Vendor to provide details of Nozzle size during contract stage.
VIII.	In case Bidder provides a Vertical Agitator with hub design the same has to be of Alloy 926 or better material.
IX.	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
X.	Operation speed of the Agitator motor shall be at least 25% below the first critical speed.
XI.	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.

6.3 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

6.3.1 AC Motors Type

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 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.

a. All motors, the maximum temperature rise shall be 70^0 C by resistance method for both class B & F insulation.
b. For motors with starting time up to 20secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit

shall be 3 second more than the starting time at minimum rated voltage(85%). For motors with starting time more than 20secs and up to 45secs at minimum voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5secs more than starting time at minimum rated voltage(85%). For motors with starting time more than 45secs at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at high voltage limit shall be more than starting time at minimum rated voltage(85%) by at least 10% of the starting time. Speed switch mounted on the motor shall be provided in cases where above requirements are not met.

c. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Pull-out torque at rated voltage shall not be less than 205%of full load torque.
d. Starting voltage requirement will be 85% of rated voltage up to 1500kw rating motor.
e. Single phase space heaters suitable for 240 v AC shall be provided on motors rated 30kw and above to maintain winding in dry condition when motor is standstill. Separate terminal box for space heater (As per clause no: 6.0.2) and RTDs shall be provided.
f. All motors shall be Totally Enclosed Fan Cooled (TEFC), for Motors below 30 kw, winding shall be suitable for heating at 24v, 1 phase AC.
g. Winding and Insulation shall be of type Non-hygroscopic, Oil and Flame resistant. It shall be capable two hot starts in succession with initially at normal running temperature. The insulation shall be Class B or better.
h. Noise level of all motor shall be limited to 85 dB(A). Vibration shall be limited within the limit prescribed by IS12075, Part-14. Motor shall withstand the vibration produced by driven equipment. Combined vibration of the equipment at site shall only be accepted as per the Schedule of Guarantee Clause, as mentioned in the data sheet.
i. Motor body shall have two earthing points on opposite side.
j. inside the terminal box to suit the conductor size
   - Motors up to 1 kw - 8 SWG wire
   - 1kw - 30 kw - 25x3 mm GI flat
   - 30 kw - 60 kw - 25x6 mm GI flat
   - 60 kw & above - 30x 6 mm GI flat

6.3.2 Terminal Box

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

Terminal boxes of LT motors 160 KW (& above) shall be capable of withstanding system fault level of 31 MVA for 0.12 second.

Ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any tolerance)

- Upto 110KW : 11.0
- Above 110KW & upto 1500KW : 10.0
- Above 1500KW & upto 4000KW : 9.0
- Above 4000KW : 6 to 6.5

6.3.3 Testing of LT Motors

a. LT Motors shall be of type tested quality. For each type and rating of LT Motors, rated above 50KW,the vendor shall submit for Owner's approval the report of all type tests as per relevant standards and carried out within last five (5) years from the date of Purchase Order(PO). These reports should be for the test conducted on the equipments similar to those proposed to be supplied under this contract , and the tests should have been either conducted at an independent laboratory or should have been witnessed by client.

b. In case vendor is not able to submit the report of the type tests, conducted within last five (5) years from the date of PO or in case the type tests report are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the ultimate purchaser (NTPC in this case) and submit the reports for approval.

c. All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

d. All Motors shall be so designed that maximum inrush currents and locked rotors and pull-out torque developed at extreme voltage and frequency variation do not endanger the motor and driven equipments.

e. Terminal boxes of breaker operated LT Motors above 160kw shall be capable of withstanding system fault level 31MVA for 0.12 second.

f. The size and number of cables to be intimated to successful bidder during detail engineering and the contractor shall provide terminal box suitable for the same.

7.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Metric unit shall be used in the drawings and in the any displays on the equipments. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm^2G. For instance the pressure gauges should have dual unit's indication.
2.	Descriptions in the drawings, 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.

