TECHNICAL SPECIFICATION

FOR

VERTICAL /TOP ENTRY AGITATORS OF SLURRY APPLICATION (SUB-ASSEMBLY OF FGD PACKAGE)

PROJECT	**FGD system for 2x500 MW Project at Tuticorin, Tamil Nadu.**
OWNER	**NLC Tamilnadu Power Ltd. (NTPL), Tuticorin**
OWNER's CONSULTANT	**DEVELOPMENT CONSULTANTS PVT. LTD.**

INDEX

	Annexure 4 : Owner's Specification (incl. Technical, Quality, Inspection, etc.)
	Annexure 5 : Painting Requirements
	Annexure 6 : Packing & Forwarding
	Annexure 7 : QAP Guidelines & Formats
	Annexure 8 : PQC / EQC Format
	Annexure 9 : Sub-vendor List
	Annexure 10 : Master Documents List (MDL) Format
	Annexure 11 : Deviation Format
	Annexure 12 : Pre-Bid Queries (PBQ) format
	Annexure 13 : Performance Guarantee Schedule format
	Annexure 14 : Motor Sizing Calculations Format

DOCUMENTS TO BE SUBMITTED WITH THE BID:

The bidder must submit the following documents along with their bid to enable BHEL to evaluate their offer :

a) Reference project details / documents meeting the Pre-Qualification Criteria/ Equipment qualification criteria / PTR [as specified in Annexure: 8]
b) Duly filled-in Datasheets of offered Agitators [Annexure: 1]
c) Preliminary GA Drawings having complete details such as Foundation details, Civil load details, Dimensions etc.
d) Copy of Un-priced BHEL Price Bid format [Annexure: 2] indicating "Quoted" /"Not Quoted" against each row & column.
e) Duly filled-in Checklist [Annexure:3]
f) Deviation list indicating "No Deviation" [Annexure: 11] (Refer **Note-1** also)
g) Duly filled-in "Performance Guarantee Schedule Format" (Annexure-13)
h) List of Commissioning Spares & Mandatory Spares offered
i) Agitator Motor Sizing Calculations (Annexure-14)
j) Catalogues / Brochures of the offered models of the Agitators

Note-1 : Bidder shall submit Annexure: 11 indicating as ***NO DEVIATION*** along with their offer. Any specific deviations, with respect to specification requirement due to design constraints and OEM limitations, which are impractical to meet, shall be raised in form of pre-bid queries as per Annexure: 12 before submission of Techno Commercial offer.

In case the above-mentioned documents are NOT submitted with the offer, the offer of the bidder may be liable for technical rejection.

1. INTENT OF SPECIFICATION

This specification specifies the minimum requirement of Complete Design, Engineering, Manufacturing, Assembling, Inspection & testing at manufacturer's works, Delivery of properly packed & painted, Supervision services at Site for Vertical/Top Entry Agitators with all equipment/ accessories as specified in the scope of work and are provided as sub-assembly of Flue Gas Desulphurization (FGD) system of 2x500 MW Project at Tuticorin, Tamil Nadu of NLC Tamilnadu Power Ltd. (NTPL) for the safe and trouble-free operation of equipment to be installed at site.

2. SPECIAL NOTES TO BIDDERS

2.1 This specification shall be read in conjunction with all its Annexures. In case of any discrepancy arising between this specification & its annexures, the most stringent of all shall be followed and shall over-ride others. Further, if a requirement in this specification or its annexures, calls for decision of owner/BHEL, it shall be bidder's sole responsibility to clearly bring out the same distinctively in his technical tender offer, so as to enable owner/BHEL to furnish their decision. If such a requirement is not duly addressed by bidder during tender stage and same comes out during order execution stage, it shall be binding on the bidder to comply with the decision furnished by owner/BHEL then, without any cost, delivery, or any other commercial implications.

2.2 Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.

2.3 The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipment's. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the Agitator unit is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.

2.4 Bidder shall quote strictly as per the scope of supply and requirements of this specification.

2.5 Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.6 In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.

2.7 Incase Bidder is unable to offer due to any specific requirement of specification; Bidder shall bring out the same in their regret letter. Otherwise it will be considered that non participation by the bidder is attributable to reasons other than any specification requirements.

2.8 In case of any conflict between this specification and Annexures, stringent of the requirement will govern.

3. PROJECT INFORMATION

Sl. No.	Description	Details
1.	Owner	NLC Tamil Nadu Power Ltd. (NTPL)
2.	Project	FGD System of 2x500 MW NTPL Tuticorin Thermal Power Project
3.	Owner's consultant	Development Consultants Pvt. Ltd.
4.	Location	Tuticorin Taluk, Tuticorin District, Tamil Nadu, India
5.	Nearest Airport	Nearest Airstrip at Pudukottai (6pprox.. 16.5km)
6.	Nearest Railway Station	Port Trust Railway Yard (Approx. 1 km)
7.	Dry Bulb Temperature (DBT) (degC)	Nor. : 27 deg C Range : 20.8 – 36.5 degC Design : 45degC
8.	Wet Bulb Temperature (WBT) (degC)	--
9.	Elevation above MSL	1.46 m
10.	Maximum Ambient temperature for Electrical equipment / system (deg. C)	50
11.	Minimum Ambient temperature for Electrical equipment / system (deg. C)	5
12.	Seismic Zone	Zone II as per IS :1893

Note: Any data required for designing the equipment, bidder may ask prior to the submission of bid.

4. APPLICATION OF SYSTEM

Agitators are envisaged to prevent caking and settlement of particles out of slurry/sludge installed inside various Tanks. For the present requirement, Top Entry (Vertical) Agitators are required for various Slurry Tanks / Sumps listed in Annexure-1 of this specification, along with the data required for the design & selection of these Agitators.

5. SCOPE OF SUPPLY / SERVICES AND TECHNICAL FEATURES

5.1. Applicable Codes and Standards:

The design and materials shall confirm to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Agitator shall follow the latest applicable Indian/International (AISI/ASME/ EN/ Japanese) Standards. **GB standards are not acceptable.**

5.2. Scope of Supply:

Bidder to note the quantity of Agitators required for various tanks in Annexure-1.

Please refer to **Annexure-1,** for more Technical details for the design and selection of Agitators.

Bidder shall include the scope of basic engineering, detail engineering, preparation and submission of engineering drawings/ calculations/ datasheets/ quality assurance documents/field quality plans, testing, painting, sub-vendors list, sub-vendors' equipment specifications / documents / drawings, storage instructions, commissioning procedures, operation & maintenance manuals, performance guarantee test etc., for the above indicated equipment / items including all requirements specified in this specification and annexures for Agitators. Further bidder shall assist BHEL in obtaining time-bound approval from Customer.

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.

Bidder shall also include the scope of supply for EACH agitator of this enquiry as given below:	
1.	Assembly of Agitator Blades and Shaft, Coupling arrangement (Flexible), Gland Packing, Seals, O-Rings, Glands, Shaft Sleeve, Lanterns/ Stools (Bearing Housing), Safety Guard, Bearings, Agitator Mounting Flanges with gaskets and fasteners, Drive Motor with gearbox arrangement etc.
2.	Mating Flange for supporting on Slurry Tank Roof / Surface (Vessel Nozzle is to be recommended by Bidder and will be in the scope of Purchaser)

3.	Cable glands & lugs for Power & Space heater (if applicable) of offered Motors. Cable details shall be furnished during detail engineering stage.
4.	First Fill of Lubricants and Consumables shall be included in Bidder's scope, unless specified elsewhere. Bidder shall also provide the details of these Lubricants and Consumables (quantity, type of lubricant, periodicity etc.).
5.	Furnishing the complete Civil Loading data (as per Annexure-1) to enable purchaser for finalizing Civil Design and BoQ.
6.	Special tools & tackles as applicable- 1 Set for Each of Agitator One set (1 Set) of Special tools and tackles [special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance (disassemble, assemble, or maintaining the unit) of the Agitator-Gear box-Motor assembly shall be quoted as per manufacturer's recommendation. 1 Set stands for requirement for 1 No. of Agitator. Bidder to furnish the list along with the offer. Prices for Special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same.
7.	Start-up and Commissioning Spares as applicable – 1 Set for Each Agitator Commissioning spares shall be as per OEM recommendations. Any leftover (unused) spares after commissioning, out of those included by vendor, shall be handed over to the owner. Bidder shall include all the required commissioning spares in their scope of supply and ensure that the erection and commissioning of the plant is not delayed for want of Commissioning spares. Prices for the commissioning spares shall be part of main scope of supply. No separate price shall be offered for the same. *<u>Note</u>: Any commissioning spare consumed over and above the commissioning Spares supplied by vendor, during commissioning shall be supplied free of cost by the equipment vendor only without any delivery implication.*
8.	Mandatory Spares: Bidder shall include Mandatory Spares in the scope as per the below list. These spares shall be dispatched in separate secured boxes / containers and distinctly marked as "Mandatory spares" with Project details, BHEL PO details etc. Prices of Mandatory spares will be used for evaluation of the bids.

All the spares supplied shall be strictly inter-changeable with the parts of Main equipment.

In case, Agitator or Spares of any agitator are identical to the other agitator within this enquiry, the quantity of spares shall be estimated as defined below on the overall quantity of this enquiry and items not necessarily be quoted for each & every of these identical spare items.

For Eg.: Impeller qty. is defined as "1 No. each type & Size", which means in case if impeller assembly is identical for 2 or more agitators, then it is adequate to consider only "1 No. of each type & size" in the scope of bidder and not necessarily 2 Nos. or more numbers of impeller assemblies.

Similarly, in case, Motor or Motor's Spares of any agitator are identical to the other agitator within this enquiry, the quantity of spares shall be estimated as defined above on the overall quantity of this enquiry and items not necessarily be quoted for each & every of these identical spare items.

Sl. No.	Spare item description	Quantity
A. FOR AGITATORS :		
a.	Impeller Assembly	1 No. of each type & size
b.	Bearings	2 Sets of each type & size
c.	Shaft Assembly	1 No. of each type & size
d.	Shaft Seal	1 No. of each type & size
e.	Gearbox, if applicable	1 No. of each type & size
f.	Complete Agitator Assembly	1 No. of each type & size
B. FOR MOTORS :		
a.	Motor of each type & rating	10% qty. or Minimum 1 No. whichever be higher
b.	End Shield Cover Driving & Non-Driving End	1 set for each type and rating of Motor
c.	Heaters, if applicable	2 sets for each type and rating of motor
d.	Bearings (DE and NDE) for each type and rating of motor	2 sets
e.	Cooling Fan for all type and rating of LT motors	1 Set
f.	Dust seals and gaskets for each type of motors	1 Set
g.	Motor Terminal Block	1 set for each type and rating of Motor
h.	Complete Set of Coupling	1 set for each type and rating

9. Recommended Spares List (**Not** in Bidder Scope):

	Bidders shall also furnish the "List of Recommended Spares" list along with the offer, required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will **not** be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.
10.	Necessary Bolts, nuts, shims/grouting pads etc.
11.	Any other items required for completeness of the equipment except the items covered in the exclusions.

5.3. Scope of Services :

Bidder shall quote for services, which includes supervision of Erection & Commissioning (including trial operation), start-up, testing and trial runs of all equipment / items under the scope of this specification and comprehensive training to BHEL / end customer's Personnel covering the all aspects of Agitators – Operation & Maintenance, Troubleshooting etc.

Bidder to note that the service charges for the above shall consists of the following:

- Per day supervision charges of an Engineer including all other expenses like boarding, lodging, local travel, insurance etc.
- Travel expenses (inclusive of any clearance charges like Visa fee etc, insurance) from / to vendor works to site.

Per diem charges shall be applicable from the day bidder's representative reports to site, up to the day certified by BHEL.

For the purpose of tender evaluation man days and Visits as mentioned in Price bid shall be followed. Please refer to price bid format enclosed as **Annexure-2-I &II.**

Notes:

i. However, either or both of 'the number of man days' or 'number of visits' may change on either side based on the actual site requirement.
ii. All payments towards supervision services shall be made only after BHEL certification.
iii. Bidder to mobilize concerned competent person for supervision service activities within a period of 7 days of receipt of intimation in this regard by BHEL.
iv. Bidder to quote supervision service activities strictly as per BHEL's price format.

5.4. TECHNICAL FEATURES :

SL. No.	Technical Requirement
I.	GENERAL REQUIREMENTS

1.	All agitators shall be designed for continuous operation unless otherwise specified elsewhere. The design of the agitators shall be of proven type.
2.	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
3.	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
4.	The Material of Construction of all Agitators shall be as per Annexure-1
5.	Each agitator and its associated equipment shall be arranged in such a manner so-as to permit easy access for operation, maintenance and removal of agitator without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the auxiliary absorber vessel without having to drain completely the absorber.
6.	Lifting lugs and eyes as required for Agitator Assembly and its associate components shall be provided to permit easy handling.
7.	~~Static balancing (for all agitators) and dynamic balancing (for high speed agitators) shall be carried out after assembly.~~ Static and dynamic balancing of agitators shall be carried out after assembly and rubber lining (if applicable), based on ISO-1940 standard. Any deviation to this requirement is subject to our review during detailed engineering based on applicable codes and standards.
8.	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power.
9.	All exposed moving parts shall be covered by guards made up of Mild Steel.
10.	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of **2** ~~3~~ years under design conditions.
11.	It shall be noted that all Vertical/Top Entry 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" so that no chemical reaction will take place.
12.	Maintaining a uniform concentration over the 95% of liquid column, absolute sweeping of solid particle from tank bottom is a must for all the Agitators. If speed is required to be increased to guarantee the above requirements, the same can be increased by vendor as per OEM standard practice.
13.	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".

14.	Vendor must ensure nil settlement; utilization of solid material shall be a critical parameter for operation and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the critical parameters of performance of offered agitators.
15.	Agitator and its driver shall perform on the test stand at shop and on the Agitator's permanent location at site, within vibration limits as per relevant international design standards. The vibration of combined unit will be the responsibility of Agitator suppliers. Agitator manufacturer is to ensure that Site performance of vibration is one of the "Acceptance Criteria" of the equipment. Please note that the vibration levels at test stand can only be taken for information of purchaser.
16.	The minimum operating level of liquid in every tank for every Agitator shall mandatorily be considered to assess the combined operation of Agitators as well as that of pumps located in the downstream, taking suction from the tank. The minimum tank water level based on process requirement is indicated in **Annexure-1.**
17.	Agitator must be selected with low-pitch propeller with low solidity ratio and Power Number (or) other optimum designs suitably, by the bidder in order to optimize the power consumption of the Agitators. The Maximum Input Power at motor terminals shall be calculated for maximum liquid level in tank and to be specified in the datasheet. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted to purchase during detail engineering stage. A characteristic curve showing 'Power required for Agitator' versus 'Liquid Level' should be submitted from the lowest liquid level to the 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 the frequency variation (mentioned elsewhere in the specification)
18.	Bidder shall provide the design and arrangement (size, material, thickness, inclination, drawing, recommended supporting arrangement) of baffle plates (if applicable / recommended) for the tanks. Baffle plates are in the scope of purchaser.
19.	All agitators have to be designed for outdoor condition.
II.	**CONSTRUCTIONAL FEATURES**
A)	**BLADE AND HUB OF PROPELLER**
i)	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption.

ii)	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence rotating assembly shall be dynamically balanced to its rated speed after rubber lining (if applicable), based on ISO-1940. Any deviation to this requirement is subject to our review during detailed engineering based on applicable codes and standards.
iii)	Impeller should be dynamically balanced to Gr: G6.3: ISO-1940. Any deviation to this requirement is subject to our review during detailed engineering based on applicable codes and standards.
iv)	For circular tanks, impeller diameter shall be at least one-third of the Tank diameter in case of Top Entry Agitators.
v)	For Circular tanks with Top Entry agitators, at least two stages (levels) of impellers have to be offered in case of the following conditions: a) (Slurry Filling Height X Specific Gravity)/Tank Dia. >1, b) (Slurry Filling Height X Specific Gravity)/ Impeller Tip Dia. > 3. The tip diameter of both the impellers have to be same for maintaining uniform suspension. However, bidder may propose two stages (levels) of impellers for other tanks if their standard design permits the same. In case of any deviation by the bidder to the above requirement, bidder should mention specific justification / clarification in their offer for the review by Purchaser and Bidder shall ensure that proven design is offered in all the cases to meet the desired suspension of slurry mentioned in this specification. Based on this, purchaser will review the suitability of the offer. If necessary, the matter can further be discussed & settled mutually based on the references of OEM during post-order stage.
B)	**SEAL**
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 shall be as per Annexure-1. Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m

	for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed. If split shaft is proposed for larger tanks, shaft flanges & their fasteners at the joining interface shall also be same as shaft material.
D)	**BEARING & BEARING HOUSING IN GEAR BOX**
i)	Bearing shall be of rolling type radial and thrust bearing and make shall be as per Vendor List (Annexure-9). If this item is not listed in Annexure-9, the make shall preferably be FAG/SKF/ Timken as required. Thrust bearing shall be sized for continuous operation under all specified conditions.
ii)	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 the bearing. Life of every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hrs. (minimum).
iii)	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant–level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one (1) number G1/2" thread (ISO-228,Part-1) port is required for remote control of temperature of bearing housing oil bath RTD.
iv)	If bearing housing requires cooling water, quantity (m3/hr) and pressure (kg/cm2(g)), Supply / Return temperature (degC) of cooling water is to be indicated in Technical Data Sheet by bidder.
v)	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 O&M Manual.
E)	**MATERIALS**
i)	All agitator components shall meet the requirements of this specification and the applicable design standards.
ii)	A detail quality plan is to be submitted along with offer for all items marked "Full Compliance Material".
F)	**Driver (Motor)**
i)	Supply Power Parameters: 415 V, 50 Hz : For Motors above 200w (or 0.2kW) and upto & including 160 Kw Frequency Variation: +5% and -5% Voltage variation: (+/-)10% Combined Variation of Voltage and Frequency: 10% Absolute Sum (Also please refer to Annexure-4, for requirements of Motors)
ii)	Motor Design Standard: as per Customer Motor Specification (Annexure-4). Energy Efficient Class: IE3 as per IS12615 / IEC60034 Motor Protection: IP 55

	System Fault Level Current: 50 KA for 1 Sec Service Factor:1.0 Canopy: To be Provided for all Motors (Also please refer to Annexure-4, for requirements of Motors)
iii)	The motor name-plate rating at 50degC shall have at least 15% margin over the input power requirement of the driven equipment at rated duty point and also covering the 10% margin on maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, whichever is higher. Driver shall also meet all specified operating conditions including bearing housing, seal, external gear box and coupling loss (if any).
iv)	Please also refer and comply with requirements specified in Motor Specification (Annexure-4).
G)	**GEAR BOX**
i)	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box Rating of 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 that 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, mis-alignment 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 holes, 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**
i)	All the fasteners located inside the tank (Wetted or Un-wetted Condition) must be of Alloy 926 or superior material OR nickel based alloy suitable for the application (Please also refer to Annexure-1) 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)	**TOP ENTRY AGITATORS**
i)	All Agitators shall be designed for continuous operation.
ii)	The Material of Construction (MOC) of Agitators Shall be as per Annexure-1.
iii)	It should be roof mounted.
iv)	Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type coupling between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.
v)	Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.
vi)	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top.
vii)	In case Bidder provides a Vertical Agitator with hub design the same has to be of blade / impeller material as indicated in Annexure-1.
viii)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft (if rubber lining is applicable as per this specification).
ix)	Operation speed of the Agitator motor shall be at least 25% below the first critical speed.
x)	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. OPTIONAL PRICES :

Bidders shall also furnish the **Optional Price for 3 years** Recommended Spares required for normal operation of Agitators, along with the offer, as per Price Bid Format (**Annexure-2**). Prices of these spares will not be used for evaluation of the bids and will remain valid up to 6 months after placement of Notification of Award for the main equipment.

7. EQUIPMENT QUALIFICATION CRITERIA (EQC) / PRE-QUALIFICATION CRITERIA (PQC) :

Vendor shall meet the qualification criteria specified elsewhere in the specification and shall furnish duly filled-in Experience Record Proforma /Pre-qualification Criteria in the prescribed format.

The purchaser reserves the right to prescribe / request for additional drawings / documents / information / clarifications / justifications during the evaluation of the PQC & Offer, in order to satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement.

The purchase shall also reserves right to verify the information furnished by bidder. In case the information / documents / data furnished by bidder are found to be false / incorrect, the technical offer that bidder will be liable for rejection.

8. QUALITY PLAN AND INSPECTION & TESTING

8.1. QUALITY PLAN

Quality plan will be reviewed during detailed Engineering stage with respect to inspection, standard Engineering practices & specification requirements and various tests and stages of inspection and appropriate agencies for Inspection will be Intimated. Bidder to abide by the same.

However, bidder shall include all the necessary requirements of all the necessary Tests & Inspections for the offered package, based on relevant design standards.

Please refer **Annexure-7** for guidelines & QAP format. For details, refer enclosed specifications.

8.2. INSPECTION & TESTING:

The General inspection requirements to be considered are as below:

Sl. No.	Description

1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/Customer/Consultant prior to manufacture.
2.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by BHEL/Customer/Consultant.
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 parameters.
4.	Power consumption test at motor terminals and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.
5.	No liquid should enter the tube through any flange joint. "O"-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It can not be considered as a guarantee of functional objective of rubber used.
6.	**Dynamics of Agitator**
6.1	CRITICAL SPEED
6.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
6.1.2	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.
6.2	VIBRATION SEVERITY
6.2.1	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.
6.2.2	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.
6.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
6.2.4	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
7.	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.
8.	For surfaces with rubber lining (if applicable) 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.
9.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
10.	For surfaces with rubber lining (if applicable), adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.
11.	For surfaces with rubber lining (if applicable), Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
12.	All offered agitators will be inspected at the Bidder's works before dispatch or where the test facilities are available. **In case the systems / Agitators / parts of agitators are being supplied from outside India** and the inspection and witnessing of performance test shall be by renowned Third Party Inspection (TPI). In such a case, bidder shall contact the purchaser in pre-bid stage itself. The inspection charges incurred towards such imported items, should be included by bidder in the Main offer. For those bidders, who are supplying from India, such third party inspection / witness charges need not be considered in bidder's price and same will be arranged by BHEL/ BHEL nominated inspection agency. Bidder to quote the price of Agitators accordingly as per price Bid format (Annexure-2). Customer and BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection. Local conveyance to be arranged by Bidder at their own cost.
13.	Job shaft mechanical seals (if applicable) shall be used during shop tests. The testing shall be done with the Job Shafts. However, if there are limitations in the bidder's test facilities to accommodate the complete length of the shaft, then the same shall be mentioned in the offer along with the justifications, for review by the purchaser. In any case, the testing shall be done with the shaft length upto first shaft sleeve from impeller end.
14.	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
15.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment.
16.	Bidder to arrange all calibrated gauges, Instruments during inspection.
17.	Mechanical running and the performance test shall be carried out by bidder using job motor, job coupling, job base plate and job gear box.
18.	Performance Guarantee at site:

19.1	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.
19.2	Noise level ≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed.
19.3	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
19.4	Acceptance tests to be carried out as per the procedure defined by the bidder, which shall be submitted and approved by Customer/Consultant/BHEL.
19.5	In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at their own cost and the performance test shall be repeated. The extension of delivery schedules will not be entertained due to this reason.
19.6	Additional Inspection & Tests shall also be included as per requirements of End user's specification enclosed as **Annexure-4.**

9. PAINTING

The VENDOR's scope of work shall include surface preparation, and application of shop painting and final painting to all equipment and accessories, uninsulated piping and structural steel work forming part of this package. The color code shall be based on Indian Standard, IS.

The Painting Shall be as follows:

i) Surface Preparation: Blast Cleaning SA 2.5

ii) PRIMER COAT:

a. Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ

iii) INTERMEDIATE COAT : One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ.

iv) FINISH COAT:

Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)

v) COLOUR CODE

Base: To be informed during contract stage.

Lettering: To be informed during contract stage

Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope. Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder.

Prior approval of painting scheme & schedule shall be taken from BHEL after award of contract.

For More Details on Painting of Agitator Assembly and all other accessories shall be as per **Annexure-4.** In case of any ambiguity, the painting shall be discussed and mutually agreed after award of contract.

Final shade for Agitator, Motor and Gearbox shall be informed during detail engineering stage

10. PACKING AND FORWARDING:

The equipment shall be protected for a storage of 12 months at site. If any extra precaution is to be taken by the purchaser for storage beyond 12 months, the same shall be explicitly indicated in the Operation & Maintenance (O&M) manual. For details please refer **Annexure-6.**

11. SUB-VENDORS

Bidder shall follow approved sub vendors list as per **Annexure-9**.

In case of any specific practical difficulty, bidder is requested to bring out the same with proper reason for not following vendor list [Annexure-9] and to furnish Proven Track record, credentials for the proposed vendors for BHEL approval.

For other items for which sub-vendors are not specified in this specification, bidder can follow their standard vendors with due intimation to BHEL during detailed engineering stage. Also they have to ensure the Proven Track record of the sub-vendors and Bidder to take prior approval of BHEL for the same.

12. INSTRUCTIONS ON PRICE BID FORMAT:

Bidder to indicate his offer as per Price Bid format enclosed as Annexure-2.

All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications as per **Annexure-12**, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment. Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in bidder scope Only.

Main offer consists of those items which will be part of main order after successful bidder is identified. Optional Items consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under Main offer and Optional items as per the prescribed format. Prices quoted by the bidder shall remain firm till the successful handing over of the entire package to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

13. GUARANTEE & BID EVALUATION CRITERIA FOR POWER CONSUMPTION:

Bidder to specify the total Guaranteed Auxiliary Power Consumption of the following Agitators operating at the rated capacity (maximum liquid level in the tank) in their offer and please also refer to Cl.No.5.4.(I.18) & 8.2 etc. for Guarantee conditions.

1) Limestone Slurry Storage Tank Agitator - 2Nos.
2) Primary Hydrocyclone Feed Tank Agitator – 1No.
3) Secondary Hydrocyclone Feed Tank Agitator – 1 No.
4) Filtrate Water Tank Agitator – 1 No.
5) Waste Water Tank Agitator – 1 No.

The total auxiliary power consumption guarantees for the all the above listed agitators together (Sl. No. (1) to (5)) shall not exceed <u>68.5kW</u>, failing which the offer of bidder will <u>NOT</u> be considered for evaluation.

14. LIQUIDATED DAMAGES FOR POWER CONSUMPTION :

The bidder has to prove auxiliary power consumption of the offered agitators as indicated in bidder's offer vide **Annexure-12** format of this specification, during Performance Guarantee (PG) test.

In case, during PG test, it is found that the equipment has failed to meet the guarantees, the bidder shall carry out all the necessary modifications and / or

replacements to make the equipment comply with guaranteed requirements without any implications on cost & project schedule to the Purchaser and re-conduct the PG test with Purchaser's consent.

In case, actual Power Consumption during PG Test exceeds the guaranteed value even after modification and / or replacement, Liquidated Damages (LD) for shortfall in performance shall be deducted from contract price as per the formula given below:

Liquidated damage deductible in INR = (OAPC-OGPC) X P

Where,

OGPC- Overall Guaranteed Power Consumption quoted by bidder in kW, as per **Annexure-13**

OAPC- Overall Actual Power Consumption in kW during PG test

P - Penalty @ 4,06,500 INR

Vendor has to make own arrangements for TA/DA, accommodation etc for conducting PG test at project site.

15. PRE-BID CLARIFICATIONS & DEVIATIONS:

Bidders shall comply with various requirements of this specification. It may please be noted that the requirements specified here in this specification are the standard practices being followed by the bidders. However, same things are presented in a structured form so that it can be ensured that the requirements of ultimate customer are complied with.

