	BHARAT HEAVY ELECTRICALS LIMITED (A GOVT OF INDIA UNDERTAKING)	Flue Gas Desulphurization Group-FGD, Boiler Auxiliary Plant (BAP), Ranipet

TECHNICAL SPECIFICATION FOR GLASS FLAKE LINING OF SLURRY TANKS

SPECIFICATION NO	:	**FGD:GFL-TNKS**
BUYER (EPC)	:	**BHEL, BAP Ranipet**
APPLICATION	:	**WET LIMESTONE FGD**

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00	31-03-2020	Fresh Release	Jyotish Kumar Patel	Shanmuga Sundaram S	V.Kesavan
REV	Date	Description	Prepared	Checked	Approved

TECHNICAL SPECIFICATION FOR GLASS FLAKE LINING OF SLURRY TANKS

A) DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

Sl. No.	Description	Purpose
1	Performance certificate from end user for meeting the qualification requirement	Qualification requirement for considering the offer
2	Reference list / experience list as per Annexure-III	Qualification requirement for considering the offer
3	All pages of specification and all filled annexures duly signed & sealed	Technical evaluation
4	Write-up on technical features of glass flake lining offered for primer and build up coats along with Catalogues, Resin composition, drawings,etc.	Technical evaluation
5	Data sheets of the Glass flake lining material.	Technical evaluation
6	Surface preparation, erection sequence/Procedure of the Glass flake lining. Detailed flow chart from start to finish of the lining to be furnished.	Technical evaluation
7	Storage methods to be followed at site and the shelf life of glass flake	Technical evaluation
8	Man days required to complete the Glass flake lining for each area is to be spelt from start to finish	Technical evaluation
9	Vendor should clearly indicate the price (for both material and application)of Glass Flake lining per square meter	Commercial evaluation
10	Priced offer	Commercial evaluation

B) DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

Sl. No.	Description	Purpose	Delivery Time
1	List of datasheets/documents to be submitted for review, approval and information with submission dates	CUSTOMER/BHEL approval to start manufacturing	1 week
2	Catalogue/Datasheets for the Vinyl ester based Glass Flake Lining material	CUSTOMER/BHEL approval to start manufacturing	2 week
3	Detailed dimensional drawing of the lining surfaces indicating the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc	CUSTOMER/BHEL approval to start manufacturing	2 week
4	Surface preparation and Lining procedures	CUSTOMER/BHEL approval to start manufacturing	2 week
5	Manufacturing Quality Assurance Plan for Glass flake material and adhesive to be submitted for approval.	CUSTOMER/BHEL approval to start manufacturing	2 week
6	Field quality plan for surface preparation and lining application procedure along with testing	CUSTOMER/BHEL approval to start manufacturing	2 week
7	Repair and rectification procedure for Glass Flake lining	CUSTOMER/BHEL approval to start manufacturing	2 week

TECHNICAL SPECIFICATION FOR GLASS FLAKE LINING OF SLURRY TANKS

1. INTENT OF SPECIFICATION

a) This Specification defines the minimum requirements of glass flake lining of Slurry Tanks in the Flue Gas Desulphurization (FGD) plant for NTPC Projects.

b) Tanks/Sumps to be lined contain Limestone Slurry/Gypsum Slurry/Process water. Slurry Tank Details and Slurry conditions are given in Annexure-Tank Details . The glass flake lining shall offer better resistance to corrosion/erosion and shall be based on Vinyl ester resin. Thickness of glass flake lining required is 3 mm thk .

c) This specification covers the general design, selection of suitable glass flake material/resin, manufacture, shop inspection (As per latest applicable statutes, regulation and safety codes in the locality where the lining are to be carried out) and delivery at site, surface preparation of lining surface, lining the surface to the satisfaction of the customer, jointly calculation of total area lined, inspection of the lining at site, handling over to the ultimate customer.

d) Compliance to this specification shall not relieve the vendor of the responsibility of furnishing glass flake lining materials of proper design, materials and workmanship to meet the specified requirements.

e) In case of deviation, it shall be listed in the vendor's proposal under separate section titled as “list of deviations/exceptions” to the enquiry documents. Any deviation not mentioned in this list , but mentioned elsewhere in the proposal will not be considered.