S.No	Description
14.	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
15.	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
16.	Bidder shall provide the necessary gaskets.
17.	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
18.	Bidder to provide capacity of crane or hoist required for material handling and the details of heaviest component to be handled.
19.	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
20.	Quality Plan to be submitted along with the offer.
21.	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.
22.	Material of construction for all equipment/components shall be subject to NTPC/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.
23.	Bidder to provide sub vendor list and Bidder shall strictly adhere to NTPC approved vendor list. In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by NTPC/ BHEL before placing order and bidder shall submit relevant documents as per **Attachment-VI-Sub-Supplier Questionnaire.**
24.	It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from BHEL / NTPC for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of NTPC/ BHEL, the same may be replaced with another NTPC/BHEL approved sub-vendor only, without any price implications to BHEL.
25.	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the BIFPCL/ BIFPCL's consultant and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents:

S.No	Description
	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 NTPC along with BHEL.
26.	During detail engineering, bidder to strictly adhere to BHEL/NTPC drawing formats, document numbering, quality plan & FQP formats
27.	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
28.	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/NTPC 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/NTPC 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"
8.0	**PACKING AND FORWARDING**
1.	Proper packing to be ensured. Indigenous Supply: Blower & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Blower internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure - VII. 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

S.No	Description
	possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4.	Crates and packing material used for shipping will become the property of owner.(NTPC)
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking
8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows. **NTPC NATIONAL CAPITAL THERMAL POWER PROJECTS STAGE – II** **DADRI, 2 X 490 MW.** **UP INDIA** **EPC CONTRACTOR:BHARAT HEAVY ELECTRICALS LIMITED, INDIA"** In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match

S.No	Description
	marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care” , “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15.	**The packing slip shall contain the following information:-** Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Agitator, BHEL item Code, Gross Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very severe” during final finishing/shipping.
18.	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.

S.No	Description
	Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.
19.	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20.	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
9.0	**SUPERVISION OF ERECTION, TESTING AND COMMISSIONING**
1.	The erection of Agitators will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per boiler for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply. Only supervision for Absorber Agitators are required for the 2nd visit.
2.	There will be one visit per boiler and totally there will be 2 visits for 2 boilers. The bidder will be informed well in advance for the visit. Bidder shall include 15 working days for first visit & 5 working days for 2nd visit in the offer.
3.	TA/DA, boarding and lodging shall be borne by the bidder and shall be inclusive in supply portion.
10.0	**EXCLUSION**
	The following work associated with the Agitators will be by others: a. Walkways, platforms and ladders b. Element handling hoists.
11.0	**INSPECTION AND TESTING**
	The General inspection requirements to be considered are as below:
1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/NTPC prior to manufacture.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/NTPC.
3.	Since there is no standard for “Acceptance Test Procedure” for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.
4.	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.

S.No	Description
5.	No liquid should enter the tube through any flange joint. "O"-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It is cannot be considered as a guarantee of functional objective of rubber used.
6.	DYNAMICS
7.1	CRITICAL SPEED
7.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
7.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish that the torsional critical speed is well off the operating speed by 20% from the operating speed.
7.2	VIBRATION SEVERITY
7.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.
7.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816, 1.5-2.3mm/sec even if Motor rating falls below 15kw.
7.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
7.2.5	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
8.	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
9.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
10.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
11.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify

S.No	Description
	the absence of air packets (or) surface without adherence.
12.	For surfaces with rubber lining, Coating thickness shall be checked at 100%.A High voltage porosity test will be conducted on 100 % of the coated surface.
13.	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.
14.	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.
15.	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
16.	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
17.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipments.
18.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
19.	Bidder to arrange all calibrated gauges, Instruments during inspection.
20.	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
12.0	**PAINTING**
1.	**Surface Preparation : Blast Cleaning SA 2.5**
2.	**PRIMER COAT:** a. Zinc Epoxy b. DFT= 80micron per coat ***c.*** No of coats = 1. ***d.*** Primer coat thickness 80 micron.
3.	**FINISH COAT:** a. Epoxy High Solid b. DFT= 50micron per coat **c.** No of coats = 2. **d.** Intermediate coat thickness 100 micron. **e.** Total DFT : 180 micron.
4.	**COLOUR CODE (based on DIN 2403:2007-05 & DIN 5381)** a. Base: To be informed during contract stage b. Lettering: To be informed during contract stage
5.	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope

S.No	Description
6.	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BHEL / NTPC.
13.0	**SPARES,TOOLS & TACKLES**
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as “Special Tools for (tag / item number).”Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
13.1	**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 Blower shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipments are energized. The List of such spares to be provided during bidding stage.
14.0	**PERFORMANCE GUARANTEE**
	All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories 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. Noise level ≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. 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. Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ NTPC approval. 1) 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.