Bidders can bring out only those deviations which are impractical to meet, for our review in pre bid clarification only.

Bidders may also please note that the data sheets for valves, instruments etc., submitted along with the offer will be considered as indicative only, as the requirements specified in the specification are standard in nature. These will not be reviewed by BHEL before award of contract. Same will be reviewed during order execution stage in line with the requirements of specification and agreed deviations.
All pre-bid clarifications & deviations shall be clear as per Annexure: 12&11 only.

In case bidder doesn't bring any clarification/deviation in prebid stage, the same shall be brought in their offer with following conditions:

a) Any deviations to Customer specifications, same are acceptable provided these deviations are also regularly accepted by Customer for their direct orders on bidders. In such cases, proof of the same shall be furnished along with the offer.

b) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.

c) Price implication due to non-acceptance [by BHEL/Customer] of the deviations considered by bidder will not be permitted.

d) Deviations [if any] shall be clear bring as per Annexure-11 only.

16. DOCUMENTATION:

Please refer to enclosed Master Documentation List [MDL] for the list of DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation. Bidder shall ensure submission of all documentation as per the MDL, Annexure: 10.

Bidder to note that the dates of submission of all the documents shall be finalized based on PO date. It shall be solely bidder's responsibility to get approval on the entire document from purchaser to meet project schedule.

DEFINITION OF VENDOR DOCUMENT REVIEW STATUS ASSIGNED BY BHEL

The guidelines listed below are followed in assigning the document status code to the vendor documents: Final submittal of vendor documents will not be required as long as the document status code is 1 or 4 and the "AS-BUILT" condition of the component agrees with the current document.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the vendor and does not relieve the vendor from full compliance with contractual obligations.

Code-1: Approval

The document conforms to procurement document requirements. The document requires no changes or additions. Matters remaining to be resolved do not require document change and will be handled by correspondence. Where it is known that the design information on a vendor document is not complete and re-submittals will be required, e.g., due to "hold" areas, the document is assigned another status code.

Code-2: Revise and resubmit

Work may proceed subject to resolution of indicated comments. The document is in basic conformance with procurement document requirements. Minor deviations from procurement document requirements have been noted or other minor technical or

physical changes in the equipment are required. The vendor shall resolve comments and resubmit documents prior to shipment of commodity.

Code-3: Rejected. Revise and resubmit

The document:

- Does not conform to the procurement requirements,
- Is of a design that is technically unacceptable without significant changes,
- Does not meet project requirements, i.e., orientation of equipment, nozzles, conduit connections, etc.,
- Does not conform to project criteria or with proposal documents or data, or
- Does not meet minimum submittal requirements.

This submittal rejection does not relieve vendor of any schedule commitments.

Code-4: Review not required

The document is not subject to BHEL review. Typical uses for this status are in the review of items that are vendor standard products, small internal parts of major equipment, or vendor standardized data.

DRAWINGS REVIEW & APPROVALS:

Each drawing submitted by the bidder shall be with a title bock furnished by BHEL during detailed engg stage.

All drawings / documents shall be thoroughly checked, duly signed, and stamped by the vendor including drawing /documents of sub-vendor, before submission to BHEL. Documents, which are unchecked, unsigned, and without revisions marked clearly, shall be returned without review. Any delay on account of this shall be to the vendor's account. After first review of documents, vendor to submit all the further revisions of documents along with comment resolution sheet. Successive documents submitted without comment resolution sheet shall be returned without review.

The approval and /or review by BHEL /End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

Documents once reviewed in Code-1 shall not be submitted (incorporating some changes) again for review, however if some change is really necessary, the same shall be brought to the notice of BHEL separately through design change note for review / information. Finally, As –built drawings, duly updated, shall be submitted.

During detailed engg. stage, BHEL shall furnish check list regarding minimum contents in GA drawing. Bidder to submit GAD [duly incorporating all requirements as per the check list] along with signed checklist. GAD shall not be reviewed without duly filled in checklist signed by the bidder.

NO. OF COPIES OF EACH DOCUMENT TO BE FURNISHED:

All the documents shall be submitted as given below:

SL NO.	DESCRIPTION	NO. OF COPIES / PIECES TO BE SUBMITTED	WHEN TO SUBMIT
1)	Schedule of Documents and Drawings submission (with planned date)	Soft Copy Only	Within 3 days of placement of order
2)	Initial key drawings/ documents under approval and information	Soft copy only	Within 14 days of placement of order
3)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 21 days of document submission
4)	*Revised drawings/documents along with compliance sheet incorporating all BHEL comments. **Vendor to incorporate all BHEL comments so that further revisions can be minimized***.	Soft copy only	Within 14 days of receipt of commented Drawings from BHEL
5)	BHEL shall furnish their observation on revised submitted documents	Soft copy only	Within 21 days of document submission
6)	Final key Drawings/documents and all the balance documents	12	Within 2 months of placement of order.
7)	Erection Documentation	5	1 month before dispatch of equipment. The list of documents identified under master document list for erection to be furnished in 5 no's of folders

8)	O & M Manuals for BHEL review & approval Note: *Bidder to furnish final hard copy of O&M only after getting concurrence on soft copy.*	Soft copy	At least 2 months before the delivery date of equipment
9)	Revised O & M Manuals (Hard Copies) with Test Certificates to be submitted to BHEL	12	Within one month after the dispatch of equipment
10)	Final O&M manuals in a CD	4	Within one month after dispatch of equipment after BHEL concurrence on soft copy.

Notes:

The O&M manuals shall contain the following as minimum:

a) The identification details of the equipment like BHEL P.O. No., Vendor's Job Identification No., full contact address with telephone, fax, & e-mail details.
b) Brief description of the system.
c) All approved documents [Drawings, documents & test procedures as per MDL]
d) Bill of material, BBU, LO schedule, sub vendor list, Mandatory & commissioning spares list etc. Operation, Instruction & maintenance manuals of all equipments / items of the complete package
e) System unloading, storage erection, start up, commissioning, shut down requirements.
f) Operational & environmental safety instructions.
g) Test reports and certificates.
h) Catalogues of the equipment & instrumentation.

17. DEFECT LIABILITY / WARRANTY:

The Bidder warrants that the equipment's/items shall be free from defects in the design, engineering, materials and workmanship of the Plant and Equipment supplied and of the work executed.

The Warranty Period shall be as mentioned in commercial section of the specification. If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Bidder, the Bidder shall promptly, in consultation and agreement with BHEL regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Bidder shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect.

In case of failure of the equipment to meet the guarantee, BHEL/Customer/Consultant reserves the right to reject the equipment. However, BHEL/Customer/Consultant reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement.

18. VARIANT TABLE (For reference of BHEL only):

Variant	Item	Material Code of Agitator with commissioning spare and Special tool and Tackles	Material Code of Mandatory Spares
1	Lime Stone Slurry Storage Tank Agitator	PY9751844010	PY9751844029
2	Primary Hydro Cyclone feed Tank Agitator	PY9751844037	PY9751844045
3	Secondary waste water Hydro Cyclone feed Tank Agitator	PY9751844053	PY9751844061
4	Filtrate water Tank Agitator	PY9751844070	PY9751844088
5	Waste Water Tank Agitator	PY9751844096	PY9751844100
6	Agitator for Absorber Area Drain Sump	PY9751844118	PY9751844142
7	Agitator for Gypsum Area Drain Sump	PY9751844126	Covered in sl. No. 6
8	Agitator for Limestone Slurry Area Drain Sump	PY9751844134	
9	Supervision of E&C for Top Entry Agitators	PY9751844150	

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Reviewed By	Approved By
00	02.11.22	First Issue	Rajeev	SBN	MSSN

ANNEXURE – 1

TECHNICAL DATASHEET FOR AGITATORS AND PRELIMINARY GA DRAWINGS OF TANKS

ANNEXURE-1A : Technical Data Sheet for Agitators

PROJECT INFORMATION:		
1	Owner	**NLC Tamilnadu Power Ltd. (NTPL), Tuticorin**
2	Project	**FGD system for 2x500 MW Project at Tuticorin, Tamil Nadu.**
3	Owner's Consultant	**DEVELOPMENT CONSULTANTS PVT. LTD.**
4	Process/Application	**Flue Gas Desulphurization (FGD) of a Thermal Power Plant**

TECHNICAL INFORMATION OF AGITATOR

S.No.	Description	LIMESTONE SLURRY STORAGE TANK	PRIMARY HYDROCYCLONE FEED TANK	SECONDARY HYDROCYCLONE FEED TANK	FILTRATE WATER TANK	WASTE WATER TANK	ABSORBER AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP
1	**Agitator Sl.No.**	1	2	3	4	5	6	7	8
2	**Tank Details**								
a.	Tank shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Rectangular	Rectangular	Rectangular
b.	Tank Dimension (m)	8.0 Dia X 9.0 H	5.5 Dia X 6.0 H	8.5 Dia X 10.0 H	4.5 Dia X 4.7 H	6.5 Dia X 6.65 H	4 W X4 L X4 H	4 W X4 L X4 H	4 W X4 L X4 H
c.	Capacity of Tank (in m3)	427	130	539	66.8	204	56	56	56
d.	No. of Tanks	2 Nos. (1W+1S)	1 No.	1 No.	1 No.	1 No.	2 Nos.	1 No.	1 No.
e.	Total number of tanks for Two units (2x500MW)	2 Nos. (common for two units)	1 No. (common for two units)	1 No. (common for two units)	1 No. (common for two units)	1 No. (common for two units)	2 Nos. (1 for each unit)	1 No. (common for two units)	1 No. (common for two units)
2	**Parameters**								
a.	Type	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted	Vertical Type (Top Entry) - Center Mounted
b.	Medium to be handled	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry
c.	Seal Type	Not required	Not required	Not required	Not required	Not required	Not required	Not required	Not required
f.	Agitator location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
g.	Operation	Continuous.	Continuous.	Continuous.	Continuous.	Continuous.	Intermittent	Intermittent	Intermittent
e.	MOC of Agitator	All Agitator parts and accessories (incl. Blades, Impellers, fasteners etc) coming in contact with the stirred fluid / vapour, shall be of ***stainless steel (Alloy 926 or superior) or Nickel alloy suitable to the service condition. [Refer Note-3]*** Shaft (complete portion inside the tank including its flanges, fasteners etc) : ***Stainless steel (ie., Alloy 926 or superior) or Nickel alloy suitable to the service condition. [Refer Note-3]*** Shaft (other than above, ie., portion outside the Tank, not coming in contact with either stirred fluid or vapour) : Carbon Steel (A106GrB / AISI 1045) or superior [Refer Note-3 also]							
f.	Minimum liquid leval in the tank	1	1	1	1	1	1.4	1.4	1.4
g	Normal liquid leval in the tank	8.3	5.3	9.3	4	5.95	3.3	3.3	3.3
h.	Maximum liquid level in the tank	8.5	5.5	9.5	4.2	6.15	3.5	3.5	3.5
i.	Quantity of Agitators per Tank	1 No.	1 No.	1 No.	1 No.	1 No.	1 No.	1 No.	1 No.
j.	Total Quantity	**2 Nos.**	1 No.	1 No.	1 No.	1 No.	**2 Nos.**	1 No.	1 No.
k.	No. of stages of Agitators (No. of Propellers)	*	*	*	*	*	*	*	*
l.	Flushing System for Start-up (Complete arrangement incl. piping, fittings etc)	No	No	No	No	No	No	No	No

S.No.	Description	LIMESTONE SLURRY STORAGE TANK	PRIMARY HYDROCYCLONE FEED TANK	SECONDARY HYDROCYCLONE FEED TANK	FILTRATE WATER TANK	WASTE WATER TANK	ABSORBER AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP
1	**Agitator Sl.No.**	1	2	3	4	5	6	7	8
m.	Terminal point connection details for Flushing system line (Pipe size, End connection, MOC)	*	*	*	*	*	*	*	*
4	**Slurry Analysis**								
a.	Maximum solid particle size	200 mesh (74 µ)	200 mesh (74 µ)	200 mesh (74 µ)	6-7 mm	200 mesh (74 µ)	6-7 mm	6-7 mm	6-7 mm
b.	Normal solid particle size, d50	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	6-7 mm	6-7 mm	6-7 mm
c.	Solid to be handled	Limestone + impurities	Gypsum along with Limestone & other impurities	Gypsum along with Limestone & other impurities	Gypsum along with Limestone & other impurities	Gypsum along with Limestone & other impurities	Gypsum along with Limestone & other impurities	Gypsum along with Limestone & other impurities	Limestone + impurities
d.	Chloride concentration	max 1000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 1000 ppm
e.	Hardness of particle	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale
f.	Slurry concentration, wt%	30.0%	30.0%	16.6%	11.0%	3.0%	30.0%	30.0%	30.0%
g,	Sp. Gravity of slurry	1.219	1.216	1.113	1.071	1.024	1.216	1.213	1.215
h.	Sp. Gravity of Lime Stone & Gypsum	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)
i.	Viscosity of Slurry	30 cP	10 cP	4 cP	4 cP	3 cP	10 cP	10 cP	30 cP
j.	pH	5 to 8	4 to 8	4 to 8	4 to 8	4 to 8	4 to 8	4 to 8	5 to 8
k.	SiO_2 Content	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l
l.	Temperature	Normal -37 deg C; Design-55 deg C.	Normal -50 deg C; Design-70 deg C.	Normal -50 deg C; Design-70 deg C.	Normal -50 deg C; Design-70 deg C	Normal -50 deg C; Design-70 deg C	Normal -50 deg C; Design-70 deg C.	Normal -50 deg C; Design-70 deg C.	Normal -37 deg C; Design-55 deg C.
5	**Power loading for auxiliary power consumption (KW)**	Applicable	Applicable	Applicable	Applicable	Applicable	not applicable	not applicable	not applicable
6	Agitator Model No. Selected	*	*	*	*	*	*	*	*
7	**Motor Details**								
a.	Power consumption at Motor terminals at MAXIMUM liquid level in Tank (kW)	*	*	*	*	*	*	*	*
b.	Power consumption at Motor terminals at NORMAL liquid level in Tank (kW)								
c.	Motor Rating (kW)	*	*	*	*	*	*	*	*
d.	Motor Speed (rpm)	*	*	*	*	*	*	*	*
e.	Classication of location	Safe Area	Safe Area	Safe Area	Safe Area	Safe Area	Safe Area	Safe Area	Safe Area
f.	Motor Protection Class	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation	IP-55/ Outdoor, Class F Insulation
g.	Motor Efficiency Class	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615	IE3, as per IS:12615
6	**Impeller**								
a.	Type of impeller	*	*	*	*	*	*	*	*
b.	No. of stages of Impellers								
c.	No. of blades per impeller	*	*	*	*	*	*	*	*
d.	Impeller diameter tip-to-tip (mm)	*	*	*	*	*	*	*	*
e.	Impeller Speed (rpm)	*	*	*	*	*	*	*	*
f.	Impeller tip speed (m/s)	*	*	*	*	*	*	*	*

S.No.	Description	LIMESTONE SLURRY STORAGE TANK	PRIMARY HYDROCYCLONE FEED TANK	SECONDARY HYDROCYCLONE FEED TANK	FILTRATE WATER TANK	WASTE WATER TANK	ABSORBER AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP
1	**Agitator Sl.No.**	1	2	3	4	5	6	7	8
g.	Operating speed (rpm)	*	*	*	*	*	*	*	*
h.	Agitator Pumping Capacity (m^3/min)	*	*	*	*	*	*	*	*
i.	Volume/Agitator (m^3)	*	*	*	*	*	*	*	*
7	**Baffle Plates, if applicable (not in bidder's scope of supply, however data to be furnished by Bidder)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**	**(Refer Note-2)**
a.	No. & size of baffle plates	*	*	*	*	*	*	*	*
b.	Thickness of baffle plates (mm)	*	*	*	*	*	*	*	*
c.	Distance from Bottom of the tank(mm)	*	*	*	*	*	*	*	*
d.	Drawing with Inclination and Position w.r.t. Tank	*	*	*	*	*	*	*	*
8	**Nozzle (not in bidder's scope of supply, however data to be furnished by Bidder)**								
a.	Size of the nozzle on which agitator frame is mounted	*	*	*	*	*	*	*	*
9	**Loading Data**								
a.	Static Load (N)	*	*	*	*	*	*	*	*
b.	Dynamic load (N)	*	*	*	*	*	*	*	*
c.	Equivalent Static Load of Dynamic Load (N)	*	*	*	*	*	*	*	*
d.	Torsional Moment (Nm)	*	*	*	*	*	*	*	*
e.	Bending Moment (Nm)	*	*	*	*	*	*	*	*
12	**Gear Box (if applicable)**								
a.	Make & Model	*	*	*	*	*	*	*	*
b.	Type	*	*	*	*	*	*	*	*
c.	Rating	*	*	*	*	*	*	*	*
d.	Gear Ratio	*	*	*	*	*	*	*	*
13	**Weight of EACH Agitators assembly (kg)**	*	*	*	*	*	*	*	*

NOTES

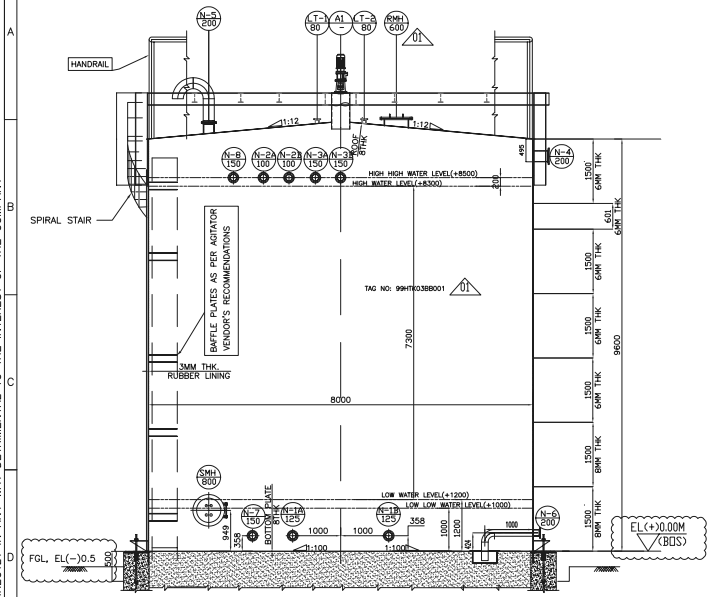
1. Bidder to submit this data sheet with filled-in data along with offer for Review by Purchaser. Post order stage, BHEL's Standard data sheet format, if any, shall be shared and vendor need to furnish the data sheet as per that format only.
2. If Baffles are recommended by bidder to mount inside the tanks, in order to avoid swirling motion of fluid, then please furnish the data requested above and also any additional recommended data, to mount the baffles by the purchaser.
3. In case bidder offers Nickel based alloy as above, the same shall be best suitable for the this application. In this regard, bidder has to provide sufficient credentials of this material and justification of its suitability for the given application. Purchaser reserves right to ask for any additional documents / references / information / data etc in this matter to satisfy himself about the suitability and bidder to furnish the same. Else, bidder to offer Alloy 926 without any price implication.
4. * - Data to be furnished by Bidder

ANNEXURE 1B -PRELIMINARY DRAWINGS OF TANKS

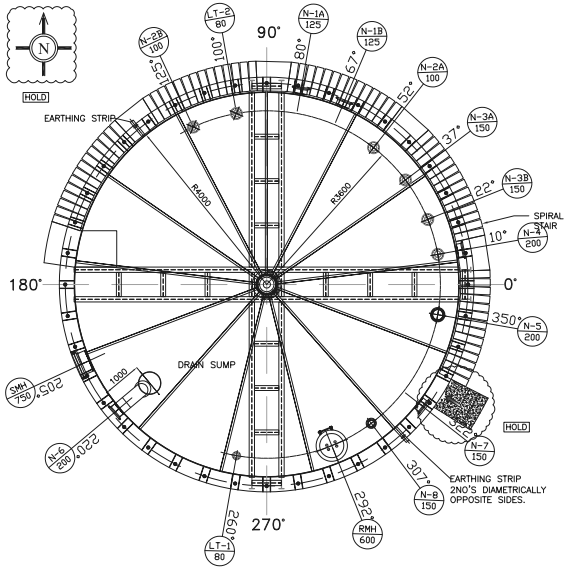
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO PYDG1M162840702 SHT.1 OF 1



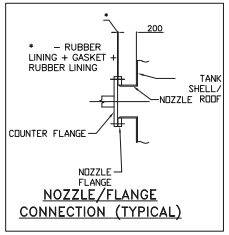
ELEVATION



PLAN

NOZZLE SCHEDULE

NOZZLE MARK	NOZZLE SIZE	NOZZLE Sch.No.	QTY	FLANGE RATING	FLANGE FACING	FLANGE STANDARD	SERVICE	REMARKS
A-1	LATER	–	1	–	–	–	AGITATOR	VERTICAL MOUNTED
RMH	NB600	10	1	PLATE	SOFF	IS-803	ROOF MANHOLE	
SMH	NB750	10	1	PLATE	SOFF	IS-803	SHELL MANHOLE	
LT-1/2	NB80	10	2	150	SOFF	ANSI B 16.5	LEVEL TRANSMITTER	
N-8	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE INLET	
N-7	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE OUTLET	
N-6	NB200	10	1	150	SOFF	ANSI B 16.5	BOTTOM DRAIN	
N-5	NB200	10	1	150	SOFF	ANSI B 16.5	VENT	
N-4	NB200	10	1	150	SOFF	ANSI B 16.5	OVERFLOW	
N-3B	N150	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(MILL HYDROCYCLONE)	
N-3A	N150	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(MILL HYDROCYCLONE)	
N-2B	NB100	10	1	150	SOFF	ANSI B 16.5	FROM ABSORBER UNIT-2	
N-2A	NB100	10	1	150	SOFF	ANSI B 16.5	FROM ABSORBER UNIT-1	
N-1A/B	NB125	10	2	150	SOFF	ANSI B 16.5	PUMP SUCTION	



NOZZLE/FLANGE CONNECTION (TYPICAL)

MATERIAL SPECIFICATION

ITEM	MATERIAL
SHELL, ROOF, BASE AND BOTTOM PLATE	IS: 2062 E250 GRADE BR
STRUCTURES	IS: 2062 E250 GRADE A/ BR
STAIRWAYS & PLATFORMS	IS: 2062 E250 GRADE A/ BR
MANHOLE	IS: 2062 E250 GRADE BR
NOZZLE	IS: 2062 E250 GRADE BR/ A106 Gr B
NOZZLE FLANGES	IS: 2062 E250 GRADE BR
NOZZLE REINFORCEMENT	IS: 2062 E250 GRADE BR
NOZZLE NECKS	IS: 1239
HAND RAILING	IS: 1239 PART(I) MED. GRADE PIPE
GASKETS	NEOPRENE
BOLT	IS: 1367 CLASS 4.4
FITTINGS	UP TO 50NB ASTM A105,ABOVE 50NB & UPTO 300NB ASTM A234 Gr.WPB. 350NB & ABOVE FABRICATED FROM PARENT PIPES
EARTHING LUG	AUSTENITIC STAINLESS STEEL (SS 304)
ANCHOR CHAIR	IS: 2062 E250 GRADE BR
FOUNDATION BOLTS	IS 2062/ IS:1367 CLASS 4.4
NAME PLATE	AUSTENITIC STAINLESS STEEL (SS 304)

DESIGN DATA

DESIGN CODE	–	IS:803/ API-650
STORAGE PRODUCT	–	LIMESTONE SLURRY
TANK CAPACITY(HOLD VOLUME)	M3	427
TANK CAPACITY(EFFECTIVE)	M3	367
TYPE OF TANK	–	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	–	5°
DESIGN PRESSURE	–	HYDROSTATIC HEAD
OPERATING PRESSURE	–	ATMOSPHERIC
DESIGN TEMPERATURE	°C	55
OPERATING TEMPERATURE	°C	37
SPECIFIC GRAVITY	–	1.219
HYDRO TESTING	–	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFICIENCY	–	0.7
RADIOGRAPHY	–	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL, 2.0 MM FOR BOTTOM & ROOF PLATE
BASIC WIND SPEED	M/S	39
SEISMIC ZONE	–	II
NO. OF TANK	NO.	2
DIAMETER (ID)	MM	8000
HEIGHT	MM	9600
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	8,8,6,6,6,6
BOTTOM PLATE THICKNESS	MM	8
INSULATION	–	NOT APPLICABLE
EMPTY WEIGTH	TON	42
WATER FILLED WEIGHT	TON	693
INSIDE LINING	–	5MM THICK RUBBER LINING

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. ELEVATION SHALL BE AS PER THE FOUNDATION INPUT DRAWING.
3. FOR LOCATION REFER PLOT PLAN, PY-DG-0-M162-1252-01 & FOUNDATION INPUT DRAWING
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG AND NAME PLATE SHALL BE WELDED TO THE TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER DRG NO:PYDE2M162840702 FOR LOADING DETAILS.
17. THE THICKNESS OF TANK IS CALCULATED AS PER IS 803
18. ALL ERECTION CLEATS,LUGS,ETC. TEMPORARY ATTACHMENTS SHALL BE REMOVED BEFORE HYDROTEST.
19. INSPECTION & TESTING SHALL BE AS PER APPROVED QAP.
20. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEME FOR STORAGE TANKS Doc No. PY-AZ-4-M162-8442-01

HOLD POINTS:

** AGITATOR SHOWN ARE INDICATIVE ANS SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

*** NOZZLE LOCATION & ORIENTATION SHOWN IN DRAWING ARE INDICATIVE AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS

S.NO.	DRAWING/DOCUMENT	DRG.DOC NO.
1.	PROCESS P&ID LIME STONE SLURRY STORAGE TANK	3-FW-000-01633
2.	FOUNDATION INPUT DETAIL LIMESTONE SLURRY STORAGE TANK	PYDE2M162840702
3.	DESIGN CALCULATIONS FOR LIMESTONE SLURRY STORAGE TANK	PYCD1M162840702
4.	FGD- SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS(SLURRY & WATER)	4-FW-000-01072
5.	PLOT PLAN FOR FGD SYSTEM	PY-DG-0-M162-1252-01
6.	PAINTING SYSTEM FOR FGD STORAGE TANKS	PY-AZ-4-M162-8442-01

(CUSTOMER NO'S: G515 & G516

PROJECT:	NTPL 2x500 MW PROJECTS AT TUTICORN (FGD PACKAGE)
CUSTOMER:	NLC TAMILNADU POWER LTD (NTPL), TUTICORN
PMC CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SAMPATH KUMAR.V		14.06.2021	
CHD.	K.N.B. REDDY		14.06.2021	-N.A.-
APPD.	M.S.S NAGESH		14.06.2021	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD	GR.					
CODE 450	F/M/F	NTS	-N.A.-	-N.A.-	-N.A.-	-N.A.-

TITLE GENERAL ARRANGEMENT OF LIMESTONE SLURRY STORAGE TANK(CAP: 357M3) 01

CARD CODE

DRAWING NO. PY-D-G-1-M162-8407-02 REV. 01

SHT. No 1 NO. OF SHT. 1

REV.	DATE	ALTERED	CHD/APPD
01	02.08.21	ALTERED V SAMPATH	CHD/APPD M.S.S.N

ZONE 01: REVISED IN LINE WITH CUSTOMER COMMENTS

REVISION REASON: IFI/ IFA/ IFD/ IFC/ CANC

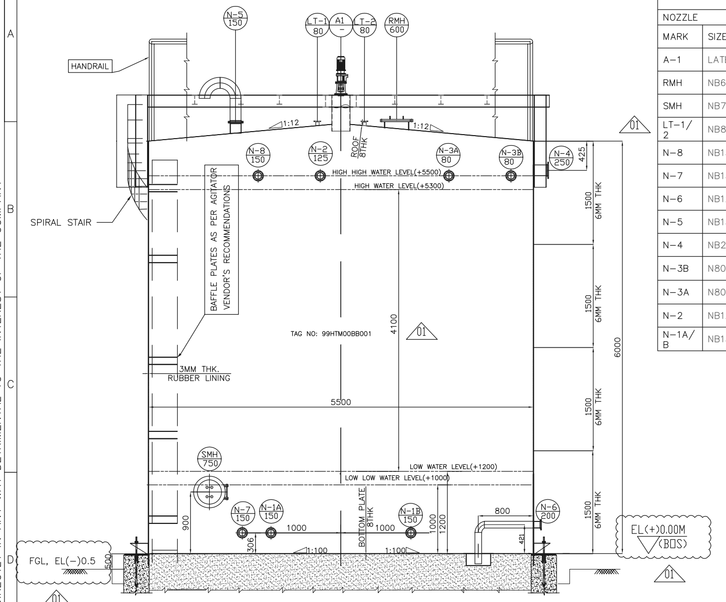
COMPUTER FILE NAME XXXXXXXXXX-SSA-XXXJ.DWG

SIGN. AND DATE | REF. DRG. NO. | INVENTORY NO.