2.0 CODES AND STANDARDS:

The glass flake lining shall conform to the latest version of Indian/British/American/International Standards. Nothing in this specification shall construe to relieve the contractor of the required statutory responsibility. The Glass Flake Lining material shall be designed for the corrosion protection of the Slurry tank. The lining shall be glass flake filled vinyl ester based coating system. Only Proven material has to be offered by the bidder

REFERENCE STANDARDS:

ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers
ASTM E 337	Standard test Method for Relative Humidity by Wet and Dry Bulb Psychrometer

ASTM D 4618	Standard Specification for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application
ASTM D 5162	Practice for Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates
NACE Standard RP0178-2003	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be lined for Immersion Service
ISO 8501-1, 1988	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness
SSPC"PA2	Measurement of Dry Paint Thickness with Magnetic Gauges

3.0 QUALIFYING REQUIREMENTS

(1) Glass Lining material selected should have been used in Wet Limestone based FGD application for *coal fired power plants* or similar corrosive environment for minimum 2500 sq.m for atleast one (1) project.

(2) The lining material should have completed minimum ***2 years of operation*** reckoned as on/before the date of techno-commercial bid opening of the tender/enquiry.

(3) The manufacturer should have designed, manufactured, supplied and supervised the installation of Glass lining of the referred plants.

(4) Any Patch work/repair work will not be considered as experience/qualifying requirement unless it is done for the entire area.

(5) Performance certificate from end user for meeting the above qualifying requirements altogether shall be provided by the bidder.

Lining material shall be supplied from such manufacturer who has got the proven material and meets the above Qualification requirements. Performance certificate from end user for meeting the above qualifying requirements altogether shall be provided by the bidder.

4.0 SCOPE OF SUPPLY

a) Complete selection and procurement/manufacture of all materials required for lining, storage, preparation of the surfaces for lining near site and installation of lining. All equipments required for lining shall be arranged by the lining vendor. Testing and supply of glass flake lining material for the duty condition specified in Table-1.

b) Erection and Commissioning of the glass flake lining as per the requirement. Delivery of material to site, Storage of the material, surface preparation of the surfaces to be lined, lining

the surface to the satisfaction of the customer and testing the lined surface for proper adhesion, complete coverage and intactness with the base material/surface shall be under bidder's scope, cost for Erection and Commissioning shall be included in the offer. The lining shall extend through all internal surfaces and over flange faces. The lining shall cover all the baffles inside the tank.

c) To install the linings, full scaffolding access shall be provided to reach the internal walls and the entire area. Scaffold shall be properly erected with full planking in all work areas. Scaffolding shall not contact wall surfaces in work areas during lining application and surface preparation

d) The execution of the surface preparation and lining shall be carefully planned in stages to obtain optimum lining quality with freedom from contamination and overspray or damage to lined surfaces from preparation in adjacent areas. Surface preparation will commence from the top and proceed progressively to the wall base and floor.

e) Lining and preparation works shall be staggered or proceed progressively in order to meet cleanliness requirements or overcoating times indicated in this specification.

a) The total area to be lined/coated as indicated in this specification may vary +/-10%. Hence, after the completion of work the total area lined will be jointly calculated by BHEL and the vendor. Final payment will be made based on the calculated area. Lining price quoted by vendor per sq.m shall be considered for making the final payment.

b) Air-Compressor, Airless Spray pumps, hopper, blasting hose, lining hose, spray tip, blasting gun, spray gun and other equipment for blasting and spray application has to be arranged by lining vendor. Power required for running the compressor, lighting, welding, cold storage, etc will be provided by BHEL free of cost. In case of Diesel compressor, vendor to arrange the diesel themselves. Water, if required, shall be provided by BHEL free of cost. Compressed air and instrument air will not be provided. Any cold storage container, if required, shall be arranged by vendor. Any scaffolding shall be made of Steel only. Scaffolding material shall be arranged by vendor. All travel, TA/DA, Stay charges, site visit charges shall be in vendor’s scope.

c) 10 copies of Operation and Maintenance Manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

5.0 ATMOSPHERIC CONDITION REQUIREMENTS

This section deals with the atmospheric condition requirement to be checked while undertaking the Glass Flake Lining at site.

1. Blasting or Coating shall not be applied if following conditions prevail.

   - When temperature of the surface to be coated is less than 3°C above the dew point, or the relative humidity is higher than 85%.