S.No	Description
15.0	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:**
1.	**POWER GUARANTEE** Bidder to specify the total guaranteed power per Agitators operating at the rated capacity in their offer
2.	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:** Total guaranteed power consumption for Agitators shall be quoted by bidder. Lowest quoted guaranteed power consumption will be taken as base value. Bid prices of other bidders will be loaded @ 197,080 INR for every KW excess over the base value as per the formula given below. Adjustment factor for excess power consumption in INR = (GPC-BV) X PL GPC- Guaranteed Power Consumption quoted by bidder in KW BV- base Value i.e. lowest quoted power consumption in KW PL- Power Loading @ 197,080 INR/KW No Price advantage apart from NIL Power Loading will be given if Guaranteed Power consumption offered is less than the ceiling value.
16.0	**LIQUIDATED DAMAGES FOR POWER CONSUMPTION**
	If actual Power Consumption during prove out (or) PG Test operating at the duty point exceeds the value guaranteed by the bidder, liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below Liquidated damage deductible in INR per Total Agitators = (GPC-APC) X P Where GPC- Guaranteed Power Consumption quoted by bidder in KW APC- Actual Power Consumption in KW N- Total Number of Agitators • P- Penalty @ 197,080 INR per KW
17.0	**WARRANTY**
1.	The warranty period shall begin on the date of taking over by NTPC or date of issuance of the provisional acceptance certificate for the unit (whichever occurs first) and shall end after twenty-four (24) months. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.

S.No	Description
2.	In case of failure of the equipment to meet the guarantee, NTPC/BHEL reserves the right to reject the equipment. However, NTPC/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement .
18.0	**FIRST FILL OF CONSUMABLES:**
1.	Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
2.	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the NTPC/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
19.0	**TRAINING**
	Successful bidder shall provide comprehensive training for NTPC/BHEL Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Agitators - Operation & Maintenance, Troubleshooting etc.
20.0	**CONFLICT**
	Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising BIFPCL 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.
21.0	**DOCUMENTATION**
A	**DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER**
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation as per Annexure VI. Annexure VI documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.

S.No	Description
B	**DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT**
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified under Annexure VI. Drawings that are reviewed by the NTPC/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. NTPC/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by NTPC must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per NTPC requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team.

22. REFERENCE DOCUMENTS

1. E,C&I specification – NTPC:DADRI:FGD:AGIT:00

23.0 ANNEXURES

ANNEXURE II- SCHEDULE OF GUARANTEES

TO BE FILLED INDEPENDENTLY FOR EACH TANK'S AGITATORS)

Sl. No.	Description	Unit	Data
1	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency (*)	KW	###
2	Possible Rate of deposit of solid particles at tank bottom of total solid particle inflow/outflow	%	###
2	Noise level at a distance of 1.0 meter from the equipment at site	dB(A)	85
3	Maximum vibration velocity at site) (RMS)	mm/sec	2.3
4	Life of Agitator components parts, from the date of commissioning ▪ Blade of the agitators shall be of stainless steel or Nickel alloy suitable to the service condition. In case, the ,vendor offers the Blade with Rubber lining' the guarantee life of Rubber lining of the Blade shall be minimum life ▪ Shaft should be of "Stainless steel" or "nickel alloy"		24 months
	Anti-friction Bearing		25000 hrs.