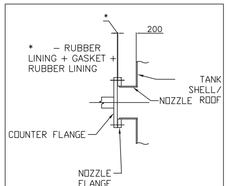
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

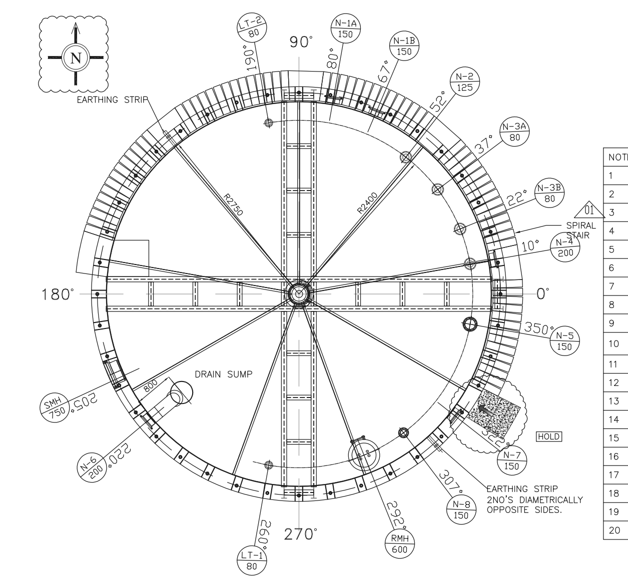
DRG. NO. PYDG1M162840703 SHT.1 OF 1



ELEVATION



NOZZLE/FLANGE CONNECTION (TYPICAL)



PLAN

NOZZLE SCHEDULE

NOZZLE MARK	SIZE	Sch.No.	QTY	FLANGE RATING	FACING	STANDARD	SERVICE	REMARKS
A-1	LATER	_	1	–	–	–	AGITATOR	VERTICAL MOUNTED
RMH	NB600	10	1	PLATE	SOFF	IS-803	ROOF MANHOLE	
SMH	NB750	10	1	PLATE	SOFF	IS-803	SHELL MANHOLE	
LT-1/2	NB80	10	2	150	SOFF	ANSI B 16.5	LEVEL TRANSMITTER	
N-8	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE INLET	
N-7	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE OUTLET	
N-6	NB125	10	1	150	SOFF	ANSI B 16.5	BOTTOM DRAIN	
N-5	NB150	10	1	150	SOFF	ANSI B 16.5	VENT	
N-4	NB250	10	1	150	SOFF	ANSI B 16.5	OVERFLOW	
N-3B	N80	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(VACUUM BELT FILTER A	
N-3A	N80	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(VACUUM BELT FILTER B	
N-2	NB125	10	1	150	SOFF	ANSI B 16.5	MINIMUM FLOW	
N-1A/B	NB150	10	2	150	SOFF	ANSI B 16.5	PUMP SUCTION	

DESIGN DATA

DESIGN CODE	–	IS:803/ API-650
STORAGE PRODUCT	–	Gypsum Slurry
TANK CAPACITY(HOLD VOLUME)	M3	131
TANK CAPACITY(EFFECTIVE)	M3	102
TYPE OF TANK	–	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	–	5°
DESIGN PRESSURE	–	HYDROSTATIC HEAD
OPERATING PRESSURE	–	ATMOSPHERIC
DESIGN TEMPERATURE	°C	70
OPERATING TEMPERATURE	°C	50
SPECIFIC GRAVITY	–	1.216
HYDRO TESTING	–	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFICIENCY	–	0.7
RADIOGRAPHY	–	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND 2.0 MM FOR ROOF & BOTTOM PLATE
WIND CODE	–	39
SEISMIC CODE	–	II
NO. OF TANK	NO.	1
DIAMETER (ID)	MM	5500
HEIGHT	MM	6000
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	6,6,6,6
BOTTOM PLATE THICKNESS	MM	8
INSULATION	–	NOT APPLICABLE
EMPTY WEIGHT	TON	22
WATER FILLED WEIGHT	TON	214
INSIDE LINING	–	5MM THICK RUBBER LINING

NOTES:

1	ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2	EL(±)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+)209.0M. FGL OF THE AREA IS EL(–)0.500
3	FOR LOCATION REFER PLOT PLAN, PY-DG-0-M162-1252-01 & FOUNDATION INPUT DRAWING.
4	OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5	NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803
6	NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7	ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8	NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803
9	ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10	ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11	HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12	ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13	BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14	THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15	EARTHING LUG AND NAME PLATE SHALL BE WELDED TO THE TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16	REFER DRG NO:PYDE2M162840703 FOR LOADING DETAILS.
17	THE THICKNESS OF TANK IS CALCULATED AS PER IS 803
18	ALL ERECTION CLEATS,LUGS,ETC. TEMPORARY ATTACHMENTS SHALL BE REMOVED BEFORE HYDROTEST.
19	INSPECTION & TESTING SHALL BE AS PER APPROVED QAP.
20	PAINTING SHALL BE AS PER APPROVED PAINTING SCHEME FOR STORAGE TANKS Doc No. PY-AZ-4-M162-8442-01

HOLD POINTS:

** AGITATOR SHOWN ARE INDICATIVE ANS SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

*** NOZZLE LOCATION & ORIENTATION SHOWN IN DRAWING ARE INDICATIVE AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS

S.NO.	DRAWING/DOCUMENT	DRG.DOC NO.
1.	PROCESS P&ID OF PRIMARY HYDROCYCLONE FEED STORAGE TANK	3-FW-000-01634
2.	FOUNDATION INPUT DETAIL OF PRIMARY HYDROCYCLONE FEED STORAGE TANK	PYDE2M162840703
3.	DESIGN CALCULATIONS FOR PRIMARY HYDROCYCLONE FEED STORAGE TANK	PYCD1M162840703
4.	FGD- SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS(SLURRY & WATER)	4-FW-000-01072
5.	PLOT PLAN FOR FGD SYSTEM	PY-DG-0-M162-1252-01
6.	PAINTING SYSTEM FOR FGD STORAGE TANKS	PY-AZ-4-M162-8442-01

(CUSTOMER NO'S:G515 & G516

PROJECT: NTPL 2x500 MW PROJECTS AT TUTICORN (FGD PACKAGE)

CUSTOMER: NLC TAMILNADU POWER LTD (NTPL), TUTICORN

PMC CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	SAMPATH KUMAR.V		14.06.2021
CHD.	K.N.B. REDDY		14.06.2021
APPD.	M.S.S NAGESH		14.06.2021

NO.OF VAR. –N.A.–

REV.	DATE	ALTERED	CHD/APPD	ZONE	REVISION REASON
01	06.08.21	V SAMPATH	M.S.S. NAGESH		REVISED IN-LINE WITH CUSTOMER COMMENTS RECEIVED.

DEPT. PE&SD CODE 450 | UNTOL. DIMS. GR. | SCALE NTS | WEIGHT (KG) –N.A.– | REF. TO ASSY. DRG. –N.A.– | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE GENERAL ARRANGEMENT OF PRIMARY HYDROCYCLONE FEED STORAGE TANK(CAP:102M3)

DRAWING NO. PY-D-G-1-M162-8407-03 REV. 01

SHT. No 1 NO. OF SHT. 1

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

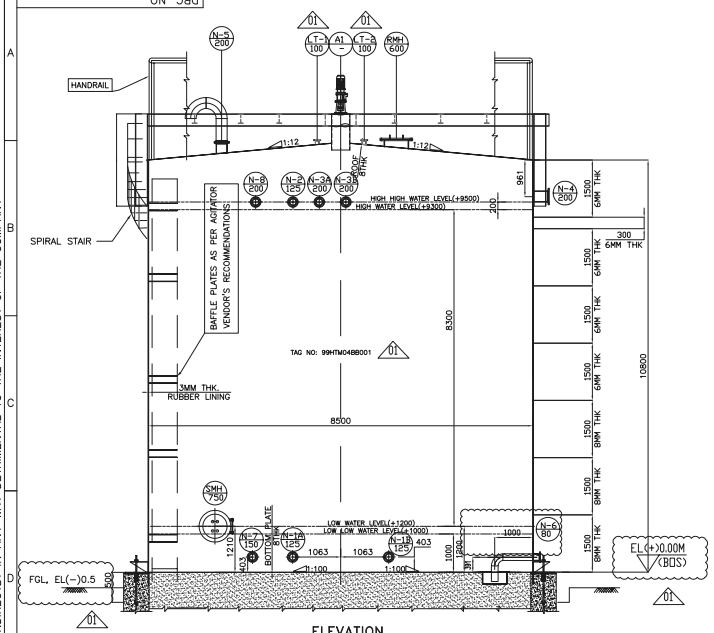
COMPUTER FILE NAME XXXXXXXXXXX-SXX-RXX.DWG

REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO.

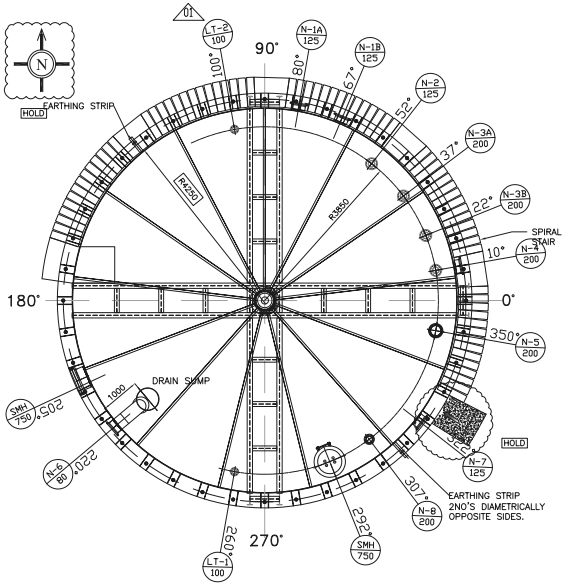
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. PYDG1M162840704 SHT.1 OF 1



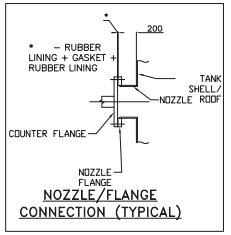
ELEVATION



PLAN

NOZZLE SCHEDULE

NOZZLE MARK	NOZZLE SIZE	NOZZLE Sch.No.	QTY	FLANGE RATING	FLANGE FACING	FLANGE STANDARD	SERVICE	REMARKS
A-1	LATER	–	1	–	–	–	AGITATOR	VERTICAL MOUNTED
RMH	NB600	10	1	PLATE	SOFF	IS-803	ROOF MANHOLE	
SMH	NB750	10	1	PLATE	SOFF	IS-803	SHELL MANHOLE	
LT-1/2	NB100	10	2	150	SOFF	ANSI B 16.5	LEVEL TRANSMITTER	
N-8	NB200	10	1	150	SOFF	ANSI B 16.5	SPARE INLET	
N-7	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE OUTLET	
N-6	NB80	10	1	150	SOFF	ANSI B 16.5	BOTTOM DRAIN	
N-5	NB200	10	1	150	SOFF	ANSI B 16.5	VENT	
N-4	NB200	10	1	150	SOFF	ANSI B 16.5	OVERFLOW	
N-3B	N200	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(PRIMARY HYDROCYCLONE)	
N-3A	N200	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(PRIMARY HYDROCYCLONE)	
N-2	NB125	10	1	150	SOFF	ANSI B 16.5	MINIMUM FLOW	
N-1A/B	NB125	10	2	150	SOFF	ANSI B 16.5	PUMP SUCTION	



NOZZLE/FLANGE CONNECTION (TYPICAL)

MATERIAL SPECIFICATION

ITEM	MATERIAL
SHELL, ROOF, BASE AND BOTTOM PLATE	IS: 2062 E250 GRADE BR
STRUCTURES	IS: 2062 E250 GRADE A/ BR
STAIRWAYS & PLATFORMS	IS: 2062 E250 GRADE A/ BR
MANHOLE	IS: 2062 E250 GRADE BR
NOZZLE	IS: 2062 E250 GRADE BR/ A106 Gr B
NOZZLE FLANGES	IS: 2062 E250 GRADE BR
NOZZLE REINFORCEMENT	IS: 2062 E250 GRADE BR
NOZZLE NECKS	IS: 1239
HAND RAILING	IS: 1239 PART(I) MED. GRADE PIPE
GASKETS	NEOPRENE
BOLTS & NUTS	ASTM A 194 GR.B7 & ASTM A 193 GR 2H
FITTINGS	UP TO 50NB ASTM A105,ABOVE 50NB & UPTO 300NB ASTM A234 Gr.WPB. 350NB & ABOVE FABRICATED FROM PARENT PIPES
EARTHING LUG	AUSTENITIC STAINLESS STEEL (SS 304)
ANCHOR CHAIR	IS: 2062 E250 GRADE BR
FOUNDATION BOLTS	IS 2062/ IS:1367 CLASS 4.4
NAME PLATE	AUSTENITIC STAINLESS STEEL (SS 304)

DESIGN DATA

DESIGN CODE	–	IS:803/ API-650
STORAGE PRODUCT	–	GYPSUM SLURRY
TANK CAPACITY(HOLD VOLUME)	M3	539
TANK CAPACITY(EFFECTIVE)	M3	471
TYPE OF TANK	–	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	–	5°
DESIGN PRESSURE	–	HYDROSTATIC HEAD
OPERATING PRESSURE	–	ATMOSPHERIC
DESIGN TEMPERATURE	°C	70
OPERATING TEMPERATURE	°C	50
SPECIFIC GRAVITY	–	1.113
HYDRO TESTING	–	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFICIENCY	–	0.7
RADIOGRAPHY	–	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND 2.0 MM FOR ROOF & BOTTOM PLATE
WIND CODE	–	39
SEISMIC CODE	–	II
NO. OF TANK	NO.	1
DIAMETER (ID)	MM	8500
HEIGHT	MM	10800
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	8,8,8,6,6,6,6,6
BOTTOM PLATE THICKNESS	MM	8
INSULATION	–	NOT APPLICABLE
EMPTY WEIGHT	TON	41.5
WATER FILLED WEIGHT	TON	796
INSIDE LINING	–	5MM THICK RUBBER LINING

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. ELEVATION SHALL BE AS PER FOUNDATION INPUT DRAWING
3. FOR LOCATION REFER PLOT PLAN, PY-DG-0-M162-1252-01& FOUNDATION INPUT DRAWING.
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG AND NAME PLATE SHALL BE WELDED TO THE TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER DRG NO:PYDE2M162840704 FOR LOADING DETAILS.
17. THE THICKNESS OF TANK IS CALCULATED AS PER IS 803
18. ALL ERECTION CLEATS,LUGS,ETC. TEMPORARY ATTACHMENTS SHALL BE REMOVED BEFORE HYDROTEST.
19. INSPECTION & TESTING SHALL BE AS PER APPROVED QAP.
20. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEME FOR STORAGE TANKS Doc No. PY-AZ-4-M162-8442-01

HOLD POINTS:

** AGITATOR SHOWN ARE INDICATIVE ANS SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

*** NOZZLE LOCATION & ORIENTATION SHOWN IN DRAWING ARE INDICATIVE AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS

S.NO.	DRAWING/DOCUMENT	DRG.DOC NO.
1.	PROCESS P&ID FOR SECONDARY HYDROCYCLONE FEED STORAGE TANK	3-FW-000-01634
2.	FOUNDATION INPUT DETAIL SECONDARY HYDROCYCLONE FEED STORAGE TANK	PYDE2M162840704
3.	DESIGN CALCULATIONS FOR SECONDARY HYDROCYCLONE FEED STORAGE TANK	PYCD1M162840704
4.	FGD DESIGN BASIS-PROCESS	XX-XXXX-XXXXX
5.	PLOT PLAN FOR FGD SYSTEM	PY-DG-0-M162-1252-01
6.	PAINTING SYSTEM FOR FGD STORAGE TANKS	PY-AZ-4-M162-8442-01

(CUSTOMER NO'S: G515 & G516

PROJECT: NTPL 2x500 MW PROJECTS AT TUTICORN (FGD PACKAGE)

CUSTOMER: NLC TAMILNADU POWER LTD (NTPL), TUTICORN

PMC CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	SAMPATH KUMAR.V		14.06.2021
CHD.	K.N.B. REDDY		14.06.2021
APPD.	M.S.S NAGESH		14.06.2021

DEPT. PE&SD; CODE 450; UNTOL. DIMS. GR. ℊ/M/F; SCALE NTS; WEIGHT (KG) –N.A.–; REF. TO ASSY. DRG. –N.A.–; ITEM NO. –N.A.–; NO.OF ITEMS –N.A.–

TITLE GENERAL ARRANGEMENT OF SECOND. HYDROCYCLONE FEED STORAGE TANK(CAP: 471M3)

CARD CODE

DRAWING NO. PY-D-G-1-M162-8407-04

REV. 01

SHT. No 1 NO. OF SHT. 1

REV.	DATE	ALTERED	REVISION REASON: IFI/ IFA/ IFD/ IFC/ CANC
01	02.08.21	CHD/APPD M.S.S. NAGESH	REVISED IN-LINE WITH CUSTOMER COMMENTS RECEIVED.

ZONE

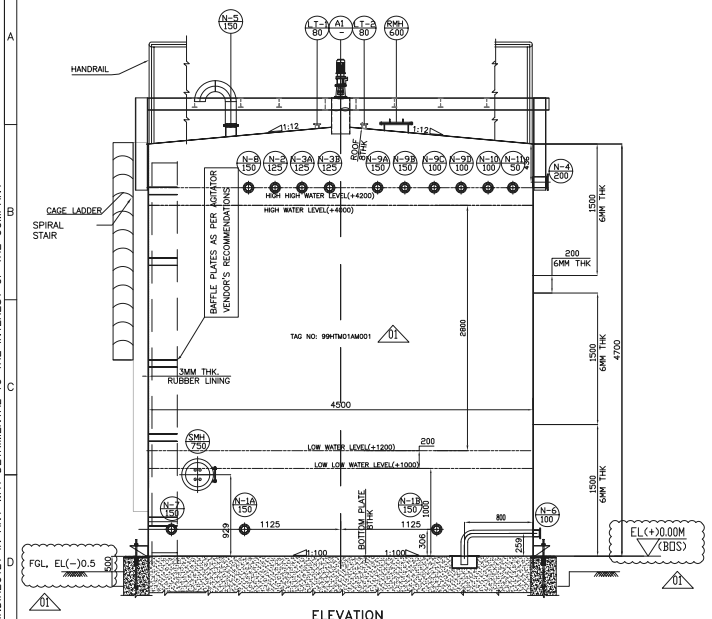
COMPUTER FILE NAME XXXXXXXXXX-SXA-XXXJ.DWG

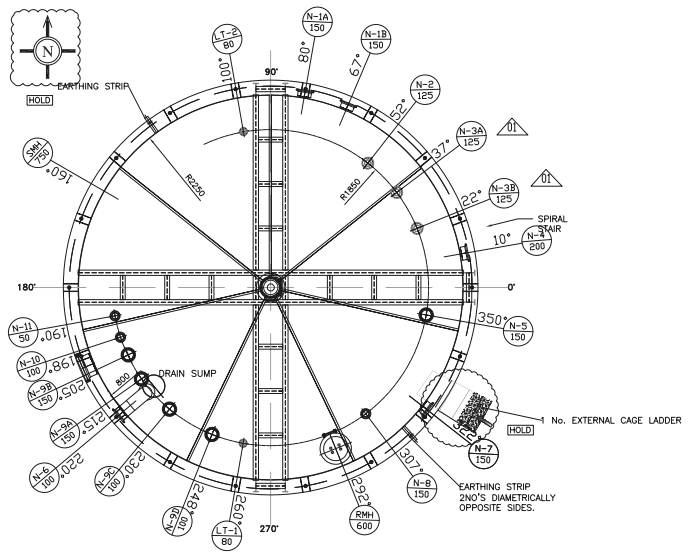
SIGN. AND DATE | REF. DRG. NO. | INVENTORY NO.

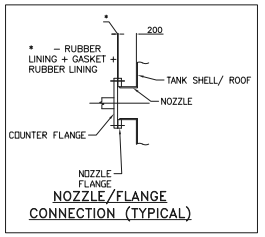
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. PYDG1M162840707 SHT.1 OF 1







NOZZLE SCHEDULE

NOZZLE MARK	NOZZLE SIZE	NOZZLE Sch.No.	QTY	FLANGE RATING	FLANGE FACING	FLANGE STANDARD	SERVICE	REMARKS
A–1	LATER	–	1	–	–	–	AGITATOR	VERTICAL MOUNTED
RMH	NB600	10	1	PLATE	SOFF	IS–803	ROOF MANHOLE	
SMH	NB750	10	1	PLATE	SOFF	IS–803	SHELL MANHOLE	
LT–1/2	NB80	10	2	150	SOFF	ANSI B 16.5	LEVEL TRANSMITTER	
N–11	NB50	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(WASTE WATER PUMP–A/B)	
N–10	NB100	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(GYPSUM AREA)	
N–9C/D	NB100	10	2	150	SOFF	ANSI B 16.5	LIQUID INLET(VACUUM RECEIVER)	
N–9A/B	NB150	10	2	150	SOFF	ANSI B 16.5	LIQUID INLET(VACUUM BELT FILTER)	
N–8	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE INLET	
N–7	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE OUTLET	
N–6	NB100	10	1	150	SOFF	ANSI B 16.5	BOTTOM DRAIN	
N–5	NB150	10	1	150	SOFF	ANSI B 16.5	VENT	
N–4	NB200	10	1	150	SOFF	ANSI B 16.5	OVERFLOW	
N–3A/B	N125	10	2	150	SOFF	ANSI B 16.5	LIQUID INLET(WASTE WATER HYDROCYLONE A/B)	
N–2	NB125	10	1	150	SOFF	ANSI B 16.5	FROM ABSORBER	
N–1A/B	NB150	10	2	150	SOFF	ANSI B 16.5	PUMP SUCTION	

MATERIAL SPECIFICATION

ITEM	MATERIAL
SHELL, ROOF, BASE AND BOTTOM PLATE	IS: 2062 E250 GRADE BR
STRUCTURES	IS: 2062 E250 GRADE A/ BR
STAIRWAYS & PLATFORMS	IS: 2062 E250 GRADE A/ BR
MANHOLE	IS: 2062 E250 GRADE BR
NOZZLE	IS: 2062 E250 GRADE BR/ A106 Gr B
NOZZLE FLANGES	IS: 2062 E250 GRADE BR
NOZZLE REINFORCEMENT	IS: 2062 E250 GRADE BR
NOZZLE NECKS	IS: 1239
HAND RAILING	IS: 1239 PART(I) MED. GRADE PIPE
GASKETS	NEOPRENE
BOLT	IS: 1367 CLASS 4.4
FITTINGS	UP TO 50NB ASTM A105,ABOVE 50NB & UPTO 300NB ASTM A234 Gr.WPB. 350NB & ABOVE FABRICATED FROM PARENT PIPES
EARTHING LUG	AUSTENITIC STAINLESS STEEL (SS 304)
ANCHOR CHAIR	IS: 2062 E250 GRADE BR
FOUNDATION BOLTS	IS 2062/ IS:1367 CLASS 4.4
NAME PLATE	AUSTENITIC STAINLESS STEEL (SS 304)

DESIGN DATA

DESIGN CODE	–	IS: 803/ API–650
STORAGE PRODUCT	–	GYPSUM SLURRY
TANK CAPACITY(HOLD VOLUME)	M3	67
TANK CAPACITY(EFFECTIVE)	M3	45
TYPE OF TANK	–	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	–	5°
DESIGN PRESSURE	–	HYDROSTATIC HEAD
OPERATING PRESSURE	–	ATMOSPHERIC
DESIGN TEMPERATURE	°C	70
OPERATING TEMPERATURE	°C	50
SPECIFIC GRAVITY	–	1.071
HYDRO TESTING	–	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFICIENCY	–	0.7
RADIOGRAPHY	–	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND 2.0 MM FOR ROOF & BOTTOM PLATE
WIND CODE	–	39
SEISMIC CODE	–	II
NO. OF TANK	NO.	1
DIAMETER (ID)	MM	4500
HEIGHT	MM	4700
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	6,6,6,6
BOTTOM PLATE THICKNESS	MM	8
INSULATION	–	NOT APPLICABLE
EMPTY WEIGHT	TON	14.5
WATER FILLED WEIGHT	TON	104
INSIDE LINING	–	5MM THICK RUBBER LINING

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. EL(±)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+)209.0M. FGL OF THE AREA IS EL(–)0.500
3. FOR LOCATION REFER PLOT PLAN, PY–DG–0–M162–1252–01 & FOUNDATION INPUT DRAWING
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS: 803
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED–OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG AND NAME PLATE SHALL BE WELDED TO THE TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER DRG NO: PYDE2M162840707 FOR LOADING DETAILS.
17. THE THICKNESS OF TANK IS CALCULATED AS PER IS 803
18. ALL ERECTION CLEATS,LUGS,ETC. TEMPORARY ATTACHMENTS SHALL BE REMOVED BEFORE HYDROTEST.
19. INSPECTION & TESTING SHALL BE AS PER APPROVED QAP.
20. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEME FOR STORAGE TANKS Doc No. PY–AZ–4–M162–8442–01

HOLD POINTS:

** AGITATOR SHOWN ARE INDICATIVE ANS SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

*** NOZZLE LOCATION & ORIENTATION SHOWN IN DRAWING ARE INDICATIVE AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS

S.NO.	DRAWING/DOCUMENT	DRG.DOC NO.
1.	PROCESS P&ID OF FILTRATE WATER STORAGE TANK	3–FW–000–01632
2.	FOUNDATION INPUT DETAIL OF FILTRATE WATER STORAGE TANK	PYDE2M162840707
3.	DESIGN CALCULATIONS FOR FILTRATE WATER STORAGE TANK	PYCD1M162840707
4.	FGD– SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS(SLURRY & WATER)	4–FW–000–01072
5.	PLOT PLAN FOR FGD SYSTEM	PY–DG–0–M162–1252–01
6.	PAINTING SYSTEM FOR FGD STORAGE TANKS	PY–AZ–4–M162–8442–01

(CUSTOMER NO'S: G515 & G516

PROJECT:	NTPL 2x500 MW PROJECTS AT TUTICORN (FGD PACKAGE)
CUSTOMER:	NLC TAMILNADU POWER LTD (NTPL), TUTICORN
PMC CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SAMPATH KUMAR.V		14.06.2021	
CHD.	K.N.B. REDDY		14.06.2021	–N.A.–
APPD.	M.S.S NAGESH		14.06.2021	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE 450	GR. F/M/F	NTS	–N.A.–	–N.A.–	–N.A.–	–N.A.–

TITLE: GENERAL ARRANGEMENT OF FILTRATE WATER STORAGE TANK(CAP: 45M3)

CARD CODE

DRAWING NO. PY–D–G–1–M162–8407–07

REV. 01

SHT. No 1 NO. OF SHT. 1

REV.	DATE	ALTERED	CHD/APPD
01	06.08.21	V SAMPATH	CHD/APPD M.S.S. NAGESH

REVISED IN–LINE WITH CUSTOMER COMMENTS RECEIVED.