- When the base metal temperature is greater than 60°C.
- When the atmospheric temperature is below 4°C.
- When there is, in the opinion of lining Contractor, the likely hood of an unfavourable change in the weather condition within 2 hours after coating.
- When there is deposition of moisture in the form of rain or condensation.

2. Humidity shall be calculated by bidder using whirling hygrometer whose thermometers are calibrated.

3. Surface temperature shall be measured using suitable temperature gauge and calibration certificate of the same shall be provided by bidder.

4. Record will be maintained throughout the execution period. Readings shall be taken once in every 4 hours up to the time work is in progress. The frequency of reading should be increased during adverse weather conditions.

5. While working in unfavourable weather conditions (like monsoons or winters or if provided for in the contract or in large confined spaces where blasting and priming of the entire surface cannot be completed in one days operation, use of dehumidifier shall be resorted to. The dehumidification equipment will have to be maintained in such a way that the humidity is around 65% -75% inside the sump at all times during the work. No flash rusting of the blast surface should take place till the time it receives a primer coat.

6. Where dehumidification equipment is to be used the humidity readings are to be taken inside and outside the equipments to be coated.

7. Dehumidification equipment may not be necessary for contained space working if work is done at near ideal atmospheric conditions as described above.

8. In cases where dehumidification is not possible, alternate methods of warming up the work front like use of halogen lights, room heaters are to be adopted.

9. Humidity is to be taken at the location where the blasting coating operations taking place.

5.1 APPLICATION & MEDIUM:

Glass flake lining is done in order to protect the slurry tanks which contain limestone/gypsum slurry. Coated surfaces are exposed to slurry whose conditions are given in Table-1 . Typical Drawing of the Tanks is enclosed.

6.0 PRELIMINARY CHECK REQUIREMENTS

This section deals with the preliminary check requirements to be done while doing the lining work.

6.1 CHLORIDE CONTAMINATION TEST:

The 2% ferricyanide paper method will generally be used to determine the chloride contamination as described below:

1. Apply de-mineralized water on approximate 12 cm² area of substrate and wait for 3 to 4 minutes.
2. Remove excess moisture by patting the substrate with clean lint free cloth.
3. Press a ferricyanide paper of approximate 12 cm² area against the substrate for approximately 5 seconds and remove the paper.
4. Total absence of blue spots on paper indicates the substrate is free from soluble salts
5. Light speckling paper indicates the substrate has still contamination but it is as the acceptance level. The component should be released for further process.
6. Large blue spots on the paper indicate the substrate is heavily contaminated.
7. In this case the following procedure to be done before coating.
    i. Pressures wash the substrate with copious amount of town water.
    ii. Dry the substrate completely.
    iii. Re-blasts the surface.
    iv. Follow the salt contamination checking procedure again till you get the desired results.
8. The Ferricyanide papers should be stored by vendor in air tight container before and after use and the shelf life of Ferricyanide paper shall be one month.

6.2 ABRASIVE DRYNESS CHECK:

The abrasive to be used will be checked for dryness by taking a small quantity of abrasive on a filter /tissue paper and checking of traces of moisture absorbed in the filter/tissue paper. Frequency of test shall be once in day prior to blasting operation.

6.3 COMPRESSED AIR DRYNESS CHECK:

Compressed air to be used for blasting shall be free from oil & moisture and shall be tested adopting "Blotter Test" by vendor. A piece of blasting Paper will be held in front of blast hose nozzle to check for traces of oil/moisture captured by the blotting Paper. Frequency of test shall be once in day prior to blasting operation.

7.0 SURFACE PREPARATION

This section deals with the methods of surface preparation before coating application

7.1 MASKING:

1. Bidder to ensure that areas not being coated are fully and adequately masked.
2. Bidder to ensure that stud holes, dowel/oil ways etc. are suitably masked or plugged to prevent ingress of blasting abrasives.

7.2 SURFACE PREPARATION METHODS:

The method of surface preparation dry abrasive manual blasting shall be done as follows:

1. Surface to be coated shall be abrasive blasted. Before this operation, removal of existing coating to be carried out by chipping, grinding or by other suitable means. The walls of the tanks are painted with min 60µ DFT of Red Oxide Phosphate(rust proof primer), which is to be removed by vendor during blasting. Clean & dry Copper Slag Abrasive shall be used for ferrous base substrate.