Note:

- (*) -Any excess KW at motor terminal will be liable to charge (Power Loading) @ 197,080 INR/KW (**###**) –Data to be filled up by vendor

SIGNATURE OF VENDOR _____

NAME _____

DESIGNATION _____

ANNEXURE III- VENDOR TO PROVIDE THE LIST OF COMMISSIONING SPARES

Sl. No.	Description	Quantity
1.		
2.		
3.		
4.		
5.		

Qty will be Number or Set as applicable

- Vendor to identify each and every item which they consider as recommended spares. Each and every part that is considered to fall under guarantee clause shall be indicated in this list.
- Rubber items which are having a **Self-Life** will also be considered as wear item.

SIGNATURE OF VENDOR _____

NAME _____

DESIGNATION _____

ANNEXURE – IV

a) REFERENCE LIST as per format shown below. (Atleast two reference plant details)

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

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

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

Sl No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

ANNEXURE -VI

A) DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER / AWARD OF CONTRRACT:

Sl. No.	Description	With Proposal	After Award Of Contract
1.	Compliance of specification	yes	--
2.	Deviation List	Yes	--
3.	Performance Curve	yes	Yes
4.	General Assembly Drawing	Yes	Yes
5.	Motor Sizing Calculation	Yes	--
6.	Cross-sectional Drawing	Yes	Yes
7.	Data Sheet	Yes	Yes
8.	Sub-Vendor List	yes	Yes
9.	Material Test Certificates	--	yes
10.	Erection check list	--	yes
11.	Pre Commissioning Check List	--	yes
12.	Scope of Supply	Yes	--
13.	Quality Plan	yes	Yes
14.	Operation & Maintenance Manual	--	10 copies + CD
15.	Spare List (Mandatory., Recommended)	Yes	Yes
16.	Start-up & Commissioning Spare	yes	Yes
17.	List of Special Tools	Yes	Yes
18.	Delivery Schedule	yes	yes
19.	Test Arrangement	Yes	Yes
20.	T-N curve	Yes	Yes
21.	Motor Drawing	Yes	Yes
22.	Curve of Motor (T-N, Efficiency, time etc.)	Yes	Yes
23.	Catalogue	Yes	--

SIGNATURE OF VENDOR _____

NAME _____

DESIGNATION _____

ANNEXURE-VII

TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING

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

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

ANNEXURE-VIII

INSPECTION & TESTING

Refer to all clauses for Inspection & testing requirements.

Sl. no.	Item	Category	Unit of Quantity	Quantity	Component
1	Material Test	Shop Inspection	Set		
2	DP Test	Shop Inspection	Set		
3	Radiographic	Shop Inspection	Set		
4	Magnetic Particle Test	Shop Inspection	Set		
5	Ultrasonic	Shop Inspection	Set		
6	Hydro test	Shop Inspection	Set		
7	Inter Granular Corrosion Test	Shop Inspection	Set		
8	Dynamic Balancing Test	Shop Inspection Testing	Set		
9	Performance Test (Internal)	Shop Testing	Set		
10	Power measurement at situ	Site Testing	Set		
11	Vibration Test	Shop Testing	Set		
12	Vibration Test	Site Testing	Set		
13	Noise Test	Shop Testing	Set		
14	Noise Test	Site Testing	Set		

Note:

- Enlarge the table to incorporate items
- Set to be interpreted as a complete unit

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

ANNEXURE-IX

HEALTH & SAFETY MANAGEMENT MANUAL

Refer to all clauses for Health & Safety requirements.

SIGNATURE OF BIDDER ----------

NAME ----------

DESIGNATION ----------

PART – II

TEN YEARS - AMC and O&M SPARES

24.0	O & M Services for 10 Years Operation – Annual Maintenance Contract (AMC).

O & M Services of Agitator & its accessories to be taken up by Bidder at DADRI Site. The O & M services will be for a period of 10 years.