REVISION REASON: IF1/ IFA/ IFD/ IFC/ CANC

ZONE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

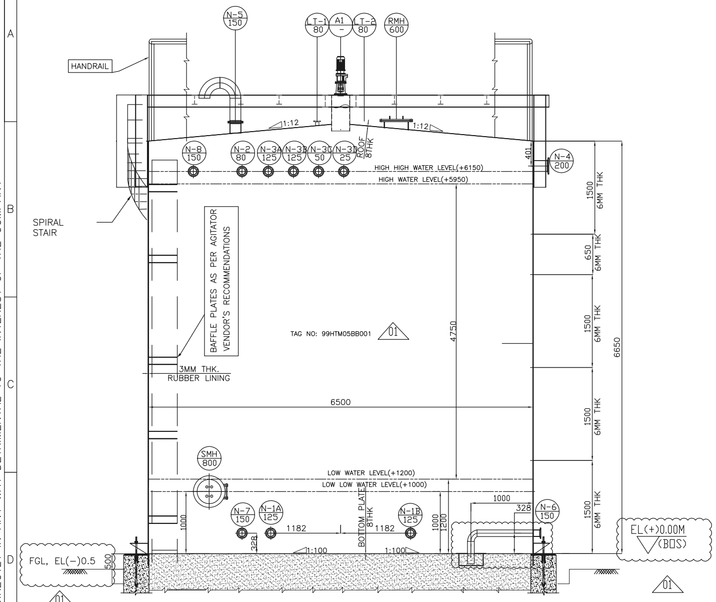
COMPUTER FILE NAME XXXXXXXXXX–SSA–PXXJ.DWG

SIGN. AND DATE | REF. DRG. NO. | INVENTORY NO.

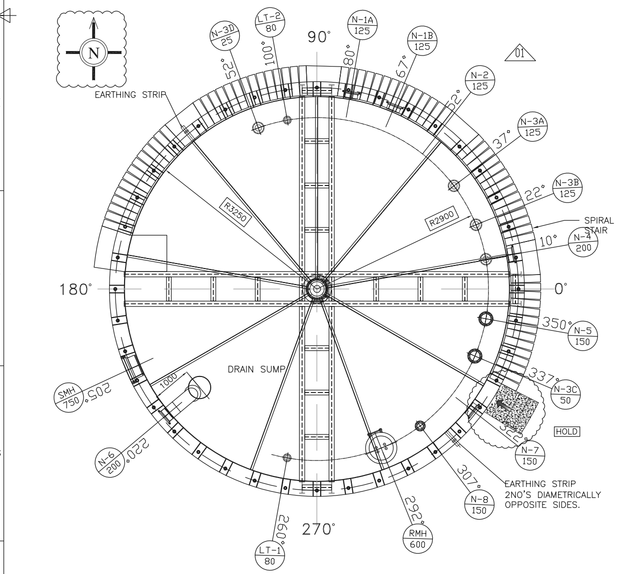
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. PYDG1M162840705 SHT.1 OF 1

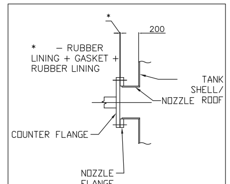


ELEVATION



PLAN

NOZZLE SCHEDULE								
NOZZLE			QTY	FLANGE			SERVICE	REMARKS
MARK	SIZE	Sch.No.		RATING	FACING	STANDARD		
A−1	LATER	−	1	−	−	−	AGITATOR	VERTICAL MOUNTED
RMH	NB600	10	1	PLATE	SOFF	IS−803	ROOF MANHOLE	
SMH	NB750	10	1	PLATE	SOFF	IS−803	SHELL MANHOLE	
LT−1/2	NB80	10	1	150	SOFF	ANSI B 16.5	LEVEL TRANSMITTER	
N−8	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE INLET	
N−7	NB150	10	1	150	SOFF	ANSI B 16.5	SPARE OUTLET	
N−6	NB150	10	1	150	SOFF	ANSI B 16.5	BOTTOM DRAIN	
N−5	NB150	10	1	150	SOFF	ANSI B 16.5	VENT	
N−4	NB200	10	1	150	SOFF	ANSI B 16.5	OVERFLOW	
N−3D	N25	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(LIME DOSE)	
N−3C	N50	10	1	150	SOFF	ANSI B 16.5	LIQUID INLET(CONDENSATE TRANSFER PUMP)	
N−3A/3B	N125	10	2	150	SOFF	ANSI B 16.5	LIQUID INLET(FROM WASTE WATER HYDRO)	
N−2	NB80	10	1	150	SOFF	ANSI B 16.5	MINIMUM FLOW	
N−1A/B	NB125	10	2	150	SOFF	ANSI B 16.5	PUMP SUCTION	



NOZZLE/FLANGE CONNECTION (TYPICAL)

MATERIAL SPECIFICATION	
ITEM	MATERIAL
SHELL, ROOF, BASE AND BOTTOM PLATE	IS:2062 E250 GRADE BR
STRUCTURES	IS:2062 E250 GRADE A/ BR
STAIRWAYS & PLATFORMS	IS:2062 E250 GRADE A/ BR
MANHOLE	IS:2062 E250 GRADE BR
NOZZLE	IS:2062 E250 GRADE BR/ A106 Gr B
NOZZLE FLANGES	IS:2062 E250 GRADE BR
NOZZLE REINFORCEMENT	IS:2062 E250 GRADE BR
NOZZLE NECKS	IS:1239
HAND RAILING	IS:1239 PART(I) MED. GRADE PIPE
GASKETS	NEOPRENE
BOLT	IS:1367 CLASS 4.4
FITTINGS	UP TO 50NB ASTM A105,ABOVE 50NB & UPTO 300NB ASTM A234 Gr.WPB. 350NB & ABOVE FABRICATED FROM PARENT PIPES
EARTHING LUG	AUSTENITIC STAINLESS STEEL (SS 304)
ANCHOR CHAIR	IS:2062 E250 GRADE BR
FOUNDATION BOLTS	IS 2062/ IS:1367 CLASS 4.4
NAME PLATE	AUSTENITIC STAINLESS STEEL (SS 304)

DESIGN DATA		
DESIGN CODE	−	IS:803/ API-650
STORAGE PRODUCT	−	GYPSUM SLURRY
TANK CAPACITY(HOLD VOLUME)	M3	204
TANK CAPACITY(EFFECTIVE)	M3	164
TYPE OF TANK	−	VERTICAL CYLINDRICAL FIXED CONE ROOF
ROOF SLOPE	−	5°
DESIGN PRESSURE	−	HYDROSTATIC HEAD
OPERATING PRESSURE	−	ATMOSPHERIC
DESIGN TEMPERATURE	°C	70
OPERATING TEMPERATURE	°C	50
SPECIFIC GRAVITY	−	1.024
HYDRO TESTING	−	WATER FILLED HEAD UPTO OVERFLOW NOZZLE
JOINT EFFICIENCY	−	0.7
RADIOGRAPHY	−	NO APPLICABLE
CORROSION ALLOWANCE	MM	3.0 MM FOR SHELL AND 2.0 MM FOR ROOF & BOTTOM PLATE
WIND CODE	−	39
SEISMIC CODE	−	II
NO. OF TANK	NO.	1
DIAMETER (ID)	MM	6500
HEIGHT	MM	6650
ROOF PLATE THICKNESS	MM	8
SHELL PLATE THICKNESS	MM	6,6,6,6,6
BOTTOM PLATE THICKNESS	MM	8
INSULATION	−	NOT APPLICABLE
EMPTY WEIGHT	TON	24
WATER FILLED WEIGHT	TON	275
INSIDE LINING	−	5MM THICK RUBBER LINING

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS SPECIFIED OTHERWISE.
2. EL(±)0.000 IS THE GROUND FLOOR LEVEL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL(+)209.0M. FGL OF THE AREA IS EL(−)0.500
3. FOR LOCATION REFER PLOT PLAN, PY-DG-0-M162-1252-01 & FOUNDATION INPUT DRAWING
4. OUTSIDE NOZZLE PROJECTION IS 200MM UNLESS OTHERWISE SPECIFIED.
5. NOZZLE REINFORCEMENTS SHALL BE AS PER IS:803
6. NOZZLE PROJECTIONS ARE MEASURED FROM TANK SHELL INNER TO THE FLANGE FACE AS APPLICABLE.
7. ALL REINFORCEMENT PADS SHALL BE PROVIDED WITH 6MM TELLTALE HOLE.
8. NOZZLE AND FLANGE DETAILS SHALL BE AS PER IS803
9. ALL BOLT HOLES SHALL STRADDLE VERTICAL CENTERLINES ON SHELL AND RADIAL CENTERLINES ON ROOF.
10. ALL PROTRUSIONS, SHARP EDGES AND SPATTER, ETC. SHALL BE REMOVED FROM THE SURFACE AND ALL WELDS GROUND SMOOTH WITHOUT ANY CAVITIES AND IMPERFECTION BEFORE LINING.
11. HYDRO TEST SHALL BE AS PER IS803. LINING SHALL BE CARRIED-OUT AFTER HYDRO TEST.
12. ALL LONGITUDINAL JOINTS SHALL BE STAGGERED.
13. BOTTOM PLATE SHALL UNIFORMLY REST ON THE FOUNDATION.
14. THE MINIMUM SIZE OF WELD SHALL BE EQUAL TO THE THICKNESS OF THINNER MEMBER JOINT UNLESS SPECIFIED OTHERWISE.
15. EARTHING LUG AND NAME PLATE SHALL BE WELDED TO THE TANK BODY AT SITE TO SUIT SITE REQUIREMENT.
16. REFER DRG NO:PYDE2M162840705 FOR LOADING DETAILS.
17. THE THICKNESS OF TANK IS CALCULATED AS PER IS 803
18. ALL ERECTION CLEATS,LUGS,ETC. TEMPORARY ATTACHMENTS SHALL BE REMOVED BEFORE HYDROTEST.
19. INSPECTION & TESTING SHALL BE AS PER APPROVED QAP.
20. PAINTING SHALL BE AS PER APPROVED PAINTING SCHEME FOR STORAGE TANKS Doc No. PY-AZ-4-M162-8442-01

HOLD POINTS:

** AGITATOR SHOWN ARE INDICATIVE ANS SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

*** NOZZLE LOCATION & ORIENTATION SHOWN IN DRAWING ARE INDICATIVE AND THE SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS		
S.NO.	DRAWING/DOCUMENT	DRG.DOC NO.
1.	PROCESS P&ID OF WASTE WATER STORAGE SYSTEM	3-FW-000-01635
2.	FOUNDATION INPUT OF WASTE WATER STORAGE TANK	PYDE2M162840705
3.	DESIGN CALCULATIONS FOR WASTE WATER STORAGE TANK	PYCD1M162840705
4.	FGD- SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS(SLURRY & WATER)	4-FW-000-01072
5.	PLOT PLAN FOR FGD SYSTEM	PY-DG-0-M162-1252-01
6.	PAINTING SYSTEM FOR FGD STORAGE TANKS	PY-AZ-4-M162-8442-01

REVISION REASON: IFI/ IFA/ IFD/ IFC/ CANC		
REV.	DATE	ALTERED V SAMPATH
01	06.08.21	CHD/APPD M.S.S. NAGESH
ZONE		REVISED IN-LINE WITH CUSTOMER COMMENTS RECEIVED.

(CUSTOMER NO'S: G515 & G516

PROJECT:	NTPL 2x500 MW PROJECTS AT TUTICORN (FGD PACKAGE)
CUSTOMER:	NLC TAMILNADU POWER LTD (NTPL), TUTICORN
PMC CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SAMPATH KUMAR.V		14.06.2021	−N.A.−
CHD.	K.N.B. REDDY		14.06.2021	
APPD.	M.S.S NAGESH		14.06.2021	

DEPT. PE&SD CODE 450	UNTOL. DIMS. GR. C/M/F	SCALE NTS	WEIGHT (KG) −N.A.−	REF. TO ASSY. DRG. −N.A.−	ITEM NO. −N.A.−	NO.OF ITEMS −N.A.−

TITLE GENERAL ARRANGEMENT OF WASTE WATER STORAGE TANK(CAP: 164M3)

CARD CODE

DRAWING NO. PY-D-G-1-M162-8407-05 REV. 01

SHT. No 1 NO. OF SHT. 1

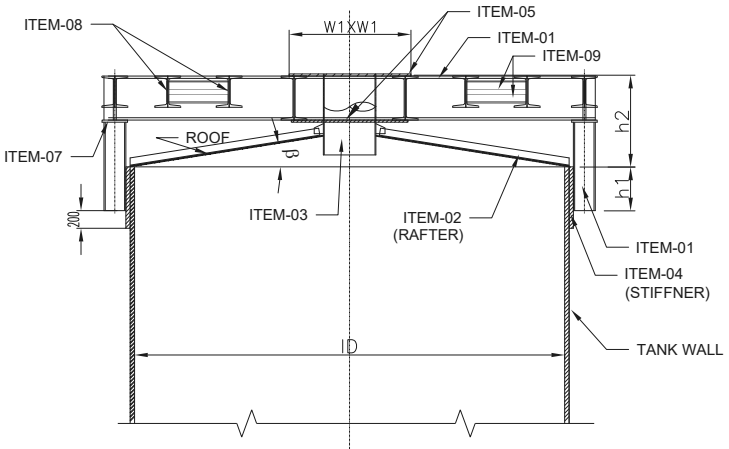
COMPUTER FILE NAME XXXXXXXXXX-SXX-RXX.DWG

ANNEXURE-1C:AGITATOR SUPPORT DETAILS (TYPICAL)

REV: 00
DATE: 01.10.2019
SHEET: 01/01

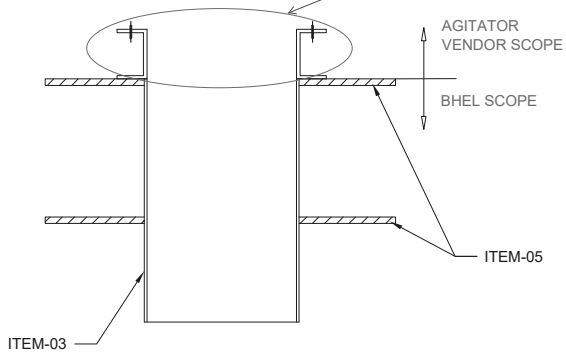
TYPICAL AGITATOR SUPPORT IN TANK

PGMA: FW721

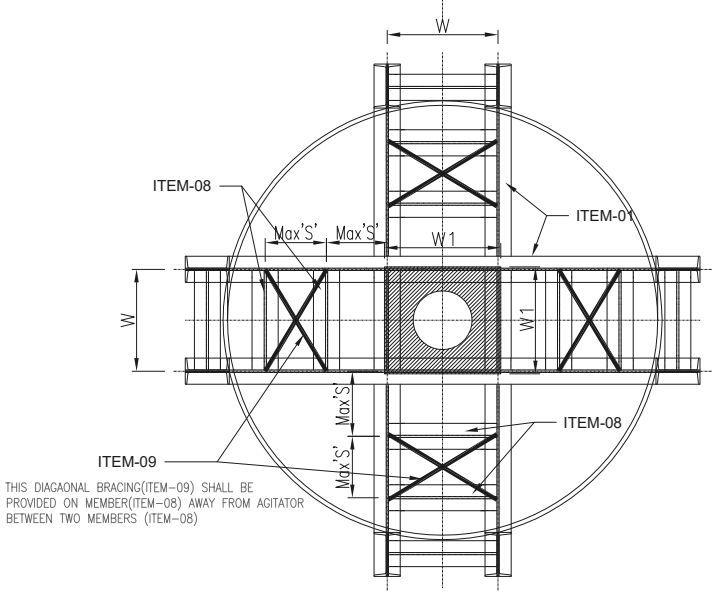


NOTE : ALL MATERIAL SHALL BE MILD STEEL (IS2062)

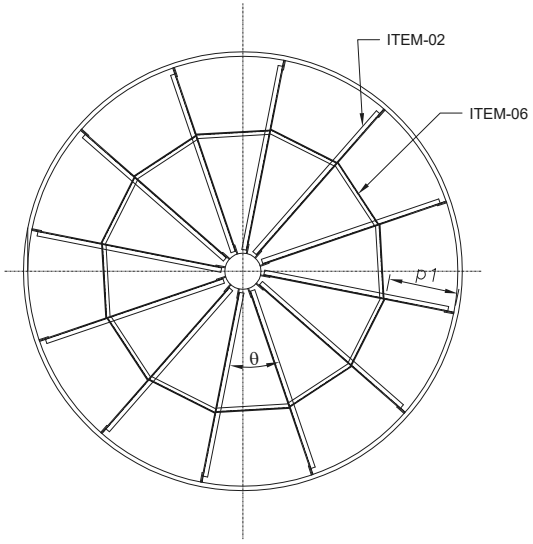
Top Entry Agitators :
Reg. Mating Flange for supporting on Slurry Tank Roof / Surface. Channel is not required.Bidder can offer plate as per dimension (W1) mentioned in this sketch. More details, if any, can be discussed post order stage



AGITATOR MOUNTING PLATFORM



AGITATOR SUPPORT DETAILS



ROOF STIFFENER DETAILS

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

Sl. No	Tank - ID	h1	h2*	p1	S**	W & B	W1	Item-1	Item-2	Item-3		Item-4	Item-5	Item-6	Item-7	Item-8	Item-9	θ	β
										Desc.	Height (Ht)	Height xWidthxThk.							
1	UPTO 3000	650	650	NA	NA	600	650	UB-305	MC100	ERW323.9X4.0	700	850x565x10	PL32	NA	PL20	UB203	NA	60°	5°
2	3001 to 6000	1000	1000	1000	2000	600	650	UB-406	MC150	ERW323.9X4.0	950	1150x578x10	PL32	MC75	PL20	UB203	NA	45°	5°
3	6001 to 9000	1200	1200	1500	1800	800	850	NPB-500	MC250	ERW323.9X4.0	1000	1400x600x10	PL32	MC75	PL20	UB305	ISA75X75X8	45°	5°
4	9001 to 13000	1700	1700	2000	1500	1000	1050	NPB-600	MC400	ERW508X4.8	1350	1700x620x10	PL40	MC75	PL25	UB305	ISA75X75X8	20°	5°
5	13001 to 16000	1900	1900	2000	1200	1200	1250	NPB-600	MC400	ERW508X4.8	1400	2100x620x10	PL45	MC75	PL32	UB406	ISA75X75X8	20°	5°

ANNEXURE – 2

PRICE BID FORMAT

ANNEXURE 2-I								Rev01
	BHARAT HEAVY ELECTRICALS LIMITED **PROJECT ENGINEERING & SYSTEMS DIVISION** **RAMACHANDRAPURAM: HYDERABAD - 502 032**							
	PRICE FORMAT (Rev00) FOR VERTICAL/TOP ENTRY AGITATORS ASSEMBLY							
PROJECT	**FGD system for 2x500 MW Project at Tuticorin, Tamil Nadu**							
CUSTOMER	**NLC Tamilnadu Power Ltd. (NTPL), Tuticorin**							
CONSULTANT	**DEVELOPMENT CONSULTANTS PVT. LTD (DCPL)**							
Bidder's Name : <Bidder to indicate>								
Bidder's Offer No. & Dt. : <Bidder to indicate>								
Bidder's Ref No. & Dt. :<Bidder to indicate>								
BHEL Enq. No. & date :<Bidder to indicate>								
Sl.No.	**Item Description**	**Material Code**	**Qty.**	**Unit**	**Weightage w.r.t Overall Price (In %)**	**Bidder's confirmation (Quoted/ Not Quoted)**	**HSN / SAC Code**	**GST (%)**
I	**MAIN OFFER**							
A	**MATERIAL SUPPLY: TOP ENTRY AGITATORS**							
	Complete Agitator with all accessories including Commissioning Spares, Special Tools & Tackles as per specification, for agitators listed below:							
1	Lime Stone Slurry Storage Tank Agitator	PY9751844010	2	Set	17.74%			
2	Primary Hydro Cyclone feed Tank Agitator	PY9751844037	1	Set	4.99%			
3	Secondary waste water Hydro Cyclone feed Tank Agitator	PY9751844053	1	Set	7.98%			
4	Filtrater water Tank Agitator	PY9751844070	1	Set	2.49%			
5	Waste Water Tank Agitator	PY9751844096	1	Set	4.99%			
6	Agitator for Absorber Area Drain Sump	PY9751844118	2	Set	4.99%			
7	Agitator for Gypsum Area Drain Sump	PY9751844126	1	Set	2.49%			
8	Agitator for Limestone Slurry Area Drain Sump	PY9751844134	1	Set	2.49%			
B	**MANDATORY SPARES FOR AGITATORS**						**Rev-01**	
1	**Lime Stone Slurry Storage Tank Agitator**	PY9751844029	**Refer Note-18**					
a	**For Agitator :**				**14.40%**			
i)	Impeller Assembly		1 No. each type & Size					
ii)	Bearings		**2 Sets of each type & Size**					
iii)	Shaft Assembly		1 SET for each type & Size					
iv)	Shaft Seal		1 SET for each type & Size					
v)	Gear Box, if applicable		1 No. each type & Size					
vi)	Complete Agitator Assembly		**1 No. each type & Size**					
b	**For Motor :**		**Refer Note-18**					
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher					
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor					
iii)	Heaters, if applicable		2 sets for each type and rating of motor					
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets					
v)	Cooling Fan for all type and rating of LT motors		1 Set					
vi)	Dust seals and gaskets for each type of motors		1 Set					
vii)	Motor Terminal Block		1 set for each type and rating of Motor					
viii)	Complete Set of Coupling		1 set for each type and rating					
2	**Primary Hydro Cyclone feed Tank Agitator**	**PY9751844045**	**Refer Note-18**					
a	**For Agitator :**							
i)	Impeller Assembly		1 No. each type & Size					
ii)	Bearings		**2 Sets of each type & Size**					
iii)	Shaft Assembly		1 SET for each type & Size					
iv)	Shaft Seal		1 SET for each type & Size					
v)	Gear Box.		1 No. each type & Size					
vi)	Complete Agitator Assembly		**1 No. each type & Size**					

b	**For Motor :**	Refer Note-17	**Refer Note-18**					
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher					
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor					
iii)	Heaters, if applicable		2 sets for each type and rating of motor	**8.09%**				
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets					
v)	Cooling Fan for all type and rating of LT motors		1 Set					
vi)	Dust seals and gaskets for each type of motors		1 Set					
vii)	Motor Terminal Block		1 set for each type and rating of Motor					
viii)	Complete Set of Coupling		1 set for each type and rating					
3	**Secondary Hydro Cyclone feed Tank Agitator**	**PY9751844061**	**Refer Note-18**					
a	**For Agitator :**							
i)	Impeller Assembly		1 No. each type & Size					
ii)	Bearings		**2 Sets of each type & Size**					
iii)	Shaft Assembly		1 SET for each type & Size					
iv)	Shaft Seal		1 SET for each type & Size					
v)	Gear Box.		1 No. each type & Size					
vi)	Complete Agitator Assembly		**1 No. each type & Size**					
b	**For Motor :**		**Refer Note-18**					
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher					
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor					
iii)	Heaters, if applicable		2 sets for each type and rating of motor	12.78%				
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets					
v)	Cooling Fan for all type and rating of LT motors		1 Set					
vi)	Dust seals and gaskets for each type of motors		1 Set					
vii)	Motor Terminal Block		1 set for each type and rating of Motor					
viii)	Complete Set of Coupling		1 set for each type and rating					
4	**Filtrater water Tank Agitator**	**PY9751844088**	**Refer Note-18**					
a	**For Agitator :**							
i)	Impeller Assembly		1 No. each type & Size					
ii)	Bearings		**2 Sets of each type & Size**					
iii)	Shaft Assembly		1 SET for each type & Size					
iv)	Shaft Seal		1 SET for each type & Size					
v)	Gear Box.		1 No. each type & Size					
vi)	Complete Agitator Assembly		**1 No. each type & Size**					
b	**For Motor :**		**Refer Note-18**					
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher					
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor					
iii)	Heaters, if applicable		2 sets for each type and rating of motor	4.07%				
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets					
v)	Cooling Fan for all type and rating of LT motors		1 Set					
vi)	Dust seals and gaskets for each type of motors		1 Set					
vii)	Motor Terminal Block		1 set for each type and rating of Motor					
viii)	Complete Set of Coupling		1 set for each type and rating					
5	**Waste Water Tank Agitator**	**PY9751844100**	**Refer Note-18**					
a	**For Agitator :**							
i)	Impeller Assembly		1 No. each type & Size					
ii)	Bearings		**2 Sets of each type & Size**					
iii)	Shaft Assembly		1 SET for each type & Size					
iv)	Shaft Seal		1 SET for each type & Size					
v)	Gear Box.		1 No. each type & Size					
vi)	Complete Agitator Assembly		**1 No. each type & Size**					

b	**For Motor :**		**Refer Note-18**				
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher				
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor				
iii)	Heaters, if applicable		2 sets for each type and rating of motor	8.10%			
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets				
v)	Cooling Fan for all type and rating of LT motors		1 Set				
vi)	Dust seals and gaskets for each type of motors		1 Set				
vii)	Motor Terminal Block		1 set for each type and rating of Motor				
viii)	Complete Set of Coupling		1 set for each type and rating				
6	**Agitator for Absorber Area Drain Sump / Limestone Slurry Area Drain Sump / Gypsum Area Drain Sump**	**PY9751844142**	**Refer Note-18**				
a	**For Agitator :**						
i)	Impeller Assembly		1 No. each type & Size				
ii)	Bearings		**2 Sets of each type & Size**				
iii)	Shaft Assembly		1 SET for each type & Size				
iv)	Shaft Seal		1 SET for each type & Size				
v)	Gear Box.		1 No. each type & Size				
vi)	Complete Agitator Assembly		**1 No. each type & Size**				
b	**For Motor :**		**Refer Note-18**				
i)	Motor of each type and rating		10% qty. or Minimum 1 No. whichever be higher				
ii)	End Shield Cover Driving & Non-Driving End		1 set for each type and rating of Motor				
iii)	Heaters, if applicable		2 sets for each type and rating of motor	4.00%			
iv)	Bearings (DE and NDE) for each type and rating of motor		2 sets				
v)	Cooling Fan for all type and rating of LT motors		1 Set				
vi)	Dust seals and gaskets for each type of motors		1 Set				
vii)	Motor Terminal Block		1 set for each type and rating of Motor				
viii)	Complete Set of Coupling		1 set for each type and rating				
C	**SUPERVISION OF ERECTION & COMMISSIONING OF ALL TOP ENTRY AGITATORS**	**PY9751844150**					
1	Supervision of erection & commissioning (including trial operation), comprehensive training the end customer's Personnel covering the all aspects of Agitators - Operation & Maintenance, Troubleshooting etc, it shall include the following: 1. Per diem charge of for the above towards offered Agitator Assembly and its assocaited accessories. 2. Charges for 1 visit Note: The above shall also include all other expenses like boarding, lodging, local travel, insurance, travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer. [Refer Note 11]		10 Mandays and 1 Visit	0.40%			
	Grand total price for Sl.No. A to C (Inclusive of Packing & Forwarding, Freight and Insurance)			100.00%			

Packing & Forwarding, Frieght, Insurance and GST :				
(I) For Supply:				
(i)	Packing & Forwarding :		In bidder's scope	Included in basic price
(ii)	Frieght:		In bidder's scope	Included in basic price
(iii)	Insurance:		In BHEL's scope	--
(iv)	GST		Extra at actuals	Extra at actuals
(v)	Any other:		shall be included in basic price	Included in basic price
(II) For supervision of E&C:				
(i)	GST		Extra at actuals	Extra at actuals
(ii)	Any other:		shall be included in basic price	Included in basic price

Notes:	
1	Bidders should quote the Total Bid Value in both in figures & words in the specified place.
2	Bidders should mention the applicable HSN/SAC code along with GST% against respective line items.
3	Bidders shall NOT fill/edit/modify anything else in the Price Bid Format.

