BIFPCL- MAITREE 2X660 MW
FLUE GAS DESULFURIZATION SYSTEM

TECHNICAL SPECIFICATION

FOR

RUBBER LINING FOR TANKS

CUSTOMER : **BIFPCL Bangladesh**

BIFPCL:MAI: RUBBER LINING TANKS:016: REV 00

Prepared	Checked	Approved
S. Shanmuga Sundaram		
Shanmuga Sundaram S Dy.Mgr/FGD	**KABILASH KM** **Senior Engineer/FGD**	**R Babu** **DGM/FGD**
R00 dated 22-02-19		

CONTENTS

1.0 PROJECT INFORMATION:

a.	Owner	BIFPCL (BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED), Bangladesh
b.	Buyer	BHEL, Ranipet
c.	Process/Application	Flue Gas Desulphurization

A) SITE CONDITIONS

1.	**Ambient Temperature and Relative Humidity**		
a.	**Average Site Condition ASC**		
	Ambient Temperature	:	27.3 deg C
	Ambient Humidity	:	87%
	Ambient Pressure	:	1007.6 mbar
b.	**Summer Site condition SSC**		
	Ambient Temperature	:	36.9 deg C
	Ambient Humidity	:	60%
	Ambient Pressure	:	1007.9 mbar
c.	**Winter Site condition WSC**		
	Ambient Temperature	:	12.2 deg C
	Ambient Humidity	:	100 %
	Ambient Pressure	:	1017.2 mbar
d.	**Reference Site condition RSC**		
	Ambient Temperature	:	31 deg C
	Ambient Humidity	:	88%

	Ambient Pressure	:	1007 mbar
2.	**Design ambient conditions for Equipments**		
a.	Maximum Design temperature (outdoor)	:	45 deg C
b.	Maximum daily average ambient shade temperature	:	38 deg C
c.	Maximum monthly average temperature (in the shade)	:	34.6 deg C
d.	Maximum annual average temperature (in the shade)	:	27.3 deg C
e.	Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms	:	40 deg C
f.	Maximum design temperature of the electrical equipment installed indoors in non-air conditioned rooms	:	45 deg C
g.	Minimum design temperature	:	0 deg C
3.	**Plant Elevation**	:	+5.0 m above sea level
4.	**Wind Load**	:	As per Bangladesh National Building code-2012, Part-6, Chapter 2.4
a.	Basic Wind speed, three-second gust at 10m above ground in exposure C, having a return period of 50 years	:	73 m/s, Exposure category-"C"
5.	**Seismic Load**	:	Seismic Zone 1 as determined by Bangladesh National Building code (BNBC-2012)

Note:

1) Equipment and Material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

B) PROJECT LOCATION AND APPROACH

a.	State/Division	**Khulna**
b.	District	Bagerhat district
c.	Place	Moithara Village, Rampal Upazila
d.	Location	Latitude- 22 deg 37' 0" to 22 deg 34' 30"N Longitude- 89 deg 32'0"E to 89 deg 34'5"E

C) APPROACH TO SITE:

The nearest town Khulna is at a distance of 23 km from project site. The site is connected by road from Mangla- Khulna Highway. Nearest Domestic airport is Jessor, Bangladesh at a distance of about 107 KM and international airport is Dhaka at a distance of 263 KM, Bangladesh. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given above is for general guidance and shall not be contractually binding on the Owner. Bidders shall obtain clarifications/ information, if any, before submitting their offers, regarding scope of work, facilities available at sites, etc. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above. All relevant site data/ information as may be necessary shall have to be obtained/ collected by the Bidder.

2.0 INDENT OF SPECIFICATION

1 This Specification and the attached Data sheets defines the minimum requirements of Rubber Lining for various slurry Tanks sumps for use in the process of Flue Gas Desulphurization (FGD)

2 The gypsum / Limestone slurry will be store in the sumps slurry tanks specific gravity, Dimension, thickness of rubber lining etc., for each Tanks are furnished in Table-1 and Table-2.

3 This specification covers the general design, selection of rubber materials, construction features, manufacture, shop inspection, testing at manufacturer's works (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 surfaces, lining the surfaces to the satisfaction of the customer.

4 Compliance to this specification shall not relieve the vendor of the responsibility of furnishing Rubber lining materials of proper design, materials and workmanship to meet the specified requirements.

5 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.

3.0 APPLICABE CODES AND STANDARDS:

The rubber lining shall conform to the latest applicable International Standards (British/American/Japanese standards). Indian standards are not acceptable. Nothing in this specification shall construed to relieve the contractor of the required statutory responsibility.