SCOPE OF O & M Services:

A) Annual Maintenance Contract (AMC):

1. The Bidder to carry out maintenance of Agitator & accessories supplied for a period of 10 years. The contract shall cover both preventive maintenance & Minor / Major Overhauls.
2. All services call shall be attended at the earliest.
3. All spare parts required for the upkeep of the equipment's (Agitator & it's accessories) to be stocked in advance or arranged within 2 - 3 days' time to ensure trouble free operation & to meet the 95 % availability as per specification.
4. The Bidder has to take necessary approval from site In-charge for carrying out necessary maintenance operation.
5. The bidder shall provide qualified technicians for carrying out the AMC at site. Necessary site support will be provided by BHEL. TA/DA, boarding and lodging of such technicians attending to AMC requirements shall be borne by the bidder and shall be included in AMC scope.

B) O & M Spares:

1. All spares required for the upkeep of the equipments for 10 years operation is in the scope of the bidder.
2. The bidder will submit a separate list of spares required for AMC from
   a) 3- 4 years operation.
   b) 5-7 years operation.
   c) 8- 10 years operation

Note: 0 -2 years covered in warranty clause.

3. The following is the minimum spare parts along with their break up price to be stocked by the bidder, if applicable.
   d) Impeller Assembly 1 no. of each type
   e) Bearing Assembly 2 no. of each type
   f) Motor 1 no. of each type
   g) Belt and Pulley (If applicable) 2 no. of each type
   h) Gear Box Assembly (If applicable) 1 no of each type

C) GENERAL

1. The AMC (A) & O & M Spares (B) are part of the scope for 10 years up keep of the equipments.
2. Maintenance charges – AMC (A) & O&M Spares (B) together will be paid yearly on a pro-rata basis for 10 years.
3. The AMC (A) & O&M Spares (B) rate to be quoted separately with the main offer.
4. The Price offer for supply of agitator & 10 years AMC (A) & O&M Spares (B) of agitator & its accessories will be considered for Evaluation.
5. All spares to be used during AMC under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements.

ANNEXURE-I- PROVENNESS CRITERIA

CLAUSE NO.	INTENT OF SPECIFICATION

4.00.00 **QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS**

4.01.00 **Provenness criteria for critical equipment, auxiliaries, systems and bought out items:**

The Bidder / Bidder's sub-vendor(s) is required to meet the Provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

4.01.01 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 the date of consideration for approval but not later than six months to award date of contract to the Main bidder:

Type and Rating for Qualification

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(f)	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

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

The Provenness criteria for equipment (Agitators) stipulated at Sl.No.4.01.01 (f) above shall also be considered acceptable provided the rating parameters (i.e., Agitator rating) is covered within the operating regime of the respective Agitators performance curve of the reference plant equipment.

4.01.03 A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).

CLAUSE NO.	INTENT OF SPECIFICATION
	Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.
4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01 (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 4.01.01 (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 equipments.
4.01.08	Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.
4.01.09	Bidder shall offer and supply only the type of the above equipment(s) for which it,itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.
4.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 4.01.01 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.

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

Bidder's Name and Address:

To
Contract Services-II
NTPC Limited
Noida-201301

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

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

Note : *Strike-off whichever is not applicable.

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

2. ~~If the qualification sought as per the clause 4.01.02, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e manufacturer of such equipments for at least 490 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be furnished.~~

3. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipments in India shall be furnished individually for each equipment by the bidder such as,

   i) Copy of document of incorporation of JV/Subsidiary company in India

   ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI.

   iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

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

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

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

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

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 for	.....MW unit size

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 docu ment 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.**

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

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

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

3.01.00 We, hereby confirm that JV company/ Subsidiary company (Strike off whichever is not applicable) formed for manufacturing and supply of equipment(s) (Agitators) has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 of sub-section-I, Part-A, Section VI of bidding documents (or the technology provider of the qualified equipment manufacturer).
Further, in such a case, such qualified equipment manufacturers is having, directly or indirectly through its holding company/subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture / Subsidiary or up to the end of defect liability period of the contract, whichever is later. Before taking up the manufacturing of such equipment(s) (Agitators), 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) (Agitators) who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment.

(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 Agitators between *us/*our sub-vendors, as per 4.01.00 above, and with qualified Agitators manufacturer, who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI are enclosed as per **Annexure-I** to this Attachment. The data in respect of proveneness criteria for the qualified Agitators 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 Agitators.