4	The rates of line items mentioned in the Price Format shall be derived by BHEL by multiplying the Total Bid Value quoted by the Bidder with the Weightage Factor assigned against respective line items. The rate of each item shall be rounded off to the next 1 (one) Indian paise.
5	The Total Bid Value quoted by the Bidder shall represent the total landed cost for this enquiry and shall include Packing & Forwarding Charges, Freight and all applicable taxes and duties, other than GST. GST shall be paid extra by BHEL at applicable rates.
6	Evaluation shall be done on the basis of total bid value (Grand Total Price as above) i.e. the total landed cost to BHEL for this enquiry.
7	**The bidders will also provide UN-PRICED PRICE FORMAT strictly in the BHEL price format given above, in the techno commercial part of their offers. BID WILL BE REJECTED IF ANY OTHER PRICE FORMAT IS USED. Both priced and un-priced price formats to be provided by the bidders shall be signed and stamped copies.**
8	Bidder to quote strictly as per BHEL's NIT requirements.
9	Bidder to note that this is a LUMP SUM Turn-Key Order. However (a) Changes to the tender specification during execution of the project for successful operation of the system need to be carried out by bidder and commercial implications if any will be settled suitably. (b) Unit rates quoted by bidder shall be applicable for any changes in BOQ during detailed engineering stage.
10	**Main offer (Annexure-2B-I)** consists of those items which will be part of main order after successful bidder is identified. **Optional Items (Annexure-2B-II)** consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under **Main offer and Optional items** as per the prescribed format.
11	Prices quoted by bidders for items under main offer : Sl. No.I(A+B+C) will be considered for evaluation of lowest bidder. For the purpose of tender evaluation (L1 bidder evaluation) following shall be noted: Referring to Sl.No.C- Supervision charges for E&C of supplied equipment / system, for the purpose of Quotation, total no of 10 man-days (94.2% of price quoted against Sl.No.C) will be covered in 1 visit (5.8% of price quoted against Sl.No.C) have been considered and payment against Sl.No.C above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates. Purchase Order for supply of main items, (A to B) shall be placed by BHEL- PE&SD Hyderabad. For Supervisionof E&C, LOI shall be placed by PE&SD and PO By BHEL-Power sector region. However, BHEL reserves the right (a) To include any of the optional items in scope of supply (as per customer contract requirements) and accordingly consider the same in evaluation. Any such scope increase and change in evalution will be intimated to vendor during technical evaluation (before price bid opening). (b) To place PO for any of the Optional items within the contract period. Hence bidders need to MANDATORILY QUOTE reasonable prices for all OPTIONAL ITEMS considering such requirement and keep the validity of the prices till the end of contract period.
12	a) For all items including Optional items, prices to be furnished in this prescribed price bid format only for each individual item. The price to be quoted against Sl.No. A to C shall be Weighed w.r.t Overall Price as mentioned above. No combined prices, common prices or any other format will be accepted and such bids may be liable for rejection. b) Bidder must NOT change the indicated item description, quantity & units in the price bid format. Bidder should only fill the unit rates & total price. c) Bidder to quote for ALL the items as per price bid format. Incomplete/partial offer may be liable for rejection.
13	a.) Commissioning spares are those spares which are required at the time of commissioning and shall be recommended (as per bidder's experience) and quoted by bidder. However commissioning spares indicated in the price bid format shall be quoted as minimum. b) Commissioning spare consumed over and above the recommended commisioning spares, during commissioning shall be supplied free of cost by the equipment vendor.
14	**With respect to Mandatory Spares,** A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced. B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.
15	Reference document: **PY51844, R00 & annexures.**
16	Unpriced price bid format indicating as "Quoted" against each applicable item shall be submitted duly signed & stamped along with technical offer by bidder as a token of concurrence that prices are submitted in this format only. The offer shall be liable for rejection in case if un-priced price bid format is not submitted or any modification is carried out in price bid format.
17	**In case the systems are being supplied from outside India** reputed Third Party Inspection as mentioned in BHEL Tender Specification has to be considered and the charges should be included in the Main offer. For those bidders who are supplying from India, such third party inspection charges need not be considered and same will be arranged by BHEL/BHEL nominated inspection agency.
18	**(i) In case, Agitator or Spare of any agitator is identical to the other agitator within this enquiry, the quantity of spares shall be estimated as defined above on the overall quantity of this enquiry and items not necessarily be quoted for each & every of these identical spare items.** **<u>For Eg.:</u> Impeller qty. is defined as "1 No. each type & Size", which means in case if impeller assembly is identical for 2 or more agitators, then it is adequate to consider only "1 No. of each type & size" in the scope of bidder and not necessarily 2 Nos. or more numbers of impeller assemblies.** **(ii) In case, Motor or Motor's Spare of any agitator is identical to the other agitator within this enquiry, the quantity of spares shall be estimated as defined above on the overall quantity of this enquiry and items not necessarily be quoted for each & every of these identical spare items. It is mentioned in Cl.No.8.0, Page 8 of 25, Doc. No.PY51844 in our NIT.**

ANNEXURE 2-II

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING & SYSTEMS DIVISION
RAMACHANDRAPURAM: HYDERABAD - 502 032

PRICE FORMAT (Rev00) FOR AGITATORS ASSEMBLY

PROJECT	**FGD system for 2x500 MW Project at Tuticorin, Tamil Nadu**
CUSTOMER	**NLC Tamilnadu Power Ltd. (NTPL), Tuticorin**
CONSULTA	**DEVELOPMENT CONSULTANTS PVT. LTD (DCPL)**
Bidder's Name : <Bidder to indicate>	
Bidder's Offer No. & Dt. : <Bidder to indicate>	
Bidder's Ref No. & Dt. :<Bidder to indicate>	
BHEL Enq. No. & date :<Bidder to indicate>	

Sl.No.	Item Description	Qty.	Unit	HSN / SAC Code	GST (%)	Bidder's confirmation (Quoted/ Not Quoted)							
I	**OPTIONAL ITEMS**												
A	**RECOMMENDED SPARES**												
1	Recommended spares list for **THREE YEARS** normal operation along with unit price breakup for Agiatator Assembly and other accessories. **(List with price break up to be enclosed)** (1 set stands for quantity required for the replacement required for 1 No. of each type of offered Agitator Assembly (and) accessories)	1	Set										
B	**OPTIONAL SPARES FOR AGITATORS :**												
						Lime Stone Slurry Storage Tank Agitator	**Primary Hydro Cyclone feed Tank Agitator**	**Secondary waste water Hydro Cyclone feed Tank Agitator**	**Filtrater water Tank Agitator**	**Waste Water Tank Agitator**	**Agitator for Absorber Area Drain Sump**	**Agitator for Gypsum Area Drain Sump**	**Agitator for Limestone Slurry Area Drain Sump**
B.1	**For Agitator**												
i)	Belt and Pulley (If applicable)	1 No. of Each type											
ii)	Coupling	1 No. of Each type											
B.2	**For Gear Box**												
i)	Bearings	1 Set for each type and size											
ii)	Oil seal for gear box	2 Sets											
iii)	Worm/Pinion for gear box	1 No. of each size											
iv)	Bolts for gear coupling	1 Set for each size											
v)	Complete gear box assembly	1 No. of each type & rating											

ANNEXURE – 3

CHECKLIST

ANNEXURE- 3
CHECKLIST FOR OFFER OF AGITATORS

S.No.	Description	Bidder's Confirmation
1.	**Material of Construction:** Bidder to note that **All Agitator parts and accessories** (incl. Blades, Impellers, fasteners etc) coming in contact with the stirred fluid / vapour, shall be of ***stainless steel*** **(Alloy 926 or superior)** ***or Nickel alloy suitable to the service condition*** and **Shaft (complete portion inside the tank including its flanges, fasteners etc) shall** ***be Stainless steel (ie., Alloy 926 or superior) or Nickel alloy suitable to the service condition.*** The MOC of Shaft (other than above, i. e., portion outside the Tank, not coming in contact with either stirred fluid or vapour) : Carbon Steel (A106GrB / AISI 1045) or superior	
2.	Bidder to confirm that the following documents are submitted along with their offer to enable BHEL to evaluate the offer. a) Reference project details / documents meeting the Pre-Qualification Criteria/ Equipment qualification criteria / PTR [as specified in Annexure: 8] b) Duly filled-in Datasheets of offered Agitators [Annexure: 1] c) Preliminary GA Drawings having complete details such as Foundation details, Civil load details, Dimensions etc. d) Copy of Un-priced BHEL Price Bid format [Annexure: 2] indicating "Quoted" /"Not Quoted" against each row & column. e) Duly filled-in Checklist [Annexure:3] f) Deviation list indicating "No Deviation" [Annexure: 11] (Refer Note-1 also) g) Duly filled-in "Performance Guarantee Schedule Format" (Annexure-13) h) List of Commissioning Spares & Mandatory Spares offered i) Agitator Motor Sizing Calculations (Annexure-14) j) Catalogues / Brochures of the offered models of the Agitators	

3.	Bidder to confirm that Annexure: 11 indicating as "NO DEVIATION" is submitted along with their offer. Any specific deviations due to design constraints and OEM limitations, which are impractical to meet, shall be raised in form of pre-bid queries only as per prescribed format. before submission of Techno Commercial offer. Any deviation/ queries raised during technical bid submission shall not be entertained	
4.	Bidder to confirm that Un-priced Price Bid Format as per Annexure-2 submitted with the technical offer, **indicating "Quoted" / "Not Quoted" against each row & column** and also highlighting not applicable items clearly.	
5.	Bidder to confirm that the scope of supply, services, Technical features, Design & construction, MOC and Performance requirement of all the Agitator parts & accessories are as per BHEL tender Specification & Amendments (if any) only. Bidder to Confirm.	
6.	Bidder to confirm that the offered Agitator shall meet Performance guarantee criteria as mentioned in BHEL Tender Specification.	
7.	Further, any document, drawings etc indicating scope of supply submitted by bidders shall not be considered / reviewed by purchaser. If there are any specific clarification / additional / alternative information & features requiring notice / confirmation of purchase, the same shall be specifically brought to the notice of purchaser as Pre-bid query, before submission of bid. **Bidder to note that Datasheets in formats other than Annexure-1 shall NOT be reviewed by Purchaser.**	
8.	Painting schedule shall be as per Technical specification. Bidder to Confirm.	
9.	Inspection, Testing requirements shall be as per BHEL specification requirements and BHEL QAP enclosed with the specification only. However, in case of any practical difficulties in meeting these quality requirements, same shall be mutually discussed & agreed during detail engineering stage. Bidder to note & confirm.	
10.	Cost incurred in Appointment of TPI shall be borne by bidder only in case of agitator **sourced from outside India.** (More details can be referred in Technical specification) For those bidders, who are supplying from India, such third party inspection / witness charges need **not** be considered in bidder's price and same will be arranged by BHEL/ BHEL nominated inspection agency. Bidder to confirm.	
11.	Make of all the items shall be as per Technical specification and Sub-Vendor List enclosed as Annexure. Bidder to confirm.	
12.	Bidder to confirm compliance with Master Document List enclosed with Tender Specification, w.r.t list of documents, schedule of submission.	
13.	Bidder to confirm that the Motor rating / Gearbox Rating is selected is duly taking care of all the margins as specified in BHEL tender specification.	

14.	Bidder to provide suitable Power and Space heater (if applicable) cable gland and lugs for motor. Cable details shall be furnished by Purchaser during detail engineering stage. Bidder to confirm.	
15.	Bidder to confirm that suitable canopy for each motor is considered in Bidder's scope.	
16.	Bidder to furnish list of commissioning spares as per OEM recommendation. Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Deviation in this is not acceptable. Bidder to Confirm.	
17.	Bidder to furnish list of special tools & tackles required for the offered Agitators. All these special tools and tackles are included in bidder's scope of supply. Bidder to Confirm.	
18.	Bidder to furnish list of 3 years recommended spares as per OEM recommendation. Bidder to quote for the same in the price bid as **"Optional price"**. Bidder to Confirm.	
19.	Bidder to quote individual price for each item mentioned in the seal priced bid. Bidder to check and confirm.	
20.	Bidder to confirm that the defect liability/ warranty requirement as per BHEL tender Specification shall be met by bidder.	
21.	Bidder to confirm that the training shall be provided to Customer's personnel after supply of Material at site, as per tender specification.	

SIGNATURE & DATE:
NAME:
DESIGNATION:
COMPANY:

PROJECT ENGINEERING & SYSTEMS DIVISION

Std. / Doc. Number	
PY51844	
Rev. No.	00

ANNEXURE – 4

OWNER's SPECIFICATION

5.21.00	**Agitators**	Agitators tech requirements

5.21.04 The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal, impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.

5.21.05 The agitators shall be capable of agitating limestone slurry and solid from time to time to prevent settlement of the slurry in the tanks. Protective devices shall be provided to prevent over loading of the agitators in case of increased slurry specially during start-up. The agitator must be able to mix up the contents of the tanks even after 24 hours operation break.

5.21.06 For horizontally mounted agitators, pressurized shaft sealing and shaft supports shall be provided. Seal water leakage shall be collected and piped to a drain.

5.21.07 It shall be possible to remove the sealing devices of the Agitators of the absorber vessel from outside without having to drain the absorber.

5.21.08 To prevent mechanical blocking and load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.

5.21.09

5.21.10 All exposed moving parts shall be covered by guards.

5.21.11

5.21.12 In order to avoid excessive wear, impeller tip speed must not exceed 12 m/s.

Excerpts from Vol.II-B of NTPL Specifications
Page 28 of 84

ee) . For the agitators a flushing system for start-ups shall be provided.

Page 45 of 84

8.01.08 Agitators:

i) Rubber lining shall be tested for hardness and spark test

ii) Impellers shall be tested for dimensional and balancing check

iii) Gear Boxes shall be tested for run test as per standard practice

5.25.00 **Motors**

5. 25.01 Motors rated up to and including 160kW shall be connected to 415V, 50Hz AC supply. Motors rated above 160kW up to and including 750kW shall be connected to 3.3KV, 50Hz supply. Motors rated above 750kW shall be connected to 11kV, 50Hz supply.

5. 25.02 All LT motors of S1 duty cycle shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively. For crane motors S4 duty with 40% cyclic duration factor shall be considered. Motors operating through variable frequency drives shall be suitable for inverter duty.

5. 25.03 The motor name-plate rating at 50°C shall have at least 15% margin for HT & LT system over the input power requirement of the driven equipment at rated duty point and also covering the 10% margin on maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

5. 25.04 All motors shall have Class F insulation with temperature rise limited to Class-

VOLUME: II-F

A.C. & D.C. MOTORS

1.00.00SCOPE

1.01.0 This specification covers the general requirements of the electric motors for Limestone based flue gas de-sulphurisation system.

1.02.00Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

1.04.00 Recommended spare parts for three (3) years operation in addition to mandatory spares

2.00.00CODES & STANDARDS

2.01.00All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and materials conforming to any other standard, which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.00.00SERVICE CONDITIONS

3.01.00The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00**A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water

cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method for class F insulation.

4.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity.

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively.

4.01.05 The motor name plate rating at 50^0C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 **AC motor for VFD application**

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS- 60034 part 17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage

boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VSD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D.C. Motors (If applicable)**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 600% of full load current (subject to IS tolerance of 20%) for HT motors rated upto 1000kW. For HT motors above 1000kW upto 3000kW starting current shall not exceed 600% of full load current without any positive tolerance. For HT motors above 3000kW starting current shall not exceed 450% of full load current without any positive tolerance.

For LT motors the starting current shall be as per the limit mentioned in the relevant standard with IE-3 efficiency class. For D.C. Motors the starting current shall be limited to 2 times full load current.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors (except mill motors) shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals Mill motors shall start with rated load and accelerate to full speed with 85% of rated voltage.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cold Motor Starting

Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(b) Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(c) Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 **Stress During Bus Transfer**

5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 For motors with starting time up to 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted

on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 **Enclosure**

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

Motors, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.03.00 **Cooling**

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.04.00 **Winding and Insulation**

6.04.01 All insulated winding shall be of copper.

6.04.02 HT and LT motors shall have Class F insulation with winding temperature limited to 120°C. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.05.00 **Tropical Protection**

6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.05.02 All fittings and hardwares shall be corrosion resistant.

6.06.00 **Bearings**

6.06.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.06.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.07.00 **Noise & Vibration**

6.07.01 The noise level shall not exceed 85 db (A) at 1.0 meters from the motor.

6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.

6.08.00 **Motor Terminal Box**

6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.

6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg., unless otherwise approved.

6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.

6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (415V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.08.10 The gland plate for single core cable shall be non-magnetic type.

6.08.11 Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.

6.09.00 **Grounding**

6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	25 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire

6.09.03 The cable terminal box shall have a separate grounding pad.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection (IP No.).

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0 deg.C.

Leads of all duplex or simplex type motor winding RTDs and motor bearing RTDs shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDs shall be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Loose three (3) numbers matching PS class CT shall be supplied for mounting on switchgear.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00**Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the dispatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of 11 kV & 3.3 kV motor:

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

SPARES

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

09.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

09.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

09.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

i) Efficiency curves.

j) List of motors.

k) Test reports

ANNEXURE – A

DESIGN DATA

1.0 SERVICE CONDITIONS

Refer Vol-IIA of Specification for FGD package.

2.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000V, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm. for 3sec	Motors above 750kW
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm for 3sec	Motors above 160kW up to & including 750kW
L.T. Supply	415V, 3Ø, 3W, 50 Hz, effectively earthed. Fault level 50kA symm for 1sec	Motors above 200W upto 160 kW
	240V, 1Ø, 2W, 50 Hz, effectively earthed.	Motors less than 200W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed. Fault level 25*kA for 1sec	D.C. alarm, control & protective devices

* Indicative only; actual value shall be decided by the Bidder, after substantiating the same by calculation.

3.0 RANGE OF VARIATION

A.C. Supply

Voltage: ± 10% Frequency: ± 5%

Combined Volt & frequency: 10%(absolute sum)

D.C. Supply

Voltage: (+10% to -15%)

PROJECT ENGINEERING & SYSTEMS DIVISION

Std. / Doc. Number	
PY51844	
Rev. No.	00

ANNEXURE – 5

PAINTING REQUIREMENTS

VOLUME : II-A

SECTION - V

PROTECTIVE COATING AND PAINTING

CONTENTS

VOLUME : II-A

SECTION-V

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Flue Gas Desulphurisation Plant package.

1.02.00 The bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The bidder shall follow relevant Indian and international standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

a)	SSPC SP 10 / NACE 2 / SA 2½	:	Near white blast cleaning
B)	SSPC PA 2	:	Measurement of dry film coating thickness with magnetic gauges.
c)	ASTM D 45	:	Method for pull off strength using portable adhesion tester.
d)	NACE RP 0274 – 2004	:	High-voltage electrical inspection of pipeline coatings.
e)	NACE SP 0188 – 2006	:	Discontinuity (holiday) testing of new protective coatings on conductive substrates.
f)	NACE RP 0169 – 2002	:	Control of external corrosion of underground or submerged metallic piping systems.

g)	AWWA C 210 – 2007	:	Liquid-epoxy coating systems for the interior and exterior of steel water pipelines.
h)	IS 3589:2001 Annexure-b	:	Steel pipes for water and sewage specification.
i)	AWWA C 222-2000	:	Polyurethane coating for the interior and exterior of steel water pipe and fittings.
j)	IS 13213 : 2000	:	Polyurethane full gloss enamel (two pack)
k)	ISC HD 20 (11902)	:	Polyurethane coating for interior and exterior of steel pipe and fittings.
l)	ISC HD 20 (11055)	:	Solvent less liquid epoxy system by application of interior and exterior surface of steel pipeline.
m)	IS 10221	:	Coating and wrapping for buried piping

3.00.00 GENERAL REQUIREMENTS

3.01.00 The bidder shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to owner/consultant for approval.

3.02.00 The bidder shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that manufacturing quality plan (MQP) and field quality plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.03.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.04.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.05.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.06.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a purchaser approved method shall be adopted.

3.07.00 The colour scheme of the entire FGD Plant equipment and auxiliaries area, covered under this specification shall be approved by the purchaser in advance before application.

3.08.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by purchaser.

3.09.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.

3.10.00 For vessels / tanks requiring lining and anti-corrosive painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.11.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.12.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.13.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.14.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.15.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.16.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 SURFACE PREPARATION

4.01.00 Most metallic articles that are usually given protective coatings are heavily contaminated and require, at least, some cleaning treatment before the coating is applied. The importance of surface preparation cannot be over emphasized as many investigations have shown convincingly that the performance and durability of any protective coatings are, to a large extent governed by the thoroughness of surface preparation. Often they concluded

that careful cleaning and preparation of the surface were more important than the quality of the protective coating.

4.02.00 Surface contamination in the form of rust, scale, oil grease and dirt is often obvious. Invisible contamination may also be present and represents, on the whole, a greater hazard. Examples of the latter are soldering fluxes, perspiration in the form of hand marks, chlorides from marine atmosphere and sulfite from industrial atmosphere.

4.03.00 The following table gives a surface preparation specification in the descending order of Effectiveness:

Sl. No.	Methods of cleaning	Specifications NACE/SSPC
1.	White metal blast	NACE # 1, SSPC SP 5-63
2.	Near –white metal blast	NACE # 2, SSPC SP 10-63
4.	Acid Pickling	SSPC SP 8-63
5.	Brush Blast	NACE # 4, SSPC SP 7-63
6.	Flame Clean and Power Sanding	SSPC SP 4-63
7.	Power Tool Cleaning	SSPC SP 3-63
8.	Chip and Hand Wire Brush	SSPC SP 2-63
9.	Solvent Wipe	SSPC SP 1-63

4.04.00 The following table gives the Specifications for sand / shot / grit blasting

Sl. No.	Methods of Cleaning	Specification
1.	NACE # 1	White sand blast
2.	NACE # 2	Near-white sand blast
3.	NACE # 3	Commercial blast
4.	Pickle, phosphate treated	
5.	NACE # 1	Grit
6.	NACE # 1	Shot
7.	NACE # 4	Brush blast
8.	No surface preparation	

4.05.00 Inspection of blasted steel surface

For the purpose of inspecting the blasted steel surface with sand abrasive, the respective “Visual standards” shall be utilized.

The standards used in industry to describe surface preparation are:

i. National association of Corrosion Engineers (NACE)
ii. Steel Structural Painting Council (SSPC)
iii. Swedish Pictorial Standards

White metal blast (SSPC 5-63, NACE No.1, and SA-3)

This is defined as removing all rust, scale, paint etc. to a clean white metal which has a uniform Grey white appearance. Streaks and stains of rust or

other contaminants are not allowed.

Near white metal (SSPC 10-63, NACE No.2, SA – 2.5)

This provides a surface of about 95% as clean as white metal. Light shades and streaks are not allowed.

Commercial blast (SSPC 6-63, NACE No.3, SA –2)

This type of blast is more difficult to describe. It essentially amounts to about 2/3 of a white metal blast, which allows for very slight residues of rust and paint in the form of staining.

Brush of blast (SSPC 7-63, NACE No.4 SA-1)

This preparation calls for removal of loose rust, paint, scales, etc. Tightly adherent paint, rust and scale is permitted to remain.

4.06.00 Pictorial Standards of different surface preparation to be adopted

During surface preparation operations, the surface condition obtained shall be compared with pictorial standards available for getting the specified condition. These pictorial standards are available in steel structural painting Manual (Vol. 1), "Good painting practice ", visual standards of surface cleaning sp 7,6,10 and 5 are described in page No.185 and 186 viz. Fig 9,11,12 and 13.Surface profile gauge and surface compactor could be used to check surface conditions according to NACE standard TM 01 70 of NACE.

4.07.00 PRESSURIZED WATER CLEANING METHODS

These standards provides requirements for the use of high and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream. These standards define four levels of working pressure:

SSPC-SP WJ-1/NACE WJ-1:	Water-jet cleaning of metals. Clean to bare substrate.
SSPC-SP WJ-2/NACE WJ-2:	Water-jet cleaning of metals. Very thorough cleaning.
SSPC-SPWJ-3/NACEWJ-3:	Water-jet cleaning of metals. Thorough cleaning.
SSPC-SP WJ-4/NACE WJ-4:	Water-jet cleaning of metals. Light cleaning.

This cleaning standard defines 4 levels of cleanliness for visible contamination by water jetting and 3 levels for non-visible contamination, such as chlorides and other soluble salts. See the full standard for complete definitions on the level of cleanliness.

4.08.00 SPECIFICATIONS FOR COPPER SLAG BLASTING:

1. The surface shall be cleaned of all dust and heavier layers of rust by copper slag blasting the entire internal surface to photographic standard SIS: 055900- 1967.

2. The consumption rate of copper slag is 1.6 Kg/Sqm of the blasted area. This has to be ensured strictly.

3. All tools, equipment, base material, hand and power tools for cleaning, including scaffolding material, copper slag blasting equipment, air compressor, etc. shall be arranged by the contractor at site in sufficient quantity.

4. The compressor used shall be of size enough to produce displacement of 5.6 to 7.0 Cum/Min of air at a pressure of 7 Kg/sq.cm. Standard blasting equipment, hoppers, hoses nozzles and attachments shall be used to obtain best test results and to maintain safety standards. The rate of cleaning shall be about 15 sq.mt. per hour at a pressure of 7 kg/sq.cm.

5. The abrasive used shall be of the physical properties as mentioned below and shall be free from oil, loan and mud etc.

6. The blast cleaned surface shall be blasted with dry compressed air before applying primer. This should be done even if the surface appears very clean and white in colour. The white colour may be due to deposition of silicon and reflection of light on the surface.

7. Proper earthing and bonding arrangements shall be made to prevent any damage by sparks produced by static electricity. Bonding shall be done between tank and blast nozzles and hopper and air compressor also. The bonding conductor should not be less than 16 SWG single strand copper cable.

8. The time gap between blast cleaning and application of primer shall not be more than THREE hours. Blast cleaning work shall, commence from top to bottom.

9. The blast cleaning operation shall be carried out keeping the nozzle at an angle of 30 degree to the vertical in order to prevent rebounding abrasive from showing down the abrasives emerging from nozzle and from under cutting the material to be removed.

10. A blast cleaning, the percentage of bare metal obtained shall be between 95% to standards of SA 2 ½ of the Swedish standard referred above. (Pictora) surface preparation standards for painting steel surfaces).

11. Arrangements for inspection of various stages of the job shall be made available by the Contractor so that the entire sand blasted area is available for inspection. Any defective work noticed shall be immediately rectified and even reblasting shall be done if necessary.