4.0 QUALIFYING REQUIREMENTS

Rubber Lining for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such bidders(s) who has previously executed this lining application for coal based thermal power station for Wet Limestone based FGD application or similar corrosive environment of min 2500 Sq.m for atleast 1 project such that the lining should have been in successful operation for a period not less than two (2) year reckoned as on the date of bid opening. Proof of such experience (End user certificate/performance certificate) shall be submitted along with the offer.

5.0 SCOPE OF SUPPLY

1 Design, manufacture, testing and supply of rubber lining material for the duty condition as specified in Table-1 and Table -2.

2 Delivery of material at site, scaffolding material supply and erection inside the tank ,surface preparation for lining surfaces ,deputing of personnel to site for lining the surface to the satisfaction of the end customer boarding and lodging, travel arrangement to and fro from site shall be under bidder's scope, cost for Erection and Commission shall be included in the offer.

3. Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. In addition, One (1) copy of operation and maintenance manuals shall be translated into "Bangla" and provided as paper copies and in electronic format

6.0 SURFACE PREPARATION

1 The Tanks and sump surface to be lined should be blasted to a bright grey metal finish (Sa 2½ requirement), free from rust, weld marks, oil and any other foreign matter. The blasting is carried out with the help of dry grit (copper sludge)/Sand under dry air pressure of 7 kg/cm2 by Compressor. Surface roughness shall be 50-60 Microns.

2 After blast cleaning, blasted surface will be applied by surface protecting primer to prevent the corrosion. After 100% blasting is completed, the surface is cleaned by appropriate solvent, so as to see that all the small dust particles are removed. Sharp corner shall be suitable rounded off. Surface should not have any sharp notch.

3 After this procedure suitable bonding agent and 3 to 4 coating of the specially formulated rubber adhesive should be applied for proper bonding of the Rubber Sheets to be lined.

4 Compressor and any other facilities required for grit \shot blasting shall be arranged by vendor. Any hoses provided in the compressed air line shall be tested with air before commencement of grit blasting job.

5 The grit\shot blasting machine shall be provided with safety valve (safe trip) as a protection against over pressure.

6 Any scaffolding provided by the vendor shall be of steel only.

7 Applicable standards: BS 6374 part V or equivalent international standards.

7.0 RUBBER LINING

1 The lining shall completely cover the roof, sides and internals of Slurry Tanks and sumps, support angle, insert plates, openings, Man Hole / Inspection / Flange openings.etc., Rubber lining shall be applied by vendor at site.

2 The rubber used for the lining of the tank is given below:

S.No	Tank	Rubber Lining
1.	Auxiliary Absorbent Tank	4 mm thick Bromine Butyl Rubber Lining with hardness 53±5 (Shore A Hardness).
1	Other Slurry and Sumps Tanks , Vacuum belt filter area as per table 1	4 mm thick Chloro butyl rubber lining with hardness 53±5 (Shore A Hardness).

3 After Rubber sheet applied on the surface, rubber sheets should be systematically pressed to the metal surface by the help of mechanical tools like Rubber Rollers and metal thin rollers to remove the air between metal and rubber sheet. All rubber joints are properly overlapped by 25 to 35 mm wide tapered cut rubber sheet. All the joints will be covered by 75 mm X 1.5 - 1.7 mm thick rubber strip.

4 Maximum service temperature of rubber – 85 deg c (continuous) including adhesives & primer.

5 Vendor shall specify the shelf life of the rubber material being supplied and shall furnish the storage methods to be followed at site to ensure that the rubber material shall not be spoilt during storage.

6 Vendor shall submit the surface preparation and lining procedure to the purchaser for approval. The lining work shall start only after obtaining approval from Purchaser

7 Applicable standards: BS 6374 part V or equivalent International standard.

8.0 INSPECTION AND TESTING OF RUBBER LINING

1 Ageing Test : 70°C for 24 hrs.
Change in Tensile Strength: ± 5%
Elongation at break : ± 10%

2 Abrasion Test : Wt. loss – Max. 25%

3 Tensile Strength : ≥ 2 MPa for 4 mm thk Rubber specimen.

4	Elongation at break	:	≥ 400% minimum for 4mm thk rubber specimen
5	Peeling strength	:	≥ 3 N/mm
6	Hardness	:	53 ± 5° Shore A
7	Spark Test	:	3-4kv/mm

8 Lining shall be visually inspected to ensure free from poorly weed out fibers, entrapped air and exposed fires. Defects are to be repaired by slandering a generous area around the defected portion and applying a layer of rubber material.

9 Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct test as per relevant standards.

10 After installation, the Rubber lining shall be subjected to testing at site as per relevant standards. If the performance is found not to meet the requirements as specified, the Rubber lining shall be rectified or replaced by the Vendor without any extra cost to the Purchaser.

8.1 FINISHING & INTERNAL TESTING

1 Rubber surface of all flanges and manhole of Equipment shall be finished by the mechanical tools to get leakage free surface during commissioning.