We further confirm that before taking up the manufacturing of such Agitators *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 Agitators who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment.

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

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

7.01.00 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))

7.02.00 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 **4.01.01**, 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.

ANNEXURE-I

FORM OF DEED OF JOINT UNDERTAKING TO BE PROVIDED FOR AGITATORS AS PER CLAUSE 4.01.05 (i) 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. 4.01.05 (i) OF SUB-SECTION-I, PART A, SECTION VI ALONGWITH QUALIFIED EQUIPMENT MANUFACTURER OF AGITATORSMEETING THE REQUIREMENTS AS PER CLAUSE 4.01.01 (d) OF SUB-SECTION-I, PART A, SECTION VI FOR SUCCESSFUL PERFORMANCE OF AGITATORSIN WHICH EXECUTANT OF THE DJU ARE JOINTLY AND SEVERALLY LIABLE FOR THE SUCCESSFUL PERFORMANCE OF THE AGITATORS

The DEED OF UNDERTAKING executed this .....day of .....Two thousand .....by M/s .....a Company incorporated under .....having 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 4.01.05 (i) 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 4.01.01 (d) of sub-section-I, Part-A, Section-VI incorporated under .....having 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 for **NCTPP DADRI** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-6130/0330-109-9**.

AND WHEREAS vide clause 4.01.05 (i) 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. 4.01.01 (d) 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 Wet limestone Grinding mill in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01(g)of Sub-Section-I, Part-A, Section-VI of bidding documents. Before taking up the manufacturing of Wet limestone Grinding mill, 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 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 for **NCTPP DADRI** (hereinafter referred to as "Plant") vide its Bidding Document No. **CS-6130/0330-109-9**.

AND WHEREAS M/s ..... . (Qualified Indian Manufacturing Company) meets the requirement of clause 4.01.05(i) 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 4.01.01 of Sub-Section-I, Part A, Section-VI of bidding documents.

AND WHEREAS M/s ..... (Qualified Equipment Manufacturer) meets the requirements of clause 4.01.01 of sub-section-I, PartA, Section-VI for .....(Name Of Equipment).

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 **NCTPP DADRI (Name of 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 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.

(b) In the event Indian Qualified Indian 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 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 10 Million (Indian Rupees Ten 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.

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 of the Authorised

(Signature Name)

Representative)

(Official Address)

Name ...

Designation ...

Common Seal of the
Company ...

1. WITNESS

For M/s ...
(Qualified Indian Manufacturing Company)

(Signature of the Authorised
Representative) ...

(Signature Name)

(Official Address)

Name...

Designation ...

Company ...

Common Seal of the

1. WITNESS

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

(Signature of the Authorised
Representative) ...

(Signature Name)

(Official Address)

Name...

Designation ...

Common Seal of the
Company ...

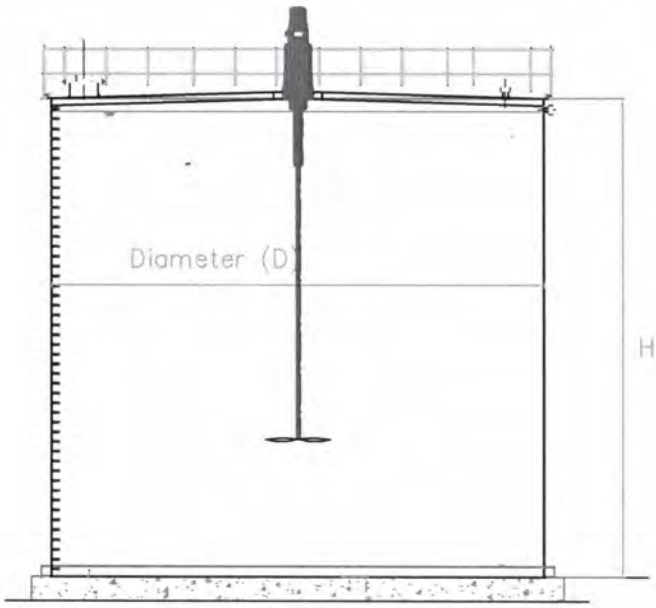
Note : Power of Attorney of the persons signing the said Deed of Joint Undertaking is to be furnished. *