2. Bidder is requested to go through all sections of the Typical GAD drawing of Slurry tank. Vendor my raise their observations during pre-bid query. Any other new requirements brought forward during technical evaluation stage shall not be considered by BHEL.

3. The minimum recommended compressed air required for Blasting shall be 7.0 m3/min at 6 kg/cm² pressure. NACE No.1/SSPC-SP-5 equivalent to SA 2½ of Swedish Standard blast profile (75 to 100 Microns) to be followed for cleaning the surface.

4. The blasted surface shall be cleaned with dry compressed air/vacuum cleaner or with clean brush so that there is no presence of Dust & other foreign material. The surface will be then checked for chloride contamination (Refer Clause.5.1 for Chloride contamination check procedure). If contamination is found then the surface to be washed and reblasted till contamination gets removed. Vendor to ensure that the blasted surface free from chloride contamination
5. When cleanliness and blast profile are acceptable, the masking tape adjacent to the area to be coated shall be peeled back to prevent overlap and subsequent edge contamination.

6. If the blasted surface has not been primed within specified time or if there is any previous visible sign of blast condition change then the surface shall be checked for metallic salt contamination and shall be reblasted. Where large areas are required to be blasted in a day, blasting shall be carried out from morning to evening ensuring weather condition. This shall be followed by a light sweep blast of the entire area, before priming. The blast cleaned surface shall be blown off with dry oil free compressed air or vacuum cleaned. A cell tape shall be thoroughly pasted to the cleaned surfaces. The tape shall be removed after a minute to check presence of dust if any. Comparator shall be used by vendor for checking the blast profile.

8.0 COATING APPLICATION

This section deals with the methods & requirements of coating application.

8.1 MIXING:

1. All coating material tins shall be individually stirred thoroughly to obtain a homogenous consistency.
2. While doing spray application, the tins which come in pre measured kits will be fully mixed individually using a pneumatic stirrer. While doing hand application only small batches of 1 Kg. capacity shall be taken. Here the mixing will be done by using a metal spatula.
3. The mixing ratios as specified in the respective data sheet will be strictly adhered to. The base will be weighed out in kgs using mechanical weighing machines calibrated at site using any standard factory packed commercial product available freely in the market. The catalyst will be measured out in ML using marked syringes or measuring cylinders.

8.2 APPLICATION PROCESS:

1. The preparation and application of coating is done as per relevant product data sheet. Reference will be made to product datasheet or where appropriate, contract specifications for carrying out coating.
2. Coating in confined spaces should be done when the ambient temperature is low to avoid excess build up of styrene fumes.
3. The entire thickness will be built in multiple coating.
4. Each coat will consist of minimum two passes of wet on wet in perpendicular directions.
5. The Dry film thickness will built of each coat will be checked and recorded.
6. All the other people working with the paint will be provided with eye splash goggles and masks.
7. Glass flake lining material shall be chosen considering the slurry conditions given in Annexure-III
8. Minimum and maximum intercoat intervals are as follows.
    a. For primer coat -At 20ºC minimum 2 hours, maximum 14 hours.
    b. For build-up coats-minimum tack free of previous coat, maximum 3 days.
9. Primer coat shall be of 75-100 µm thickness
10. Built up Coat shall be of 3000-3100 µm in multiple coats.
11. Total System DFT: 3000 microns approx
12. All weld joints phase transition joints will receive a stripe coat by brush in the same sequence of coating on the shell.

8.3 CURING & FINISH:

1. Curing:

The completed linings shall be allowed to cure for a minimum of 48 hrs at 30°C prior to being placed in service. However, curing time shall be as per the datasheet provided by vendor for a proven material.

2. Finish:

It is to be noted that the coating will follow the profile of substrate. Any unevenness or other defects in the substrate may be reflected in the finish coating also. The finished coating shall have a matt/semi-glossy finish. A few local paint sag marks will not affect performance of coating and cannot be completely avoided. Hence this is permitted.

9.0 INSPECTION AND TESTING OF GLASS FLAKE LINING

After the completion of lining, the following tests shall be conducted by the vendor to assess the quality of glass flake lined surfaces.