5.00.00 PAINT APPLICATION

The coating is a unique product. It is only after application on the substrate a coating becomes valuable and useful. The manufacturer shall produce high performance liquid coatings, yet the product usefulness lies in the hands of the applicator. That is the reason why stress is given for proper and careful application as a key to the success of any coating. Protection by coating mainly depends upon three factors

a) The material
b) The surface preparation
c) The application

If any one of the three is weak, protection value is affected to that extent.

High performance coatings are especially sensitive to misapplication and may fail drastically. Therefore, it is imperative that the instruction for application be followed explicitly, particularly when applying sensitive and expensive high performance coating systems.

The purpose of coating application is to develop a continuous highly adherent film with an even thickness over the substrate. To achieve this, various factors have to be considered such as type of coatings and weather conditions, application methods etc. It is advisable to avoid painting below 10^0C and above 40^0C, if the relative humidity is above 80%, during the rainy weather and wind velocity is above 24km/hr or else freezing will occur before the paint dries.

5.01.00 Application methods

There are a number of methods by which coatings can be applied. The two principal methods are by brush and spray. The other methods are paint pad applications, electrostatic spray, electro-coating, dipping and fluidized bed technique. The latter methods are primarily for in-plant application.

The choice of application methods depends on a number of factors. The first is the type of coating. Most of the oil-based coatings can be easily applied by brush but it is the slowest process. Spray application is the fastest for large flat surfaces. The type of surface is also a factor. For small and intricate areas, brushing is probably the best method. If the surface is used and pitted, application of the first coat by brushing is probably the best method.

Brushing can be done in almost all areas, since the liquid coating is transferred from the brush to the surface. Spraying however, causes problem with toxic solvents as well as a possible fire hazard due to fume build up.

Spraying in small, enclosed areas are usually not suggested. Clean up is also a factor. Cleaning a brush is the least difficult procedure and cleanup of spray equipment is the most time consuming and most complicated procedure.

5.02.00 Storing and handling of paints

Coating materials (paint) as they are packed at the manufacturing plant are thoroughly dispersed, with the pigments fully suspended and of a uniform consistency in terms of both texture and colour. Unfortunately, very few coatings are applied within a short time after manufacture. They may be placed in inventory at the manufacturing plant or sent to a distribution point where they will be held for a period of time. Also, the coating material may be purchased several months before its actual use and again under different conditions. Thus, coatings generally must be remixed and properly re-dispersed prior to actual application.

A pigment, which is usually heavier than the vehicle, tends to settle and may even cake at the bottom of the container. Coatings vary to a wide degree in this particular characteristic. Some may stay suspended for many years; others settle out hard at the bottom of the container. This is a defect. Paints, which gelled in the container or in which the pigment liveried (i.e. become thick and rubbery) are not satisfactory for use and cannot be practically redispersed. The formulation has to contain proper antisettling additive to avoid this defect.

The purpose of remixing and re-dispersion is to make the coating completely homogeneous, so that upon application the pigment and vehicle can produce the film that was intended by the manufacturer. In certain cases, particularly in oil-type vehicles, there may be skin on the surface of the liquid. These should be removed before re-dispersion, since they will not get redispersed into the vehicle.

5.03.00 Mixing

The mixing process is not practically easy, even if the system has not settled hard. This is often neglected by applicators, particularly in coatings, which have settled rather solidly. There have been examples of coatings that were applied with at least half of the pigment remaining at the bottom of the container un-dispersed and later thrown away with the container. This procedure does not allow for the maximum performance of coating properties and normally leads to rapid coating failure.

Mechanical mixing

It is always better to use a mechanical mixer of some type, since mechanical mixing always produces a more uniform coating and does so much more rapidly than manual mixing. Manual mixing should only be done under unavoidable circumstances and only in containers with the maximum of a 20-liter capacity.

Even when the coating has settled rather hard, the propeller-type agitator can break it up and re-disperse it to a point, which is closely equivalent to its original form. Nevertheless, care should be taken in the mixing operation, particularly to ensure that the material at the bottom and lower sides of the container has been well separated from the container and re-dispersed. Some materials form soft sediment, which clings to both the sides of the container and the bottom, making it necessary to scrape these off before they can be properly dispersed. This is usually done by manual operation. The mixing should be done in such a manner that splashing is avoided.

The speed of a mechanical mixer should be as low as possible in order to obtain the re-dispersion of the pigment in the vehicle. The coating should have a slight vortex at the surface. A large vortex tends to mix air into the coating, which can cause pinholes and air bubbles during application.

Manual mixing

If the manual mixing is necessary, the liquid portion of the coating should be separated into a clean container. The lower, thicker part of the coating can then be more readily mixed into a heavy paste, including the material, which is clinging to the sides of the container. Once the heavier material is mixed into a smooth paste, the remainder of the liquid from the second container can be remixed into the original container with the heavy material, making sure that the two are thoroughly mixed into a uniform coating. One way to do this is to pour the material back and forth between the two containers. This is called boxing. The materials should be poured back and forth several times to assure complete uniform mixing.

5.04.00 Two component coatings

In the case of two component coatings, there are two materials that must be checked to determine whether or not they are properly dispersed prior to being mixed together. Two component coatings are extremely common at the present time. They include numerous kinds of epoxy coatings, coal tar epoxy coatings, polyurethane coatings, and inorganic zinc coatings. With two component coatings, it is essential that the two components be separately and thoroughly mixed. Two component materials are designed to react chemically, so that if they are not thoroughly mixed, the chemical reaction may not take place properly. Mechanical blending of the two components is recommended to obtain a thoroughly mixed product. The two component materials often are in different colours so that a satisfactory mixing can be readily identified. The fully mixed coating should have a uniform colour and consistency.

5.05.00 Mixing dry powder and liquid

The primary example of mixing dry powder and liquid components is in the use of inorganic zinc coatings. In-organic zinc coatings are made from liquid component and dry powdered zinc. The first step is to determine whether or not the liquid component is thoroughly mixed and dispersed to a completely

homogeneous liquid. This usually is not difficult since most liquid components are lightly pigmented.

Second, stir the total contents of the powder slowly into the total content of the liquid until it becomes a well dispersed, free flowing material. In the case of inorganic zinc coatings, the manufacturers supply the liquid and the powder in two different containers in the exact amount that should be mixed. It is essential that the total powder and total liquid be used in order to obtain the desired final coating. Mixing small portions of zinc and liquid is not recommended, since correct proportions are seldom measured under field conditions.

5.06.00 Straining

Most coatings are thoroughly strained prior to being placed in their container. When the container is opened, if the contents have not settled to a hard deposit in the bottom, straining in the field may not be necessary. On the other hand, if the pigment has settled hard, if the coating has a skin on the surface, or if the product is a material such as inorganic zinc, straining is recommended. Straining prior to spraying often eliminates considerable downtime due to gun clogging by small particles those blocks the orifice in the gun.

Straining can be done with a fine fly screen with a mesh size 150µm or through nylon stocking. Nylon stocking does not contain any lint and is a very fine mesh that most coating materials can readily pass through. Mosquito netting or similar materials also are used, although they often contain some lint, which can cause problems.

5.07.00 Compatibility of different paints

While applying multicoated system of paint it is always desirable to have a first-hand knowledge of compatibility of different coating systems with one another. A general view of such information is given in the following table. This is only a general view.

Primer	Oleo resinous	Alkyd	Silicone alkyd	Vinyl	Chlorinated rubber	Epoxy (2 pack)	Urethane
Oleoresins	C	C	C	NR	NR	NR	NR
Alkyd	C	C	C	NR	NR	NR	NR
Silicone alkyd	C	C	C	NR	NR	NR	NR
Phenol resin	C	C	C	NR	NR	NR	NR
Vinyl	C	C	NR	C	C	C	NR
Chlorinated rubber	C	C	C	C	C	NR	NR
Epoxy	NR	NR	NR	C	C	C	C
Coal tar epoxy	NR	NR	NR	NR	NR	C	NR

Zinc-rich epoxy	NR	NR	NR	NR	C	C	NR
Inorganic zinc	NR	NR	NR	C	C	C	NR
Urethane	NR	NR	NR	NR	NR	NR	C

NOTE: C-Normally

NOTE: C-Normally compatible; NR- Not recommended due to known or suspected problems. Certain combinations marked "NR" may be used provided a suitable tie coat is applied.

6.00.00 INSPECTION

Inspection techniques shall be applied at various stages i.e. from purchase of coating materials to paint application and evaluation of performance during service. Inspection procedures at various stages before and after the application of coating systems over the oil installations have been described below:

6.01.00 Paint composition

The type of paint system shall be selected depending upon the environmental conditions. Generally primer, undercoat and finish coats are used in protective coating system. The purchased paint materials are used in protective coating system. The purchased paint materials shall be tested for the following properties to ascertain whether the supplied paint conforms to the specifications.

i. Type of film formers present
ii. Type of pigments present
iii. Thickness per coat
iv. Volume solids
v. Pigment volume concentration
vi. Area coverage per liter of the paint
vii. Specific gravity
viii. Drying time and
ix. Main pigment content in total pigmentation

It is the duty of the inspection engineer to get the paint system tested for the above factors. The painting operation shall be started only after the values obtained coincide with the required specification of the paint system.

It is essential to see that the surface is not wet during the application of the paint. Moreover paints should not be applied when the humidity of the environment is above 80%. The atmospheric temperature should not be below 10°C during the painting operation.

6.02.00 Procedure for testing paint samples

The following laboratory test procedures shall be adopted for the characterization of the film-formers, pigments and studying the properties of the paint.

a) Type of film-formers present

The film former shall be separated out of the paint by means of centrifuging. It is then to be analyzed using infrared spectroscopy for identifying the functional group. i.e. the type of film formers.

b) Type of pigments present

After separating the pigment from the paint and proper drying, it shall be subjected x-ray diffraction for identifying the pigment.

c) Thickness per coat

Magnetic thickness gauges are used to measure the thickness of the paint film applied over the iron-substrate. The thickness is measured in micrometer (µm). Some of the thickness gauges operating under magnetic principle are elecometer, posi test and micro test. Thickness gauges operating on eddy current principle are used to measure coating thickness over metals other than steel/magnetic substrates.

d) Volume solids

Paint is a mixture of three major components such as pigment, binder and thinner.

The pigment and film-former will remain in the paint film after the evaporation of the solvent. The pigment and film former together are called as solids. The volume of these together in the liquid paint is called as volume solids. This is determined as follows:

A known volume of the paint is taken. Let it be V1. Distilling the solvent and collecting it in a measuring cylinder determine the volume of the solvent present of the paint. Let it be V2. By subtracting V2 from V1, we can determine the volume solids.

e) Pigment volume concentration (PVC)

Pigment volume concentration is defined as

$$PVC = \frac{\text{Volume of pigment}}{\text{Volume of pigment + Volume of binder}} \times 100$$

By separating out the pigment and binder form the paint and knowing their specific gravity, we can calculate PVC.

f) Area coverage per liter of the paint

This is determined by taking a known volume of the paint and applying it over a surface. The area covered by the known volume of the paint is determined. From this value, area covered by one liter of the paint is calculated.

g) Specific gravity

For determining specific gravity, a cup of known volume is taken. The difference in weight of the cup filled with paint and the empty cup gives the weight of paint of known volume. From this, we can calculate specific gravity.

h) Drying time

i) Touch Dry

In this case, if the coated surface is touched with finger, no finger mark should be found on the coating.

ii) Hard Dry
It is the condition of coating drying very hard. Unless the coating itself is damaged with force, no pressure could mar the coating in this condition. This condition is attained usually after seven days.

i) Flow properties (viscosity) of the paint (Ford cup method)

Ford cup is the mostly used instrument for studying the flow properties of the paint. Ford cups having different orifice sizes are available in the market. The varying orifice sizes are meant for measuring the flow time of different viscosities. Generally, the most viscous liquids require bigger orifice. The results are reported simply as seconds per cup. Number

6.03.00 Spot testing procedures

The following spot tests will be useful to identify the binders (film-formers) qualitatively before application at the site.

a) EPOXY RESIN

i) Filter paper test

This test can be carried out even with paint itself. 0.5 gms of paint part (binder part) / binder is taken in a 100 ml beaker and treated with 1ml concentrated sulfuric acid. The beaker is slightly heated at 60^{o}C for a few minutes. It is again mixed with 5ml of conc.H_2SO_4 until the colour intensity is similar to that of very dilute potassium-di-chromate solution. A drop of the solution is taken in a glass rod and is spread over a filter paper. If Bis-phenol-A-type of epoxy resin is present, a purple colour develops in 1 minute, the colour eventually turns blue.

ii) Formaldehyde Test

Few drops of the sample is dissolved in 1 to 2 ml of concentrated sulphuric acid if necessary by heating to 40°C to 50°C. One to two drops of formaldehyde solution is added in to it. An orange colour, which on dilution with water turns violet to blue indicates the presence of epoxy resins.

b) Chlorinated rubber resin

Few milligrams of the sample is allowed to stand in pyridine at room temperature for few minutes. Few drops of methanolic potassium hydroxide solution is added in to it. If chlorinated rubber resin is present in the solution, a yellow precipitate is formed which gradually darkness to a yellow-brown colour.

c) Isocyanate hardener

The aliphatic nature of isocyanate is confirmed by the following spot test. A small sample of isocyanate hardener is heated in a test tube util white fumes are evolved and these fumes are absorbed on a filter paper. One drop of a solution of 4-nitrobenzene-di-azofluoroborate in methanol (1%) on the filter paper should give any coloration, confirms the presence of aliphatic isocyanate. If any coloration is seen on the filter paper, this will confirm the presence of aromatic isocyanate

The infrared spectra of the aliphatic isocyanate will show peaks at 1370 cm-1 and 2250-2350 cm-1.

Physical, Chemical and Instrumental methods of paint analysis with their relevant standards are given in the following tables.

i) Physical Tests

Paint property	IS Standard	ASTM
Preparation of panels	IS 101 PART1 – SEC3	D 609
Preparation of Tin panels	IS 101 PART1 – SEC3	D 609
Viscosity (KU)	IS 101 PART1 – SEC5	D 562
Weight per Gallon	IS 101 PART1 – SEC 7	D 1475
Fineness of Grind	IS 101 PART3 – SEC 5	D 1210
Water content	IS 101 PART2 –SEC 1	D 95
Coarse particles and skins		D 185
Drying times Set to touch Dry for recoating Dry hard	IS 101 PART3 – SEC 1 & 2	D 1640
Pigment content	IS 101 PART8 – SEC 2	D 2371
Vehicle content		D 2371
Non – volatile content	IS 101 PART2 – SEC2 & PART8 – SEC –2	D 2369
Adhesion	IS 101 PART5 – SEC2	D 3359
Brushing properties	IS 101 PART1 – SEC4	

Exposure tests of paints on metals		D 1014
Salt spray resistance	IS 101 PART6 – SEC1	B 117
Accelerated weathering	IS 101 PART6 – SEC5	D 822
Leafing		D 480
Flexibility	IS 101 PART5 –SEC	D 522

ii) Chemical Tests

PAINT PROPERTY	TEST METHOD (ASTM)
Chemical resistance	D 1308
Liquid dryers	D 564
Aluminum	D 480
Aluminum silicate	D 718
Calcium carbonate	D 34
Extenders in colors	D 126
Iron oxide	D 768, D 50
Leaded zinc oxide	D 34
Red lead	D 49
Water soluble salts	D 2448, D 2455
Zinc oxide	D 34
Zinc powder	D 521
Zinc sulfide	D 34

iii) Instrumental Tests

Paint property	Test method (ASTM)	Instrument
Dry Opacity	A 2805	Reflectometer
Gloss	D 523	Gloss meter
Color	D 2244	Colorimeter
Vehicle Identification	D 3168 D 3271	Infrared spectrophotometer Gas chromatograph
Solvent solids Identification	D 3271	Gas chromatograph
Vehicle solids Identification	D 2621	Infrared spectrophotometer

7.00.00 SPECIFICATION OF COATING SYSTEM

7.01.00 Protective coating for steel structures

Most commonly used coating system for atmospheric zone of blast cleaned steel structures are given below:

7.01.01 System-1

Coating system used for atmospheric open exposure zone is one coat of inorganic zinc-rich primer, one coat of epoxy-Glass flake filled intermediate coating and one coat of aliphatic polyurethane provides better performance in more aggressive services. The coating system for closed atmosphere is also the same system with the replacement of aliphatic urethane with aromatic polyurethane top coat. The surface preparation of this Zinc rich primer requires sand blasted surface or grid blasted surface to the Swedish Specification of Sa 2.5. The coating systems are to be applied by spray method. The specification of the system is as given below:

i. Specification of Inorganic zinc rich primer

Colour	Green Grey
Gloss Level	Matt
Volume Solids	63%
Typical Thickness (DFT)	70-80 microns
Theoretical Coverage	8.40 m²/litre
Method of Application	Airless Spray, Air Spray
Drying Time	One Hour
Volatile Organic Compound	216 g/ Litre
Mix Ratio	Liquid Binder Base part(A) 3: Powder Zinc component part (B)1
Working Pot Life	2-2.5 hours
Shelf Life	1 year

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8 - 9 m²/litre
Method of Application	Airless Spray, Air Spray
Guiding data for airless spray:	
Nozzle tip (inch/1000)	15-21

Pressure at nozzle (minimum)	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

iv. Specification for Aromatic Polyurethane top coat for closed zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.01.01 System-2

The surface preparation is not possible through blast cleaning, then the surface is cleaned with wire brushing or power tool cleaning and coated with two coats of non aluminium epoxy mastic followed by an aliphatic polyurethane coating is recommended.

i. Specification for non aluminium Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.
Full cure	7 days.
Shelf life	months (or as recommended by manufacturer

ii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.02.00 Protective coating system for Pipelines without Cathodic Protection

There are a number of factors to be considered for the selection of an external pipeline coating including physical and chemical stability of the coating in the pipeline environment, adhesion, and resistance to impact. The pipeline should be cleaned and prepare the surface for painting as follows:

The pipeline surface shall be cleaned. The main objective of surface preparation is to ensure that all contamination (rust, mill scale, etc.) is removed to reduce the possibility of initiating corrosion so that a surface profile is created that allows satisfactory adhesion of the paint to be applied. The surface of the pipe is cleaned with a wire brush or power tool cleaning to get the surface of Sa 2/St 3. Thus prepared surface to be cleaned with lint free cloth, which also includes cleaning & dewatering (in case of valve chamber) and drying the surface. After preparing the surface of the pipe for painting, the primer coat, undercoat and finish coat shall be applied. The coating system recommended for the pipeline is high build epoxy mastic coating as primer followed by an epoxy glass flake filled coating with the top coat of aliphatic polyurethane. The specifications of the systems are given below:

i. Specification for Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.

Full cure	7 days.
Shelf life	12 months (or as recommended by manufacturer

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.03.00 Protective coating for all other surfaces

The surface shall be cleaned with wire brushing or by power tools (St3). These structures will be protected by three layer system of Epoxy zinc rich primer followed by Glass Flake filled epoxy and aliphatic polyurethane finish coat. The specifications of the coating system are given below:

i. Specification for Epoxy Zinc rich primer

Colour	Grey
Finish	Matt
Type	Two pack
Application	By brush or spray

Pigment (Main)	Zinc dust (30-40% by wt. of the total pigments.)
Type of epoxy	Condensation product of bisphenol-A and Epoxide equivalent Epichlorohydrin with terminal Epoxide groups 450-500
Curing agent	Polyamide (amine value 210-230)
Dry film thickness/coat	50-60 µm
Volume solids	55±2% (volume)
Area coverage (theoretical)	11 to 14 sq.m/litre
Surface dry	2-3 hrs.
Hard dry	24 hrs.
Re-coatability	24 hours.
Full cure	5 days.
Shelf life	6 months under sealed conditions

ii. Specification for Epoxy glass flake paint

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100–110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Re-coatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for aliphatic Polyurethane top coat

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m^2/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.04.00 Summary of Specification of Coating System

The summary of the coating system shall be as mentioned below:

Area	Surface preparation	Recommended coating scheme
Directly exposed to Sunlight- Steel structures	Copper shot blasting to Sa2.5	Scheme I
	Power tool cleaning to St3	Scheme II
Indoor –Steel Structures	Copper shot blasting to Sa2.5	Scheme III
	Power tool cleaning to St3	Scheme IV
Pipelines (over ground)	Power tool cleaning to St3	Scheme V
All other surfaces	Wire brushing / Power tool cleaning to St3	Scheme VI

7.04.01 Scheme-I: For blast cleaned structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light Outdoor)	
Surface preparation	Copper slag blasting to Sa2.5	
Primer	Zinc ethyl silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.02 Scheme-II: For under prepared structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light (Outdoor)	
Surface preparation	Power tool cleaning St-3/Paint strippers	
Primer	Epoxy mastic(non aluminium)	100 – 110µm
Undercoat	Epoxy mastic(non aluminium)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		250 –280µm

7.04.03 Scheme- III: For blast cleaned structures and not exposed to sunlight

For new steel structures/Existing steel structures	Not exposed to sunlight (Indoor)	
Surface preparation	Blast Cleaning to Sa2.5	
Primer	Zinc Ethyl Silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.04 Scheme-IV: For under prepared structures and not exposed to sunlight

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy mastic	100 – 150µm
Under coat	Self-priming epoxy mastic	100-110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.05 Scheme- V: For pipelines (above ground)

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy	100 – 150µm
Under coat	Epoxy Glass flake (high build)	100-110 µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.06 Scheme-VI: Coating specifications for all other surfaces

Surface preparation	Power tool cleaning St-3/ Paint strippers	
Primer	Epoxy Zinc rich	50 – 60µm
Under coat	Epoxy glass flake	100-110µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200–230µm

8.00.00 TESTING REQUIREMENTS

8.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating: coating thickness shall be in the range of ±20% and as per SSPC PA 2.

8.01.01 Apparatus / instrument

The instrument used for dry film thickness may be type 1 pull of gauges or type 2 electronic gauges.

8.01.02 Procedures

a) Number of measurements

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness tolerance: individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

8.02.00 Electrical inspection (holiday) test

8.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

8.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

8.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing voltage $v=7900\sqrt{t}\pm10\%$ where t=the average coating thickness, mm.

8.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

8.03.00 Adhesion pull off test

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

8.03.01 Apparatus / instrument: adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “jaw” at the bottom and also dollies.

8.03.02 Prepare the test surface

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

8.03.03 Prepare dolly (test pull stub)

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

8.03.04 Select an adhesive

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

8.03.05 Attach the dolly to the surface

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to

displace any excessive adhesive.

d) Push the dolly inward against the surface, and then apply tape across the head of the dolly.

8.03.06 Adhesion test procedure

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum psi/mpa/kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum psi/mpa/kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) the force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

8.04.00 Coating repair

Defective coating shall be repaired in accordance with the following subsections.

8.04.01 Surface preparation

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

8.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

8.04.03 Coating application

The coating system shall be applied to the prepared areas in accordance with procedure.

8.04.04 Repair inspection:

Repaired portion shall be electrically inspected using a holiday detector.

8.05.00 Welded field joints

8.05.01 Preparation

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid epoxy / pu coating shall be feathered by abrading the coating surface for a distance of 25 mm.

8.05.02 Electrical inspection

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

9.00.00 INFORMATION / DATA REQUIRED

The bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. And also unit rates for application of each type of paint along with supply shall be furnished.

ANNEXURE-I
MARKET AVAILABLE COATING SYSTEMS AS PER SPECIFICATION

Sl.No.	Specification	ASIAN PAINTS	BOMBAY PAINTS GRAUER & WEIL Paints	BERGER PAINTS	GRAND POLYCOTS	International Protective Coatings	KRISHNA CONCHEM
1.	Zinc Ethyl Silicate Primer	Apcosil 605 ZS	Zinc–o-sil 75	Zinc Anode 304	GP Prime 402	InterZinc 22	-
2.	Epoxy Zinc rich Primer	Apcodur CP 686			GP Prime 205	Inter Zinc 42	
3.	Self Priming Epoxy Mastic Paints	Rust-O-Cap	Penthdur Mastic 5527	Berger protecto Mastic	GP Prime guard 235	Interplus 256	-
4.	Epoxy Glass Flake Paint	Apcodur EP glass Flake	Pentadur Glass Flake 3580	Epilux Super Build ST Glass Flake Coating	GP SUPERGUARD GLASS-FLAKE	Interzone 505	Karaikote 100 S
5.	Aliphatic Polyurethane Paint	Apcothane CP 674	Pentathane 4512 (M)	Polyurethane Coating	GP Bond 141	Interthane990	-
6..	Aromatic Polyurethane Paint	---	--	--	GP COAT 131	---	

7.	Moisture Compatible anti Corrosion system			Epilux Durebild WSE Coating			Karaikote-6545
8.	Epoxy red oxide primer	AP CODUR Epoxy polyamide primer					
9.	Epoxy MIO Under coat	AP CODUR Epoxy MIO Under coat					
10.	Epoxy TiO2 Under coat	AP CODUR Epoxy 420HS					

ANNEXURE – 6

PACKING & FORWARDING

DOMESTIC PACKING

COMMON GUIDELINES

1 GENERAL:

This standard lays down packing instructions for domestic packing of Components/Assemblies/Equipment to be despatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this product standard, must appear in the Shipping list/Packing List.

2 TYPES OF PACKING:

The following 5 types of packings have been standardized for packing of General Components/Assemblies.

1) '**OP**' - Open Type.
2) **'PP**' - Partially Packed.
3) '**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.
4) '**CQ**' - Case Packing - Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
5) '**CR**' - Case Packing - Electrical Components/Assemblies, which require special packing viz. Water Proof, Shock Proof etc...

3 DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

3.1 'OP' - Open Type

In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.

3.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film to Specification No.AA51420. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film

3.3 'CP' - Crate Packing

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

3.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of

silica gel to AA55619 or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420, wherever required.

3.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel to AA55619 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420 before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel to AA 55619.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board, meeting requirements of AA51414.

4 PREPARATION OF PACKING CASES

4.1 DOMESTIC:

Based on the availability, the wood shall be Rubber wood (Havea Brasiliensis)/Pine wood for packing of cubicles, loose items, spares and photovoltaic items meant for customers in India**.**

4.2 DIMENSIONS:

a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25 +2/-3 mm.

b) Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.

c) Minimum number of planks shall be used for a shook.

d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.

e) External sides of front and rear planks to be plained to facilitate writing of address and other markings.

f) Width of binding planks shall be minimum 100mm.

g) Distance between any 2 binding planks shall be less than 750mm.

h) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

i) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

j) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

4.3 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

4.4 TONGUE AND GROOVE JOINTS

Two Consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

4.5 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

4.6 CHEMICAL TREATMENTS FOR PRESERVATION OF WOOD

1) This treatment provides protection to the packing wood against deterioration due to fungi and attack by termites, borers and marine organism and any kind of infections.
2) The wooden planks, after making tongues / grooves shall be treated with chemicals. For pine wood, treatment with ASCU/ CCA solution need not be done.
3) The chemical used shall be ready mix ASCU paste. This consists of Arsenic pent oxide, copper sulphate sodium dichromate. This Paste shall be mixed at the rate of 1 kg of paste per 10 liters of water to the extent of water used. Alternate this CCA paste as mentioned at Para 4.6.5) can also be used.
4) The chemical treatment shall be done at the premises of the contractor. A cement concrete tank of capacity to hold a minimum of 2000liters of solution shall be constructed. The solution shall be prepared in the presence of BHEL Representative by contractor. The wooden planks shall be soaked in the solution for a minimum of 12 hours. The solution shall be replenished after treating a maximum of 12 cubic meters of wood. A log book shall be maintained by the contractor to give the details of date of preparation of solution, quantity of solution prepared, quantity of chemicals used, Quantity of wood treated and the details of replenishment. Samples of solutions before mixing will be tested at the laboratories designated by BHEL. The testing fees to be paid to the laboratories will have to be borne by the contractor. The paste shall be tested as and when required.
5) Specifications for water soluble type wood preservatives: Copper – Chromium – Arsenic [CCA]: Copper – Chromium – Arsenic preservative formulation shall be as per IS:10013 Part – II – 1981 shall consist of following active ingredients in nominal proportions by weight as shown below:

– Arsenic Pent oxide	AS2O52H2O	12.5
– Copper Sulphate	CuSO45H2O	37.5
– Sodium Dichromate	Na2Cr2O75H2O	50.0
– Or Potassium Dichromate	K2Cr2O7	

4.7 OTHER MATERIALS

4.7.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

4.7.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

4.7.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6 +0.01mm. The material shall be free from rust.