2 After above finishing, 100% testing shall be carried out for continuity by high frequency high voltage spark tester. If there is any puncture, they are checked and rectified as per the standard procedure of repair (Clause 7.1) as mentioned in procedure.

8.2 REPAIRING PROCEDURE

1 Faulty spots on the rubber lining are cut off down to be substrate and the seams of the remaining rubber are beveled.

2 Rubber sheet with a broad bevel cut is glued on the substrate laid bare.

3 On spots to be repaired of a diameter < 300 mm a second layer of Rubber sheet is glued covering the seams of the first layer.

4 Several spots to be repaired in a small area are jointly covered with a second layer of Rubber sheet.

9.0 PERFORMANCE GUARANTEE

1 Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Rubber lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. The lining should be guaranteed for faultless material and workmanship and also for a period of 24 months from the date of handing over. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

10.0 PACKING

1. The part items of the Rubber 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. Vendor should specify the storage requirements for the Rubber lining materials.
2. The list of items identified as dispatch able 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.

11.0 DOCUMENTATION

11.1 DOCUMENTS TO BE ENCLOSED ALONG WITH THE OFFER

1 Write-up on technical features of rubber lining offered along with Catalogues, Resin composition, drawings etc.

2 Data sheets duly filled in for the Rubber lining material.

3 The erection sequence/Procedure of the Rubber lining. Detailed flow chart from start to finish of the lining to be furnished. Application procedure.

4 Man days required to complete the Rubber lining for each area is to be spelt from start to finish.

5 Vendor should clearly indicate the following:

- Utility/Utilities from customer/purchaser required for Rubber lining at site.
- Storage facility requirement for Rubber lining materials

6 Vendor should clearly indicate the price for Rubber lining of carbon steel construction per Square meters to enable to meet any additional lining areas.

11.2 DATA TO BE FURNISHED BY THE VENDOR AFTER RECEIPT OF PURCHASE ORDER

1 List of Drawing and documents to be submitted for review, approval and information with submission dates

2 Quality Assurance Plan to be submitted for approval.

3 Detailed dimensional General Arrangement drawing of the lining surfaces.

4 This drawing shall indicate all the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc.

5 Installation, operation and maintenance manual.

6 Surface preparation and Lining procedures.

7 Catalogues, data sheets and drawings for Rubber lining.

Note:
The lining area indicated in Table 1 is only approximate. This area includes wall area and area of supports. During actual lining work at site, the area may be varying from the indicated area. In such case, BHEL clarifies that payment shall be made for lining work of the actual area based on justification and proof given by the vendor.

TABLE -1

Dimension of slurry tanks and sumps.

Sl.No	Description	Rubber linning thickness	MOC of Tank	Tank Dimensions (meter)	Surface area of Tanks (m^2) (Shell, Base and Roof,supports)	Number of Tanks	Total area (m^2) (including support)
1	**LIMESTONE SLURRY STORAGE TANK(CIRCULAR)**	4 mm chloro butyl	Carbon steel	Dia =9.4 , Height = 11.3	Shell surface area = 333.54 , base and Roof Surface area = 138.73 , Supports surface area = 47.23	2	1039
2	**AUXILIARY ABSORBENT TANK(CIRCULAR)**	4 mm bromo butyl	Carbon steel	Dia =12 , Height = 12	Shell surface area = 452.16 , base and Roof Surface area = 226.08 , Supports surface area = 67.83	1	747
3	**FILTRATE WATER TANK(CIRCULAR)**	4 mm chloro butyl	Carbon steel	Dia =3.2 , Height = 3.8	Shell surface area = 38.19 , base and Roof Surface area = 16.08 , Supports surface area = 5.43	2	120
4	**WASTE WATER HYDROCYCLONE FEED TANK(CIRCULAR)**	4 mm chloro butyl	Carbon steel	Dia =3 , Height = 3.6	Shell surface area = 33.92 , base and Roof Surface area = 14.13 , Supports surface area = 4.81	2	106
5	**WASTE WATER STORAGE TANK(CIRCULAR)**	4 mm chloro butyl	Carbon steel	Dia =2.7 , Height = 3.2	Shell surface area = 27.13 , base and Roof Surface area = 11.45 , Supports surface area = 3.86	2	85

6	**ABSORBER AREA DRAIN SUMP (RECTANGULAR)**	4 mm chloro butyl	Concrete	Width=4.0m Length=4.0m Dia=4.0m	Shell surface area = 64 , base and Roof Surface area = 24	2	176
7	**LIMESTONE AREA DRAIN SUMP (RECTANGULAR)**	4 mm chloro butyl	Concrete	Width=4.0m Length=4.0m Dia=4.0m	Shell surface area = 64 , base and Roof Surface area = 24	1	88
8	**GYPSUM AREA DRAIN SUMP(RECTANGULAR)**	4 mm chloro butyl	Concrete	Width=4.0m Length=4.0m Dia=4.0m	Shell surface area = 64 , base and Roof Surface area = 24	1	88
9	**VACUUM BELT FILTER AREA**	4 mm chloro butyl	Concrete	Length=14 Width=4.0	Vacuum belt filter floor area =56	4	224