1. Lining shall be visually inspected to ensure that it shall be free from poor weed out fibers, entrapped air and exposed fires. The Glass flake lining shall also be subjected to testing at site as per relevant standards.
2. Testing of coatings is normally carried out as soon as they are sufficiently cured to give true thickness & to withstand damage by the test equipment. If defects are found, repair will be carried out as per clause 10.0
3. Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct holiday test as per relevant standards. If the performance is found not to meet the requirements as specified, the Glass flake lining shall be rectified or replaced by the Vendor without any additional cost to the Purchaser. The repair shall be carried out as per clause 10.0

4. Proper documentation with details of tests conducted by the vendor for evaluation of glass flake lining shall be submitted to the purchaser.

10.0 REPAIRING PROCEDURE FOR GLASS FLAKE COATING

1. If the exposed or damaged surface less than 10cm² then such repair can be carried out without grit blasting. Any area in excess of this amount should be grit blasted using a vacuum blaster where possible.
2. In case of damage area less than 10cm² then it can be repaired as following.
    a. De-contaminate surrounding area by using a suitable solvent such as methylated spirit, acetone, xylene etc. After washing clean and allow solvent to evaporate.
    b. Roughen up exposed metal & clean using rotary wire brush or a coarse emery paper with at least 60 grade grit. Brush away residues then further roughen surface of the existing coating up to 100 mm away from the damaged area. Brush away residues & ensure the whole area is clean.
    c. Apply a thin coat of material to the surface of the exposed metal only taking care not to cover more than a few millimetre of the existing coating. Allow this freshly applied material to become tack-free.
    d. Brush styrene monomer over the whole surface to be repaired (i.e. the whole area roughened by emery) & allow to evaporate from the surface.
    e. Apply at least 2 main coats material over the treated area taking care not to brush on to any roughened or contaminated areas. The Glass flake should be allowed to harden sufficiently to bear the weight of next coat before application of further coats. However it does not need to be tack-free between coats.

11.0 PERFORMANCE GUARANTEE

The lining shall be guaranteed for uninterrupted minimum life of 25,000 hrs. Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Glass Flake lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

12.0 PACKING

The part items of the Glass flake lining should be identified by Tag numbers and should be packed as to minimize the possibility of damage during storage or transit. The packing should be suitable for tropical conditions. BHEL site will arrange for the space for storage. Vendor shall make arrangements for storing the Glass flake lining materials in AC containers at site. The list of items identified as despatchable units shall be furnished along with unit weight and the quantity for preparation of packing slip at BHEL end for dispatch to site and for easy identification, storage and erection at site.

Table -1 Process Parameters

The tanks will be handling slurry whose details are given below:

Sl. No.	Parameter	Slurry
1	Slurry to be handled	Limestone/Gypsum Slurry
2	Maximum solid particle size	From 75 micron to 7 mm
3	Normal solid particle size,d50	325 mesh (43 micron)
6	Chloride concentration	30,000 ppm (max)
7	Hardness of particle	5-7 (Mho scale)
8	Slurry concentration	30 wt%
10	Sp. Gravity of Slurry	1.22
11	Sp. Gravity of Limestone or Gypsum	2.32
12	Viscosity	3 cP to 30 cP
13	Temperature(de	70 deg C

Note: Lining material chosen shall withstand a maximum service temperature of 85 deg C.

ANNEXURE - I

TECHNICAL DEVIATION (IF ANY)

Enquiry No:

Sl. No	Sec / Clause no.	Specification	Statement of deviations/variations	Reason for deviation	Cause of withdrawal
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Note: All deviations/exceptions, if any must only be given in the Deviation Schedule. Any deviation/ exception mentioned elsewhere would not be considered for evaluation.

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

NAME ----------

DESIGNATION ----------

ANNEXURE – II- SCHEDULE OF GUARANTEES

We , _____,

guarantee that the Glass Flake Lining Lining proposed for this project will have an uninterrupted minimum life of **25,000 hrs.**

The lining is guaranteed for faultless material and workmanship and also for a period as mentioned above from the date of handing over. During the Guarantee period any defects noticed due to faulty material and workmanship, the same shall be rectified by us free of cost.

SIGNATURE OF BIDDER (Glass Flake resin Manufacturer) ----------

NAME ----------

DESIGNATION ----------

ANNEXURE – III

REFERENCE LIST as per format shown below.

S. No.	Project Name , Customer & Plant capacity	Coal fired Yes/No	Wet Limestone Based FGD (Yes/No)	Year of Commg	Glass Lining Area

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

NAME ----------

DESIGNATION ----------