4.7.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

4.7.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

4.7.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

4.7.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

70GSM (Colourless) Multi Layered Cross Laminated Polythelene Film Specification No: AA51420 are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

4.7.8 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

4.7.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

4.7.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Details and specifications are given in Fig-4

4.7.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

4.7.12 SILICA GEL:

This shall be of indicating type to conform to IS: 3401/AA55619.

4.7.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME	PLACE-PINCODE
SILICA GEL	INDICATING TYPE
BLUE :	ACTIVE
ROSE :	REDUCED ACTIVITY
WHITE :	NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

4.7.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

4.7.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

4.7.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

4.7.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.7.18 Mechanical Latching clamps:

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

4.7.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

1. Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
6) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
7) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
8) Direction sticker " Front " & " Back " - 4 nos. Size 2.0Cm x 0.75Cm
9) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
10) "Fragile " sticker: 2 Nos Size. 2.1Cm x 1.5Cm
11) "DO NOT STACK " sticker - 2 Nos. Size 3.0Cm x 2.2Cm

5 PACKING OF CUBICLES WITH RUBBER WOOD:

5.1 The packing is to be done as per clause 4 in all respects.

5.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

5.3 The cubicles will be of different sizes both widthwise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm.The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more**.**

5.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7) using blue nails (as per 4.7.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.7.7).

5.5 SILICA GEL:

Silica gel (as per 4.3.15) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.7.13).

5.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

5.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

5.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 4.7.8) with distance between consecutive layers less than 500mm.

5.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 4.7.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 4.7.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 4.7.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:

One no. (As per 4.7.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

5.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

5.14 PACKING OF CUBICLES WITH PINE WOOD

Packing of cubicles for export shall be done exactly in same manner as described at Cl.No 5 except for the following changes: -

Wood shall be Silver oak/ Pine wood instead of rubber wood.

– Double polyethylene petticoat instead of one.

– Fumigation may have to be done if required (BHEL Scope).

6 PACKING OF LOOSE ITEMS/SPARES USING RUBBER WOOD:

1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
2) Wood shall be rubber wood with Tongue and Groove joint as per clause 4.4.
3) Chemical treatment as per Clause 4.6 to be done.
4) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
5) External surface of planks on front and rear shall be plane 100% (except bottom plank).
6) Inner surfaces of all 6 sides shall be lined with bitumen coated hessian polyethylene Kraft paper (as per clause 4.7.7) using blue nails.
7) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
8) Internal packing: Items that go into the box shall be packed using 70GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No: AA51420. Any space left Between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect .
9) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.

10) Silica gel as per clause 4.7.12 held in cotton bags as per clause 4.7.13 shall be kept at proper places in the box.

11) Packing slip kept in polyethylene bag (clause 4.7.16) shall be placed in the box.

12) Marking plate as per clause 4.7.10 shall be nailed to side of the box.

13) Two numbers of hoop iron strips as per clause 4.7.3 shall be strapped tightly on the case using clips.

14) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.

15) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.

- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

7.2 BOX SIZES

Table 2 – VALVES WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1A	320X250X260	10	
1	320X250X430	15	
2	430X370X430	25	
3	670X670X470	65	
4	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
10	1300X770X1050	155	
11	2500X850X800	225	
12	2000X1500X1200	305	
14	1850X1050X1250	260	
15	2000X800X800	180	
17	2600X1500X1600	470	
21	250X250X600	20	
22	250X250X880	30	
23	300X300X700	25	
24	380X380X880	45	
25		25	
26	510X510X1400	60	
27	570X570X1400	80	
28	575X575X1875	105	
29	3600X1100X1100	390	
30	900X500X800	110	
52	2000X950X740	225	
53	1600X1120X700	220	
54	2500X2000X1200	490	
55	2900X1900X1400	525	
56	3000X1000X900	370	
57	3200X2200X950	450	
58	2150X1100X750	325	
61	2000X2000X700	130	
62	700X1200X1325	130	

TYPICAL PATTERN OF WOODEN BOX

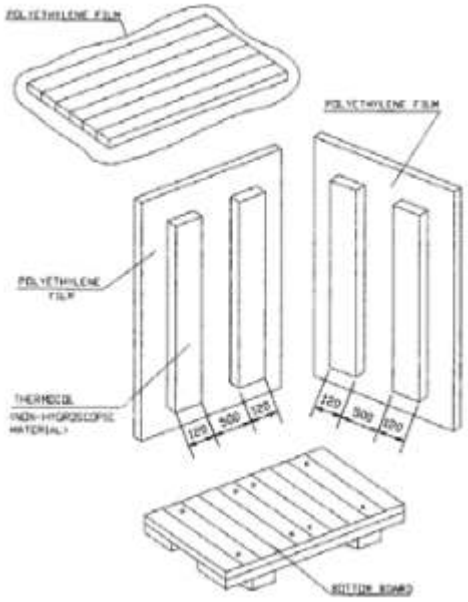


Figure 1

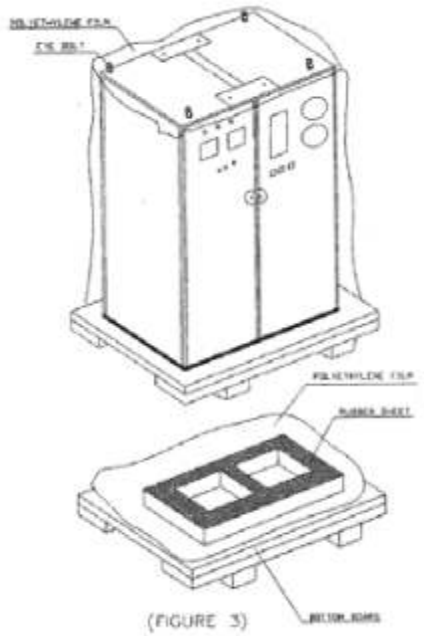


Figure 2

7.3 STANDARD BOX SIZES

WOODEN BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
01	I	2370	1570	1650	675	4000
02	IIA	1570	720	885	200	2500
03	II	1200	900	600	150	2000
04	III	900	600	600	100	1000
05	IV	600	450	450	40	750
06	V	600	300	300	35	500

STEEL BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
07	I	2480	1680	1500	339	4500
08	II	1200	900	600	061	2000
09	IIB	1800	850	950	115	2500
10	III	900	600	600	029	1000
11	IV	600	450	500	019	750
12	V	400	350	300	011	500

Table 3

7.4 STEEL CONTAINERS

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies. The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections.

a) Following precautions are to be taken during packing: -

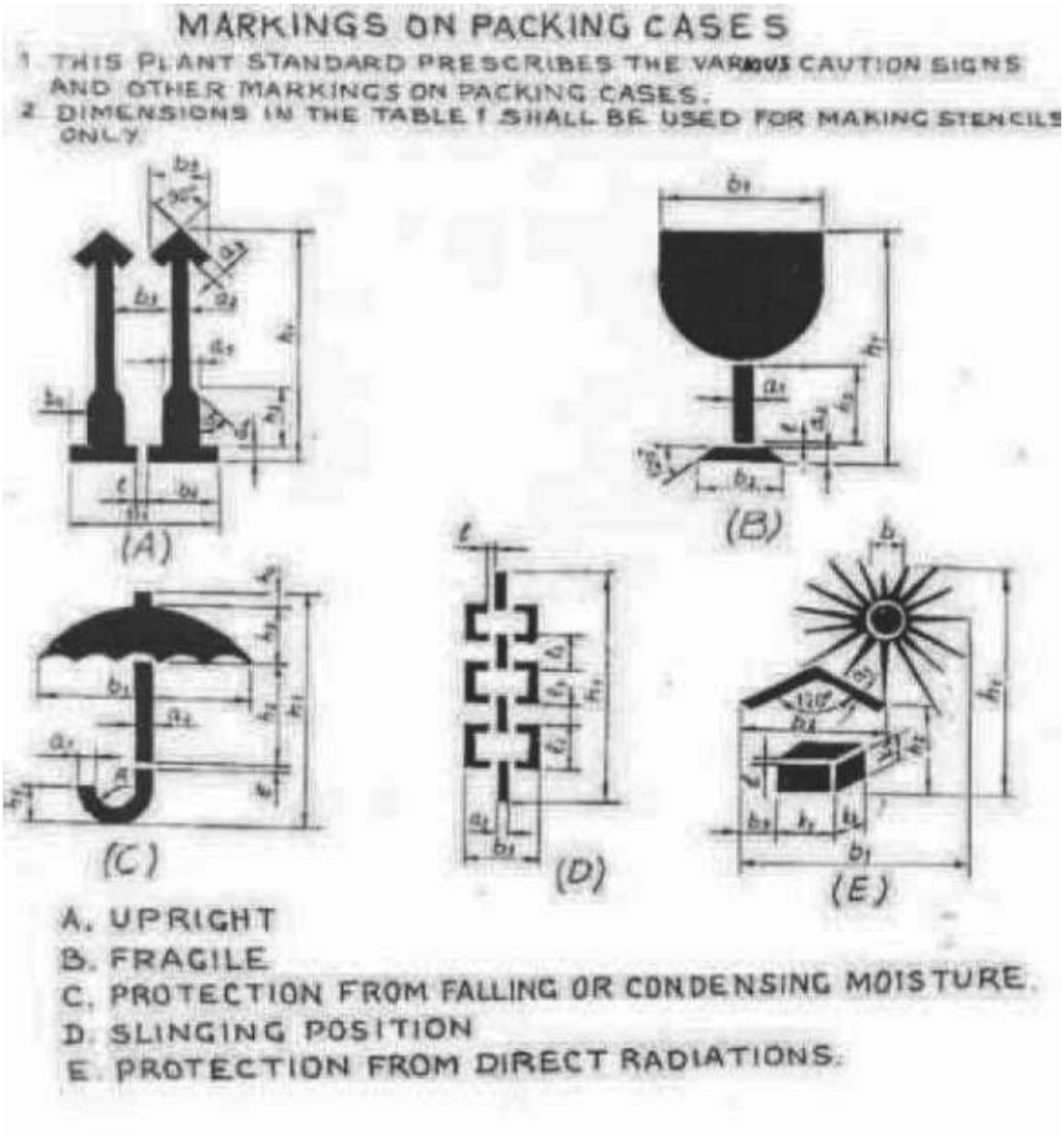
b) Put the machine in the steel container properly,

c) Cover the machine with polythene.

d) To arrest the movement in the steel container necessary wooden Blocks/Battons may be put.

e) Put cover on steel, container and Bolt Properly

8 MARKINGS/STENCILINGS



Center of Gravity

Figure 3

CORPORATE STANDARD

DESIGN-ATION		DIMENSION IN MM																						
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel(AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

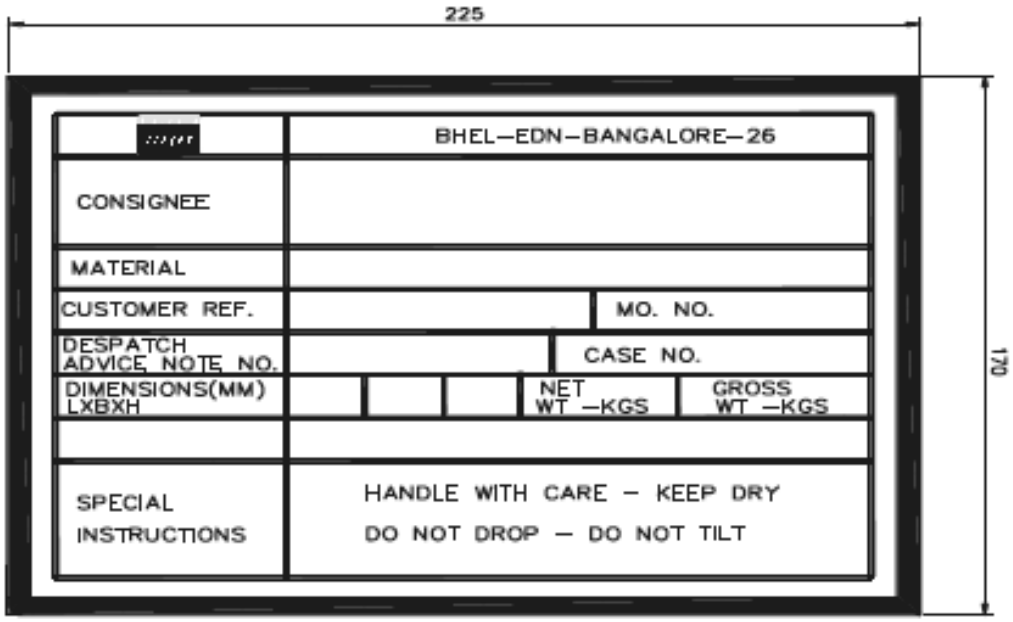


Figure 4 – TYPICAL MARKING PLATE

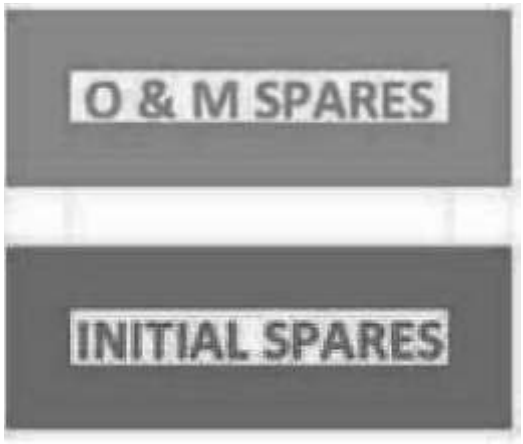


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

9 RECYCLING OF INCOMING WOODEN PACKING CASES

OBJECTIVES

– To utilize useable wood of incoming packing cases, for manufacturing of new packing boxes.
– To recycle incoming wooden packing cases, as such, wherever possible.

1) All incoming wooden packing cases received from suppliers /customers will be opened carefully, with the intention of reusing them, by Shop.
2) After carefully taking out the contents, the empty wooden packing cases will be shifted by Shop to the specified locations i.e. bin / nearly spaces, already earmarked in stores.
3) Material shifting contractor engaged by store, will collect all such wooden packing cases and scrap wood from specified points, on a regular basis.
4) After collecting / loading the empty packing cases/ scrap wood, contractor will take thecarrier first to weighment bridge for weighment, thereafter, he will go to Carpentry, where Carpentry representative will identify the packing cases which can be used by Carpentry for manufacturing of New Packing Boxes. All such identified packing boxes will be unloaded and handed over to Carpentry by contractor.
5) These packing boxes will be made re-useable after necessary rectification and additional work.
6) Contractor will again take the carrier for weighment and this second reading will also berecorded on the same “Weighment Slip”.
7) Weight of empty packing cases / scrap wood taken will be calculated on thebasis of 1st and 2nd weighment readings recorded on the “Weighment Slip”. A copy of“Weighment Slip” (where both the weighment readings are recorded) will be given by the contractor to the carpentry representative. Based on this “Weighment Slip”, carpentry will maintain a register in which details of quantity received will be recorded.
8) All “Weighment Slips” will invariably be signed by carpentry representative (even when no boxes have been unloaded by carpentry). Store will accept the scrap wood only if “Weighment Slips” are signed by carpentry representative.
9) Balance empty packing cases / scrap wood will be handed over by contractor to Store, for storing in scrap yard.
10) A separate area in Scrap yard will be provided, for executing the work of de-nailingof wooden packing cases, under supervision of carpentry.
11) Carpentry contractor will identify packing cases / scrap wood for denailing, which will behanded over to him by Store, at Scrap yard, for denailing and further operation.
12) Quality and Carpentry will jointly inspect the wood generated by de-nailing process and will prepare “INSPECTION CUM RECEIPT REPORT OF USEABLE WOOD RECEIVED FROM TPS –STORE BY CARPENTRY”.
13) After acceptance of the wood by Quality and Carpentry, the same will be shifted to carpentry for receipt and its record will be maintained by carpentry.
14) This will be a Permanent Productivity Project executed by carpentry. “Productivity Savings “duly verified at the current Purchase Order rate of wood, will be sent every month to Resource Management Department, for highlighting it in their monthly progress report.

10 STANDARD METHOD OF PACKING

Table 5 –

STANDARD METHOD OF PACKING

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSUE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							

STANDARD METHOD OF PACKING

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
BOILERS								

CORPORATE STANDARD

BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM

ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

11 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

11.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

11.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

11.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.

11.4 For critical items, where specified, special handling fixtures shall be used for lifting.

11.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

11.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

11.7 Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden pallets.

11.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

a) The markings showing the upright position.

b) The markings showing the sling position

c) Markings showing the fragile contents.

d) Other required markings as per Cl.no:08

11.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

11.8.2 Handling and lifting should be done without jerks or impacts.

11.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

11.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

11.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

11.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

12 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

12.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

Well Bed Length:	10000mm
Over Gooseneck:	13000mm
Width:	3000mm
Carrying Capacity:	40MT

2. LOW BED TRAILERS (LB 16):

Well Bed Length:	12000mm
Over Gooseneck:	16000mm
Width:	3000mm
Carrying Capacity:	75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
(for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.

The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

12.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

For Diameter up to 4000mm

Wooden Saddles Length: 1836/2743mm (6'0"/9'0")
Width: 300mm (1'0")
Height: Saddle + one/two wedges a top.
For Diameter up to 4000mm
Wooden Saddles Length: 3353mm (11'0")
Width: 300mm (1'0")
Height: Saddle + three/four wedges a top.

NUMBER OF SADDLES:
Minimum: 3 in case of Loading inside Well
+ 1 when loaded on Gooseneck.
Maximum: 4 in case of Loading inside Well
+2 when loaded on Gooseneck.

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

12.3 NUMBER OF LASHINGS ARE:

	CONSIGNMENT LOADED INSIDE WELL BED	CONSIGNMENT LOADED OVER GOOSENECK
a) up to 40MT	4 (2 Single Line lashing 2 Double Line Lashing)	5 (3 Single Line Lashing 2 Double Line Lashing)
b) 40MT to 60MT	5 (3 Single Line Lashing 2 Double Line Lashing)	5 (Single Line Lashing 3Double Line Lashing)
c) 60MT and above	5 (2 Single Line Lashing 3 Double Line Lashing)	6 (3 Single Line Lashing 3 Double Line Lashing)

13 GUIDELINES FOR HANDLING/LOADING/LASHING

13.1 HANDLING

Figure 6

Before unloading the jobs Completely painted and neatly stencilled will be checked.

Pipes with split type end cover will be checked

Figure 7

All Coil Tubes to be provided with End Caps.

Figure 8

Neatly stacked Coil Assemblies.

Figure 9

Columns to be lifted with Nylon belts. This protect painting, edges and attachments.

Figure 10

13.2 LOADING

All the components to be transported by putting inside the properly fabricated Crating

Figure 11

Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.

Figure 12

No component loaded over the crating.

Figure 13

Headers supported with wooden V blocks at 3 meters interval.

Figure 14

Spacers in between each coil assembly.

Figure 15

Goose pipe to be provided with rubber pad protects removal of painting and damage to the job.

Figure 16

13.3 LASHING

Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

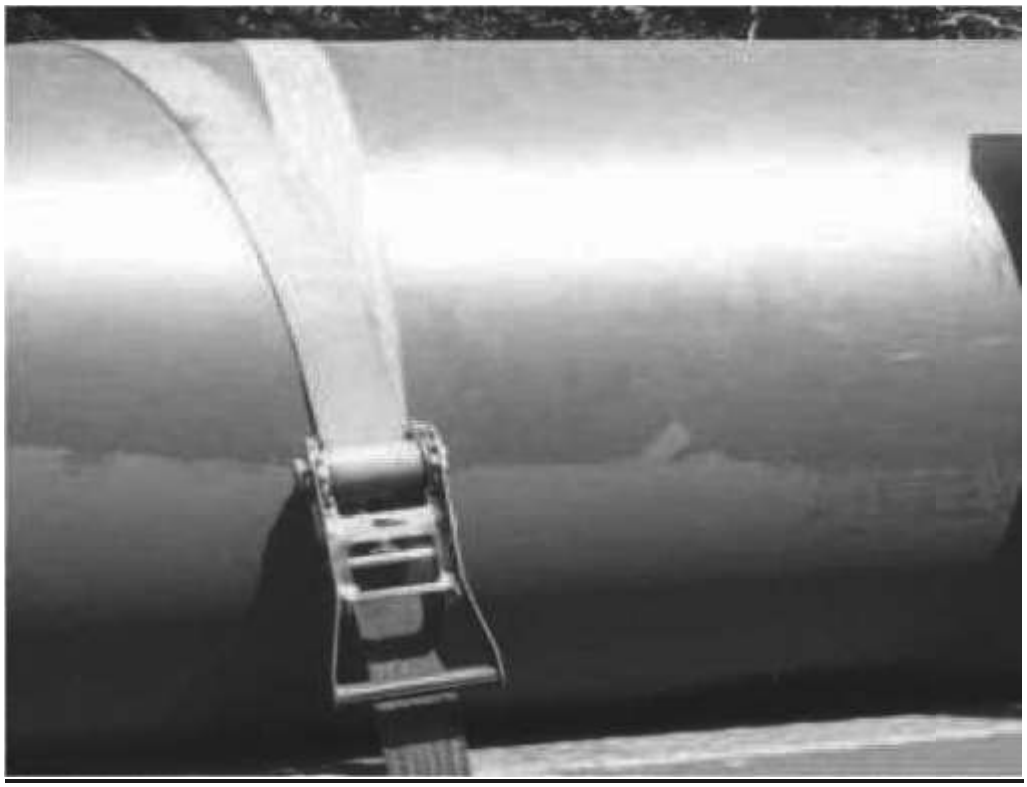


Figure 17

Nylon Belts used for lashing the beams.

Figure 18

14 PRODUCT WISE SPECIAL INSTRUCTION

Additional instructions of packing not included in this standard shall be covered by individual product standard

15 REFERRED STANDARDS (Latest publications including amendments):

1) AA51420 2) AA55619 3) AA51414 4) IS:3401

5) AA10108 6) AA56126

ANNEXURE – 7

QAP GUIDELINES & FORMAT

QAP GUIDELINES & FORMAT

`

(ANNEXURE -)

The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.

Note :

1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval.

2. No deviation to reference document is acceptable.

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.

2. Each page of QAP shall contain the following information.
   a) Vendor's name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages

3. QAP shall contain four parts / stages as follows.
   a) Raw materials and bought out items.
   b) In process Control / Inspection.
   c) Final assembly, Inspection & Testing.
   d) Painting, preservation & packing.

4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).

5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.)

6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.

7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)

8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)

9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practice etc.". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.

10. Under 'Format of record', indicate appropriately supplier's test certificate, calibration certificate, lab report, inspection report etc.

11. Please refer 'Agency' in QAP format.
    Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)

Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code1.

12. Under 'D' please put (□ Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.

13. Vendor's signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drawings.

15. The following operations/characteristics/check points may be included (AS APPROPRIATE)
    a) Visual check
    b) Dimensional check
    c) Mechanical and Chemical properties.
    d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.)
    e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.
    f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
    g) Verification of test certificate for protection class for the enclosures.
    h) Mechanical functioning of switches.
    i) Continuity of earthing and provision of earth points.
    j) Colour coding of wiring, size, tightness & dressing of wiring.
    k) Review of test certificates of assembled items, raw materials, internal test reports etc.
    l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
    m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc.
    n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.)
    o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
    p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
    q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
    r) Packing and Preservation.