Note:

1 **Bidder should clearly indicate the price for Rubber lining per Square meters to enable to meet any additional lining areas. Payment will be as per the actual also for which rubber lining is carried out.**

2 **All these tanks and sumps are fitted with an agitator. Tank base and agitator zone are subject to abrasion. Rubber lining shall be selected considering the anti abrasion effect.**

Table-2 Process Parameters:

SLURRY ANALYSIS	FILTRATE WATER TANK	WASTE WATER HYDROCYCLONE FEED TANK	WASTE WATER TANK	LIMESTONE SLURRY STORAGE TANK	AUXILIARY ABSORBENT TANK
SLURRY TO BE HANDLED	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry
MAXIMUM SOLID PARTICLE SIZE	200 mesh (75 micron)	200 mesh (75 micron)	200 mesh (75 micron)	200 mesh (75 micron)	200 mesh (75 micron)
NORMAL SOLID PARTICLE SIZE, D50	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)	325 mesh (43 micron)
SOLID TO BE HANDLED	Gypsum along with Lime Stone and other impurities	Gypsum along with Lime Stone and other impurities	Gypsum along with Lime Stone and other impurities	Lime Stone and other impurities	Gypsum along with Lime Stone and other impurities
CHLORIDE CONCENTRATION	27,000 ppm (max)	27,000 ppm (max)	27,000 ppm (max)	300 ppm (max)	27000 ppm (max)
HARDNESS OF PARTICLE	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)	5-7 (Mho scale)
SLURRY CONCENTRATION	12.5 wt%	16.6 wt%	3.0 wt%	30 wt%	30 wt%
SP. GRAVITY OF SLURRY	1.085	1.117	1.029	1.22	1.22
SP. GRAVITY OF LIME STONE & GYPSUM	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)
VISCOSITY OF SLURRY	0.003 Pa.S	0.004 Pa.S	0.003 Pa.S	0.03 Pa.S	0.01 Pa.S
PH	04-08	04-08	04-08	05-08	04-08
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

SLURRY ANALYSIS	ABSORBER AREA DRAIN SUMP	LIMESTONE AREA DRAIN SUMP	GYPSUM AREA DRAIN SUMP	VACUUM BELT FILTER AREA
SLURRY TO BE HANDLED	Gypsum slurry	gypsum slurry	Gypsum slurry	Gypsum slurry
MAXIMUM SOLID PARTICLE SIZE	6 to 7 mm	6-7mm	6 to 7 mm	6 to 7 mm
NORMAL SOLID PARTICLE SIZE, D50	325 mesh (43 micron)	325 mesh 43 micron	325 mesh (43 micron)	325 mesh (43 micron)
SOLID TO BE HANDLED	Gypsum along with Lime Stone and other impurities	limestone and other impurities	Gypsum along with Lime Stone and other impurities	Gypsum along with Lime Stone and other impurities
CHLORIDE CONCENTRATION	27000 ppm (max)	27000 ppm(max)	27000 ppm (max)	27,000 ppm (max)
HARDNESS OF PARTICLE	5-7 (Mho scale)	5-7 mho scale	5-7 (Mho scale)	5-7 (Mho scale)
SLURRY CONCENTRATION	30 wt%	30 wt%	30 wt%	45 wt%
SP. GRAVITY OF SLURRY	1.22	1.22	1.22	1.22
SP. GRAVITY OF LIME STONE & GYPSUM	2.32 (Avg)	2.32(avg)	2.32 (Avg)	2.32 (Avg)
VISCOSITY OF SLURRY	0.01 Pa.S	0.03 pa.s	0.01 Pa.S	0.01 Pa.S
PH	08-10	04 to 08	08-10	4-8
SIO_2 CONTENT	4 to 6 g/l	4-6 g/i	4 to 6 g/l	4 to 6 g/l

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

S.no	Clause	Page	Description of Deviation

Note: Enlarge the table to incorporate items

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

NAME ----------

DESIGNATION ----------

ANNEXURE – II

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	Rubber Lining Area

NOTE: Performance certificate (End user feedback) shall be submitted for meeting the qualification requirement.

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

NAME ----------

DESIGNATION ----------

ANNEXURE – III

Sea Worthy packing as per specification REF : PE-TS-888-100-A001

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

NAME ----------

DESIGNATION ----------

ANNEXURE – IV

Refer to Health & Safety Management Manual.

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

NAME ----------

DESIGNATION ----------