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

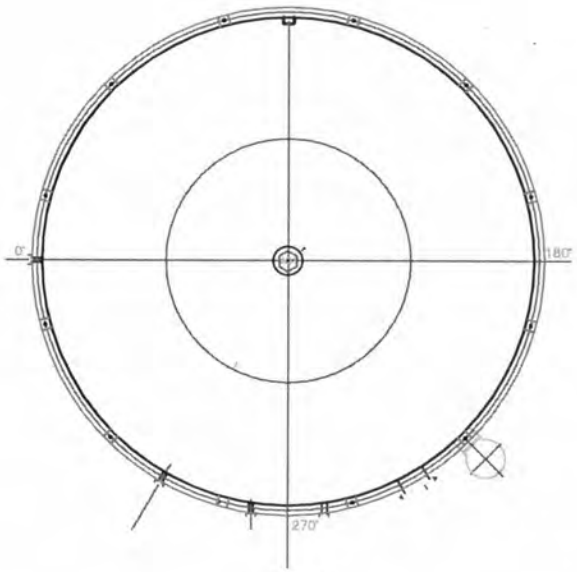
** copy of priced purchase order for the equipment/system shall be furnished by the Bidder.

Sketch of Tank (Typical)

ALL DIMENSIONS ARE IN MILLIMETRES



ELEVATION



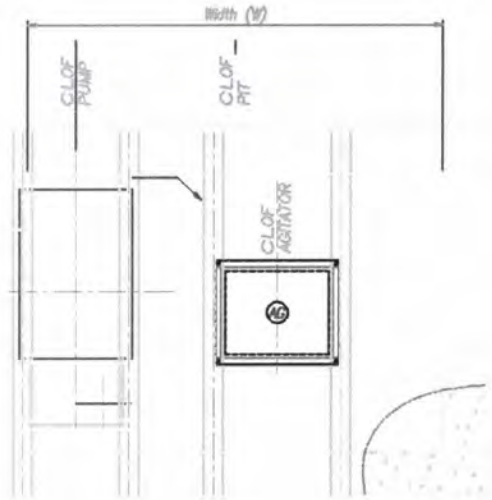
PLAN

Note:

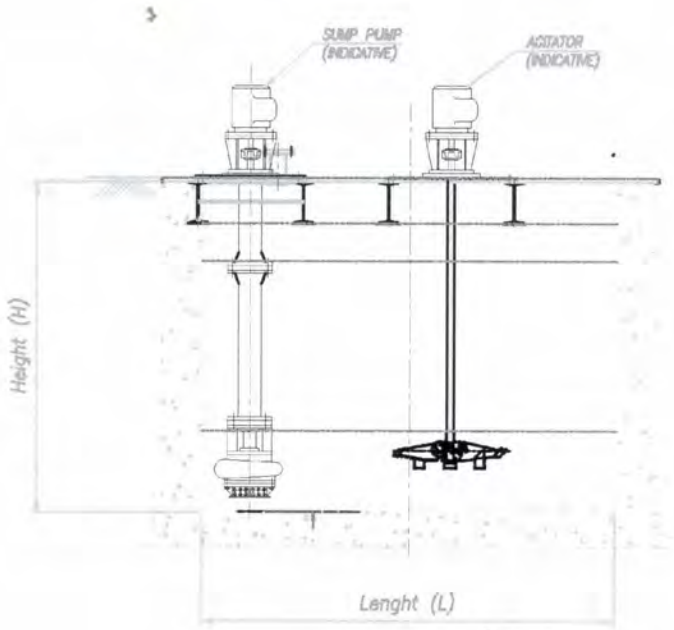
For dimension, please refer clause no: 5.1 Table –3 of technical specification

All dimensions are in mm

Sketch of Drain Pit (Typical)



Plan



Elevation

Note:

For dimension, please refer clause no: 5.1 Table No: 4 of technical specificaion