16. **QAP Format enclosed.**

17. Typical Manufacturing QAP is attached.

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**		QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO:	DATE:
			PAGE 1 OF 1	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
2.0	**INPROCESS INSPECTION**												
3.0	**FINAL INSPECTION & TESTING**												
4.0	**PRESERVATION & PACKING**												

VENDOR TO NOTE: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP

TYPICAL MANUFACTURING QUALITY PLAN

VENDOR'S NAME & ADDRESS:	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT:	BHEL P.O.NO.: P.O. DATE: BHEL SPEC:	QP NO	
			REV. NO:	
			DATE:	
			PAGE NO:	Page 1 of 3

SL. No.	COMPONENT & OPERATIONs	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS
										M	C	N	
1.0	**Raw Material Inspection**												
1.1	All materials including casting & forging	Chem. & Mech. Dimensions Surface Defects	MA MA MA	Review of MTC Measurement Visual	1/Heat 100% 100%	As per spec. & Appd. Dwg		TC IR IR	√	P P P	V - V	V - V	
1.2		UT (if shaft dia > 50mm)	MA	NDT	100%	As per spec. & Appd. Dwg		UT Report	√	P	V	V	
1.3	Mechanical Seal	Material & Leakage check (Air test)	MA	OEM's Certificate review		As per spec. & Appd. Dwg		OEM's Certificate	√	P	V	V	
1.4	Coupling	Chem. & Mech. Properties	MA	Review of MTC	1/Heat	As per spec. & Appd. Dwg		MTC	√	P	V	V	
1.5	Safety Guard, Support leg, Flange, Fasteners, gaskets etc.	Chem. & Mech. Properties	MA	Review of MTC	1/Heat	As per spec. & Appd. Dwg		MTC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Welding Qualifications	WPS & PQR	MA	WPS, PQR & WPQ	100%	ASME Sec IX		IR	√	P	V	V	Refer Note-4
2.2	Marking, Cutting, Edge Preparation Tacking	Dimensions	MA	Measurement	100%	As per spec. & Appd. Dwg		IR		P	-	-	
2.3	Welds	Dimensions & Surface Quality	MA	Measurement	100%	Appd.Dwg.& ASME Sec VIII		IR	√	P	W	V	
2.4	Machining of Components	Dimensions Surface Defects	MA	Measurement DPT/MPI	100% 100%	As per spec. & Appd. Dwg		IR	√	P P	- V	- V	
2.5	Impeller	Dimension & Dynamic balance test	MA	Measurement	100%	As per spec. & Appd. Dwg		TR	√	P	W	V	
2.6	Rotor assembly	Dynamic balance test	MA	Measurement	100%	As per spec. & Appd. Dwg		TR	√	P	W	V	
2.7	Motor	Verification as per Dwg	MA	Mech & Chem Properties	100%	As per spec. & Appd. Dwg		TC	√	P	V	V	
		Type Test	MA	Review of Tests certificates	100%	As per spec. & Appd. Dwg		TC	√	P	V	V	
		Routine Test	MA	Testing	100%	As per spec. & Appd. Dwg		TC	√	P	W	V	Refer Note-12
2.8	Gear Box	Run Test	MA	Review of TCs	100%	As per spec. & Appd. Dwg		TC	√	P	V	V	
2.9	Assembly	Dimensions Completeness	MA	Measurement Visual	100% 100%	As per spec. & Appd. Dwg		IR	√	P P	V V	V V	
2.10	Alignment	Alignment Check	MA	Review of report	100%	As per spec. & Appd. Dwg		IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Final Assembly	Overall Dimensions & Completeness	MA	Measurement Visual	100%	As per spec. & Appd. Dwg		IR	√	P	W	V	100% W by BHEL/TPIA & End Customer
3.2	Free Air Run Test of complete assembly with Job Motor, Job coupling, Job base plate, Job gear box etc.	Measurement of Current, RPM, Deflection of Shaft at free end, Noise & Vibration	MA	Measurement	100%	Vendor Standard / Approved Drawing / Data Sheet		IR	√	P	W	W	100% W by BHEL/TPIA & End Customer

LEGEND: *RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. M: MANUFACTURER / SUB SUPPLIER, C: BHEL/BHEL's TPIA. N: END CUSTOMER P: PERFORM W: WITNESS V: REVIEW MA: MAJOR AND MI: MINOR	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP

TYPICAL MANUFACTURING QUALITY PLAN

3.3	Rubber Lining	Thickness, Hardness test & Spark test, Adhesion Test	MA	Measurement	100%	As per spec. & Appd. Dwg	TR	√	P	W	W	
3.4	Spares	Spares Verification	MA	BOM Check	100%	As per spec. & Appd. Dwg	IR	√	P	W	W	
3.5	Review of QA Documents	Verification of QA Documents	MA	Verification	100%	As per Appd. MQP	Index Sheet	√	P	V	V	
4.0	**Painting & Preservation**											
4.1		Painting Material	MI	Review of MTC	100%	Appd. "Painting Procedure'/ Approved Painting Schedule	IR	√	P	V	V	
4.2		DFT Check	MI	Measurement	100%	--do--	IR	√	P	V	V	
4.3		Painting Surface Quality	MI	Visual	100%	--do--	IR	√	P	V	V	
5.0	Packing	Marking, Packing List & Details etc. Check	MI	Verification	100%	As per spec.	Packing report	√	P	V	-	

Notes: -

1. This Standard MQP should be read along with specification (latest revision as per PO), approved drawings & approved datasheet, approved BOM (as applicable).
2. Approved drawing/datasheet & specification shall prevail over quality plan in case contradiction if any.
3. Material test certificate shall include tensile, impact, hardness, bend, IGC, hot tensile, grain size, chemical analysis etc. as required by applicable material code /approved drwg./data sheet.
4. WPS/PQR/WPQ to be submitted for review wherever required. All welding shall be done by qualified welders. Duly endorsed documents will be submitted to BHEL/TPIA's review.
5. Hydro test shall be done in un-painted condition as per approved procedure/relevant code.
6. Any other tests/ checks indicated in specification, P.O., or drawing/data sheet & any additional checks envisaged by BHEL/Customer as part of correspondence to ensure workmanship, finish, aesthetics, etc. shall also be conducted and witnessed/verified by BHEL /TPIA /Customer as per project requirement.
7. Only type test certificate of same design and same Material of Construction of equipment to be submitted, wherever required.
8. All the relevant test reports /certificates shall be submitted during inspection. The reviewed and certified documents by BHEL/TPIA/Customer shall be submitted (QAP cl no wise with page nos) to BHEL as documentation package.
9. All sub-ordered items, bought out items, electrical & instrumentation Items shall be procured from approved / agreed vendor list with BHEL/BHEL's Customer.
10. IGC test as per ASTM A262 Practice B/E and Microscopic Structure Examination at 250X Magnification for SS Material.
11. All test reports shall be from NABL accredited lab only.
12. For Agitator Motors, Routine tests are to be conducted as per IS:325 in presence of BHEL/BHEL's TPIA and Type Test certificates shall be submitted to BHEL/BHEL's TPIA and End Customer for approval before dispatch.
13. Vendor has to submit the detail Quality plan for the items marked as "Full Compliance Material" in BHEL specification.
14. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It cannot be considered as a guarantee of functional objective of rubber used.
15. Acceptance test to be carried out as per the procedure defined by the bidder.

LEGEND: *RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. M: MANUFACTURER / SUB SUPPLIER, C: BHEL/BHEL's TPIA. N: END CUSTOMER P: PERFORM W: WITNESS V: REVIEW MA: MAJOR AND MI: MINOR	PREPARED BY VENDOR'S SIGNATURE & STAMP	APPROVED BY BHEL QA SIGNATURE & STAMP	APPROVED BY CUSTOMER'S SIGNATURE & STAMP

ANNEXURE – 8

FORMAT FOR PRE-QUALIFICATION CRITERIA (PQC)

BHARAT HEAVY ELECTRICALS LIMITED भारत हेवी एलेक्ट्रिकल्स लिमिटेड
RAMCHANDRAPURAM, HYDERABAD – 502032
रामचन्द्र पुरम, हैदराबाद - 502 032
परियोजना इंजीनियरिंग विभाग PROJECT ENGINEERING & SYSTEMS DIVISION

परियोजना / PROJECT : FGD system for 2x500 MW Project at Tuticorin, Tamil Nadu.
विषय / SUB : PQC for Vertical or **Top Entry Agitators** for Slurry Application

A. <u>TECHNICAL QUALIFICATION CRITERIA:</u>
Bidder shall meet the following criteria as mentioned in Sl.No.1 & 2 below

1. Bidder should have designed, manufactured, tested, supplied / commissioned **at least 1 No. of Vertical or Top Entry Agitator** in the **last 15 years*** either for Wet Limestone based Flue Gas Desulphurization (FGD) application or any other industrial / process application such as petrochemicals, metals, mining, sugar, paper, fertilizers etc. and the equipment should have been in trouble-free operation at site for **at least One (1) Year*** as on initial enquiry submission due date.

   * The time period mentioned above shall be reckoned from PO date of reference project to the Initial bid submission due date of present enquiry.

   To assess the above qualification, bidder to furnish the below supporting documents:

   a) Copy of Purchase Order / LOI / Invoice / IRN **AND**
   b) Copy of Satisfactory Performance Certificate / Customer's Letter of appreciation for operation / any supporting documents# of the project to establish the fact that the operation of the agitator at site is successful for 1 year.

      In case bidder is unable to furnish Performance certificate as above, bidder to furnish Copy of PO / LOI / Invoice / IRN dated at least 3 years before initial enquiry submission due date.

2. The agitators provided as reference above, shall also be meeting the below criteria

   i. <u>Size of Tank</u>:
      - Diameter of the tank shall be at least 5.5m
      - Height of the tank shall be at least 6.5m

   ii. <u>Motor rating</u>: Motor rating shall be at least 65% of offered kW in the present enquiry per each agitator.

   To assess the above qualification, bidder to furnish the supporting documents along with technical offer as below:

   a) Any project documents (such as Datasheet / Drawing / IRN / Inspection Report / Commissioning Report / Performance Report / Guarantee Test Report etc.) indicating the technical details including the Motor rating and Tank size.

3. Bidder also to furnish reference list in the format enclosed as 'Annexure-5B-I' to this document.

ANNEXURE-8 : EXPERIENCE RECORD PROFORMA

S.No.	Description	Reference Project-1	Reference Project-2
1.	Name of Customer		
2.	Service / Working Fluid / Application		
3.	Type of Agitator	Top Entry	Top Entry
4.	Model No. of Agitator		
5.	Quantity of Agitators supplied		
6.	Size of Tank (Dia x Height) in mtrs		
7.	Rating of Motor (kW)		
8.	Volume of Tank (m3)		
9.	Viscosity (centi poise)		
10.	Specific Gravity		
11.	Percentage of Solids		
12.	MOC of Impeller & Blades		
13.	MOC of Shaft		
14.	PO No. & Date		
15.	Enclosed Purchase Order / LOI / Invoice / IRN & Date (Yes / No) (Refer Cl.No.A.1.(a))		
16.	Enclosed MRC / Site Inspection Report / Performance certificate (Yes / No) (Refer Cl.No.A.1.(b))		
17.	Enclosed Project document (Yes / No) (Refer Cl.No.A.2.(a))		
18.	Year of Commissioning		
19.	Remarks		

ANNEXURE – 9

SUB-VENDORS LIST

FINALIZATION OF SUB VENDORS

i. **Category – I: Sub vendors accepted.** The acceptance will be based on past experience of Purchaser/Consultant.

ii. **Category – II: Sub vendors enlisted for future acceptance**. Such acceptance will be based on the various details regarding capacity, capability, experience etc of the sub-vendor proposed by the successful Bidder. It is the responsibility of the successful Bidder to get the details of the sub vendors under category II, compiled and submitted to Purchaser/consultant for scrutiny and acceptance. The acceptance criteria are mentioned below. However, Purchaser reserves the right to accept or reject any of the proposed vendors based on information available with them.

NTPL FGD_Mech_Sub vendor List

Class II items

S. no.	Item/System Description	Category I	Category II
14	Piping	SAIL	
		JINDAL INDUSTRIES	ASIAN MILLS, AHMEDABAD
		WELSPUN	ADVANCE STEEL TUBES
		JINDAL SAW	PSL
		MAHARASHTRA SEAMLESS	SURYA ROSHINI
		ISMT	MUKAT PIPES
		TISCO	JCO PIPE
			INDUS PIPES
			DADU PIPES
			JINDAL PIPES LTD
			ASIAN TUBES LTD
			MAN INDUSTRIES
			SHRIRAM SEPL, CHENNAI
			EPP COMPOSITE, RAJOKOT
			GRAPHITE INDIA, NASIK
			EXTRACO COMPOSITES
			PACIFIC PIPES, AHMEDABAD
			AMIANTIT FIBER GLASS, GOA
			KEMROCK, BARODA
			MEGHA FIBER GLASS, HYDERABAD
			RATNAMANI
			HEAVY METAL TUBES
			PRAKASH STEELAGE
			RAJENDRA MECHANICAL WORKS (REMI)
			SANDVIK

NTPL FGD_Mech_Sub vendor List

Class II items

S. no.	Item/System Description	Category I	Category II
14	Piping	SAIL	ASIAN MILLS, AHMEDABAD
		JINDAL INDUSTRIES	ADVANCE STEEL TUBES
		WELSPUN	PSL
		JINDAL SAW	SURYA ROSHINI
		MAHARASHTRA SEAMLESS	MUKAT PIPES
		ISMT	JCO PIPE
		TISCO	INDUS PIPES
		DEE DEVELOPMENT ENGINEERS LTD.,	DADU PIPES
		S&G ENGINEERS (P) LTD	JINDAL PIPES LTD
		UNITECH MACHINES LTD.,	ASIAN TUBES LTD
		AJANTHA FABRICATION WORKS UNIT-II	MAN INDUSTRIES
		ALTEC FABRICATORS	SHRIRAM SEPL, CHENNAI
		BABY ENGINEERING PVT. LTD	EPP COMPOSITE, RAJOKOT
		BEND JOINTS PVT LIMITED	GRAPHITE INDIA, NASIK
		EMCEE ENGINEERING WORKS	EXTRACO COMPOSITES
		ENESTEE ENGINEERING LTD	PACIFIC PIPES, AHMEDABAD
		FLASH FORGE PVT. LTD.,	AMIANTIT FIBER GLASS, GOA
		GUJARAT INFRAPIPES PVT. LTD.,	KEMROCK, BARODA
		ISGEC HEAVY ENGINEERING LIMITED	MEGHA FIBER GLASS, HYDERABAD
		POWER PIPING CO.,	RATNAMANI
		SAKTHI HI-TECH CONTSTRN. (P) LTD	HEAVY METAL TUBES
		SRI SASTHA ENGINEERING WORKS	PRAKASH STEELAGE
		SUN ENGINEERING	RAJENDRA MECHANICAL WORKS (REMI)
		TRIOMECH ENGINEERING PVT.LTD.,	SANDVIK
		SEAM INDUSTRIES LIMITED	JIANGSU WUJIN STAINLESS STEEL PIPE
			ZHEJIANG JIULI HI-TECH METALS Co. L
			SALZGITTER MANESSMANN STAINLESS
			TUBACEX TUBOS INOXIDABLES, S.A
			HUADI STEEL GROUP CO. LTD.
			TUBE BEND (CALCUTTA) PVT LTD
			PETRO-CHEM INDUSTRIES
			EFTEN ENGINEERING PVT.LTD.,
			UI PIPE FITTINGS PVT LTD.,
			GUJARAT INFRAPIPES PVT. LTD.,
			FIT TECH INDUSTRIES PVT LTD.

Amended Sub-vendor list of piping for FGD

415

NTPL FGD_Mech_Sub vendor List

Class II items

S. no.	Item/System Description	Category I	Category II
			P.K.TUBES & FITTINGS PVT. LTD,
			SAWAN ENGINEERS PVT LTD
			AST INDUSTRIES
			BARODA EQUIPMENT & VESSELS PVT LTD
			BOSTIN ENGINEERS PRIVATE LIMITED
			EXCEL INDUSTRIES
			FABRIMAX ENGINEERING PVT LTD
			HITECHNOCRATS PVT LTD
			KOTHARI CHEMICALS
			PAL ENGINEERING CORPORATION
			SAMARTH ENGINEERING
			SHIVAM HITECH STEES PVT LTD

5/5

13.	L.T. Motors (AC & DC)	• ABB • ALSTOM • Bharat Bijilee Ltd., • Jyoti Limited • Kirloskar Electric Co. Ltd • Laxmi Hydraulics Pvt Ltd • Marathon Electric Motors India Limited • Siemens • WEG	• BHEL Electrical Machines Ltd • ELJIN MOTOR • GE POWER • Hem Industries • HYUNDAI • IJLIN • JEUMOUNT ELECTRIC • NANYANG EXPLOSION • Power House • SHANGAI ELECTRIC • TECO ELECTRIC & MACHINERY (P) Ltd. • TMEIC • CGPower & Industrial Solutions Limited • NGEF(Hubli) Ltd

		• Radiant • SRIRAM CABLES PVT. LTD • Suyog Cables • SUYOG ELECTRICALS LTD., BARODA, • TCL CABLES LTD • TECHMECH ENGINEERS, BANGALORE • THERMO CABLES LIMITED • TORRENT CABLES • TOSHNIWAL CABLES, JAIPUR • UNIVERSAL CABLES	• SPM POWER & TELECOM PVT LTD. • STEP Industries • SUJOG ELECTRICALS • SURAJ CABLES • TC COMMUNICATION PVT LTD. • TERACOM • TERACOM LIMITED • THERMO PADS • TIRUPATI PLASTOMATICS PVT. LTD. • TirupatiPlasomatics • TORRENT Power • VARSHA CABLES PVT LTD • VIKAS CABLE COMPANY • WINDSOR CABLES PVT. LTD.
17.	LT Power Cables (XLPE)	• APAR INDUSTRIES LTD. • CCI • CMI LIMITED, • CORDS CABLE INDUSTRIES LTD. • DELTON CABLES • ELKAY TELELINKS, NEW DELHI • FINOLEX • GEMSCAB INDUSTRIES LTD, • GLOSTER CABLES LTD • GOVIND CABLE INDUSTRIES • GOYOLENE FIBRES (INDIA) PVT LTD., DAMAN • GUPTA POWER INFRASTRUCTURE LTD, • HAVELL'S INDIA LTD., NEW DELHI • HINDUSTAN VIDYUT PRODUCTS LTD. • ICL • INCAB • INDO ASIAN FUSE GEAR LIMITED, • KEC INTERNATIONAL LIMITED, • KEI INDUSTRIES • KRISHNA ELECTRICAL INDUSTRIES LTD, • LAPP INDIA (P) LTD • NICCO CORPORATION LTD • PARAGON • Paramount cable • POLYCAB • Radiant • RAVIN • RAVIN CABLES LIMITED • Sbee Cables	• Advance cable • ALPHA COMMUNICATION LTD • AVOCAB • BHANSALI CABLES & CONDUCTORS PVT LTD • BROOKS CABLES,MUMBAI • CHANDRESH CABLES LIMITED • CRYSTAL CABLES, KOLKATA • DIAMOND POWER INFRASTURCTURE LTD • DYNAMIC CABLES • EPSILLON CABLES PVT. LTD, • FINECAB WIRES & CABLES PVT. LTD • MANOJ CABLES LTD. • MANSFIELD CABLE CO., • NANGALWALA IMPEX (P) LTD • NATARAJ PLAST INDUSTRIES LTD., NEW DELHI, • PAGODA CABLES PVT. LTD • PARAMOUNT COMMUNICATIONS LTD. • Plaza CABLES • Rallison • RALLISON ELECTRICALS PVT. LTD. (Old name-Roolex lectroproducts LTd) • RPG • RR KABEL • SBEE CABLES LTD., • Scott Innovation wires and cables • SERVAL • SHIVAPRIYA CABLES LTD., • SPECIAL CABLES PVT. LTD • SPM POWER & TELECOM PVT LTD. • Sri Ram Cables

		• SHYAM CABLE INDUSTRIES DELHI • TCL CABLES LTD • THERMO CABLES LIMITED • Thermocables • TORRENT CABLES • TOSHNIWAL CABLES, JAIPUR • UNIVERSAL CABLES	• STEP Industries • SURAJ CABLES • SUYOG ELECTRICALS LTD., BARODA, • TC COMMUNICATION PVT LTD. • TECHMECH ENGINEERS , BANGALORE • TERACOM LIMITED • THERMO CABLE • THERMO PAD • TIRUPATI PLASTOMATICS PVT. LTD. • TORRENT POWER LIMITED • VARSHA CABLES PVT LTD • VIKAS CABLE COMPANY • WINDSOR CABLES PVT. LTD.

		• SIEMENS	
3.	Cable Glands	• 3D • BRACO ELECTRICALS (INDIA) PVT. LTD. • Commet • COSMOS • DOWELLS • Jainson • SUNIL & COMPANY	• HMi • SMI
4.	Cable Lugs	• 3D • Commet • COSMOS • DOWELLS • HEX • Jainson	• A.F.Noman& Co • Excel Enterprises Chennai • Fomra Electricals • Goodwill Hardware Stores • Industrial Equipment Suppliers

		• Sunil & Co.	• Kayser Electricals • M.J.Traders • Navakar Trading Co. Pvt. Ltd. • Rangoon Mill Stores • Rashmi Electric Co • S.M Trading Co. • Shanthi Electricals • Singhi Industrial Electrical • South India Astek Electricals &Controls switch Gear Co • South India Switch Gear Co. • Southern Industrial Products • Standard Electric Co.

ANNEXURE – 10

MASTER DOCUMENTS LIST (MDL) FORMAT

MASTER DOCUMENT LIST

Name of Package / System / Equipment :	Supplier	Project:	Supplier Job No.	BHEL PO No.	BHEL PO Date	Supplier Doc. No.	
Agitators for Slurry Application (FGD Proj)						**Rev No.**	
						Date	

LEGEND FOR STATUS OF DRAWING/ DOCUMENT :				LEGEND FOR DOCUMENT APPROVAL CODE :			
1	LIST OF SUPERCEDED DRAWINGS / DOCUMENTS	S	1	NO COMMENTS			Code- 1
2	LIST OF ACTIVE DRAWINGS / DOCUMENTS	A	2	COMMENTS AS MARKED CLEARED FOR MANUFACTURE			Code- 2
3	LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION	UP	3	COMMENTS AS MARKED			Code- 3
4	LIST OF DESIGN / APPROVED DRAWINGS	ADS	4	RETAINED FOR INFORMATION			Code- 4

Sl.No.	Title of Drawing / Document	Drg. / Doc. No.	Category of Doc. (A-Approval, I-Information)	Applicable for Doc. / Drg. Delay analysis (YES / NO)	Schedule of Doc./ Drg. Submission (Days from PO)	Rev.	Received from Vendor	Comments sent to Vendor	Pending with (BHEL / Vendor)	BHEL Approval Status	Remarks
A	**MECHANICAL & TECHNICAL DOCUMENTS OF ALL AGITATORS**										
1	Datasheet of Agitators (BHEL format)		A	Yes	2 weeks						
2	Performance / Operational Curve of Agitator		I	No	2 weeks						
3	GAD of Agitator with part details, sectional views, MOC details		A	Yes	2 weeks						
4	Sizing Calculations of Motors		A	Yes	2 weeks						
5	Motor Data Sheet (BHEL format)		A	Yes	2 weeks						
6	Motor GA drawing		A	Yes	2 weeks						
7	Motor TB drawing		I	No	2 weeks						
8	Motor Curves		I	No	2 weeks						
9	T-S Curve of Motor		I	No	2 weeks						
10	Gear Box Data sheet, if applicable		A	No	2 weeks						
11	Gear Box GAD, if applicable		A	No	2 weeks						
12	Mechnical Seal Documents		I	No	2 weeks						
13	Foundation Drawing and Details of Agitator Assembly		I	No	2 weeks						
14	Electrical Load List (ELL)		I	No	2 weeks						
15	Utility Consumption Data, if applicable		I	No	4 weeks						
16	List of Commissioning Spares		A	No	8 weeks						
17	List of Mandatory Spares		A	No	8 weeks						
B	**MISCELLANEOUS**										
1	Performance Test Procedure		A	No	8 weeks						

Sl.No.	Title of Drawing / Document	Drg. / Doc. No.	Category of Doc. (A-Approval, I-Information)	Applicable for Doc. / Drg. Delay analysis (YES / NO)	Schedule of Doc./ Drg. Submission (Days from PO)	Rev.	Received from Vendor	Comments sent to Vendor	Pending with (BHEL / Vendor)	BHEL Approval Status	Remarks
2	Vibration test procedure & Noise test procedure		I	No	8 weeks						
3	Hydro Test Procedure		I	No	8 weeks						
4	NDE Test Procedure		I	No	8 weeks						
5	Painting procedure with Paint Schedule		I	No	10 weeks						
6	Packing List		I	No	2 weeks before PO delivery date						
7	Bill of Material (BoM)		A	No	4 weeks before PO delivery date						
8	Billing Break-up, if applicable		A	No	1 week before despatch						
9	Quality Assurance Plan (QAP)		A	Yes	2 weeks						
10	Sub-Vendors List		I	No	6 weeks						
11	Consumables & Lube Oil Schedule		I	No	10 weeks						
12	List of Special Tools & Tackles		I	No	8 weeks						
C	**CERTIFICATES & MANUALS**										
1	O& M Manuals (Soft Copies & Hard copies)		A	No	12 weeks						Hard copy shall be furnished after getting concurrence on soft copy.
2	Start-Up Procedure		I	No	12 weeks						
3	Erection Procedure		I	No	12 weeks						
4	Commissioning Procedure		I	No	12 weeks						
5	Factory Acceptance Test (FAT) Procedure		I	No	12 weeks						
6	Inspection / Test Reports / Certificates		I	No	Within 3 days from Inspection						

Notes:

1	The above list of documents and other details are indicative. The final list of documents and their details will be furnished after placement of order, during detail engineering stage.
2	Post order Stage, Vendor to provide data sheet in Customer Standard Format Data Sheet. The Standard format shall be furnsihed during detail Engg.
3	Bidder to submit the documents as per above schedule, irrespective of categorization under delay analysis. Any document (not identified under delay analysis) delayed more than 2 weeks than the above schedule shall also be considered as delay by the vendor.
4	Bidder to ensure to submit the documents with proper quality for review by purchaser. Purchaser reserves the right to return the document without review, if the document is not found to the mark / not acknowledged / incorporated the comments / observations on the documents.

ANNEXURE – 11

DEVIATION FORMAT

FORMAT FOR DEVIATION LIST

Sl. No.	Section / Part / Subsection	Page No.	Clause No.	Bid Specification Requirement	Bidder's Deviation

Notes:

1. Bidder to furnish duly filled format along with SEAL & SIGN along with their offer.
2. All the pre-bid queries (if any) shall be raised before submission of the offer as per pre-bid query format (enclosed as Annexure to the specification).
3. Deviations, which are impractical, and the same were raised during pre-bid stage as per pre-bid query format, but still purchaser's reply/clarifications could not be met shall only be raised in this format.
4. If there are no deviations, bidders shall indicate as "No deviation" and submit the same along with their offer.
5. Deviations indicated elsewhere in bidders offer except raised through this format shall not be considered and reviewed during technical evaluation of their offer.

SIGNATURE: _____
NAME : _____
DESIGNATION: _____
COMPANY : _____
DATE : _____

COMPANY SEAL

ANNEXURE – 12

PRE-BID QUERIES (PBQ) FORMAT

FORMAT FOR PRE-BID QUERIES

Sl. No.	Section / Part / Subsection	Page No.	Clause No.	Bid Specification Requirement	Bidder's Query	Purchaser's Reply

Notes:

1. During the preparation of pre-bid queries, bidder to refer to complete Bid specification and its Annexures & Amendments (if any).

PROJECT ENGINEERING & SYSTEMS DIVISION

Std. / Doc. Number	
PY51844	
Rev. No.	00

ANNEXURE – 13

PERFORMANCE GUARANTEE SCHEDULE FORMAT

ANNEXURE-13
PERFORMANCE GUARANTEE SCHEDULE FORMAT (TOP ENTRY AGITATORS)
PROJECT: FGD system for 2x500 MW Project at NTPL Tuticorin, Tamil Nadu.

Sl.No.	Description / Item	Working	Standby	Power Consumption (kW) per each Agitator (at motor input terminals)	Total Power Consumption (KW)
Col. (1)	Col. (2)	Col. (3)	Col. (4)	Col. (5)	Col.(6) = Col.(3) * Col.(5)
1)	Limestone slurry storage tank agitator	2	0		
2)	Primary Hydro-cyclone feed tank agitator	1	0		
3)	Secondary hydro-cyclone feed tank agitator	1	0		
4)	Filtrate Water Tank Agitator	1	0		
5)	Waste Water Tank Agitator	1	0		
A)	**Total Guaranteed Power(kW) = (1) + (2) + (3) + (4) + (5)**				

Notes :

1	Power consumption (kW) of motors shall be measured at motor input terminals when the system operating at the rated capacity (ie., maximum liquid level in the tank).
2	Power quoted by bidder shall be termed as 'Guaranteed Power consumption' (GPC) and bidder to prove Guaranteed Power Consumption (kW) value during PG test at site. If the actual power consumption exceeds the guaranteed power consumption, **liquidated damages** (LD) shall be payable by the successful bidder at the rate of **INR 4,06,500/- per kW** for excess power consumption over the guaranteed power consumption indicated by bidder in his bid. Such liquidated damages will be recovered by the BHEL by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the BHEL.
3	For evaluation of Liquidated Damage (LD), the total actual power consumption of all the above mentioned agitators (as indicated at Sl.No.A) at site will be considered (and not the individual power consumption against each agitator)

ANNEXURE – 14

MOTOR SIZING CALCULATIONS FORMAT

MOTOR SIZING CALCULATION (TO BE FILLED FOR EACH AGITATOR)

Project :

Enquiry No :

S.No	**Parameters**		Data
1	Tank size (Dimension in m)		
2	Specific Gravity of Slurry	**ρ**	
3	IMPELLER TIP DIA(in m)	**d**	
4	AGITATOR SPEED(RPM)	**n**	
5	POWER NO OF THE AGITATOR	**Np**	
6	NO OF IMPELLER STAGES	**I**	
7	AGITATOR POWER(P)	**Np*ρ * d^5 *n^3 * I**	
8	GEARBOX EFFICIENCY	**η1**	
9	BEARING TRANSMISSION EFFIFICIENCY	**η2**	
10	EFFICIENCY DUE TO ANY OTHER LOSSES	**η3**	
11	MECHAINCAL POWER REQUIRED(X)	**X= P/(η1*η2*η3)**	
12	MOTOR EFFICIENCY	**η**	
13	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency or Agitator BKW	**Agitator BKW = X/η**	
14	MOTOR POWER (KW)	Motor margin shall be as per purchase specification enclosed.	