
TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS

CONFIDENTIAL

CUSTOMER : M/s. BIFPCL Bangladesh
PROJECT : Maitree 2X660MW
APPLICATION : FLUE GAS DESULPHURIZATION SYSTEM
TECH SPECIFICATION NO : BIFPCL: MAI: FGD: CSRLP - 1: R00



BHARAT HEAVY ELECTRICALS LIMITED

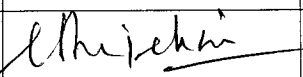
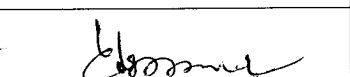
(A GOVT OF INDIA UNDERTAKING)

Flue Gas Desulphurization Group

Ranipet

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BIFPCL:MAI:FGD:CSRLP-1:R00	

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Department	Prepared	Checked	Approved
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Revision – 00 Dated 22/10/2019		COMMENTS : -----	

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CONTENTS

1.0	GENERAL
2.0	SCOPE OF WORK
3.0	QUALIFICATION REQUIREMENT
4.0	DESIGN CONDITIONS
5.0	TECHNICAL SPECIFICATION OF RUBBER LINED PIPE
6.0	GENERAL REQUIREMENTS
7.0	PACKING & FORWARDING
8.0	SUPERVISION OF ERECTION
9.0	INSPECTION AND TESTING
10.0	PAINTING
11.0	PERFORMANCE GUARANTEE
12.0	WARRANTY
13.0	DOCUMENTATION
14.0	ANNEXURES Annexure- 1 : Bill of quantity(BOQ) Annexure- 2 : Technical specification of piping fabrication & Rubber lining Annexure- 3 : Typical Quality plan for Inspection & Testing Annexure- 4 : Painting Specification Annexure- 5 : List Of Deviations

	TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS - MAITREE 2X660MW
BIFPCL:MAI:FGD:CSRLP-1:R00	

1.0 GENERAL

1.1 This specification covers requirements of Carbon Steel Rubber lined (CSRL) pipes and fittings for interconnecting process line of FGD, Maitree 2x660 MW.

A) 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

B) 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.

C) APPLICABLE CODES & REGULATIONS:

The design of Piping and Lining shall conform to the latest edition of International codes as mentioned in the specification. Any Indian standards Material and GB Standards (Chinese) Material is not acceptable.

2.0 SCOPE OF WORK

2.1 *Scope of supply and work by the Bidder is as follows:*

- 2.1.1 Fabrication of metal pipe & fittings with vendors raw material along with flanges & stubs as per BHEL drawing which will be issued after award of contract.
- 2.1.2 Bidder to submit offer for the Supply of Rubber lined Piping & fitting as per the Bill of Quantity specified in Technical Specification –Annexure-1 Table-1 to 5. The Quantity specified in the table are indicative only. The actual quantity may vary $\pm$ 10% according to the fabrication drawings. Bidder to note and quote accordingly.



**TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS -
MAITREE 2X660MW**

BIFPCL:MAI:FGD:CSRLP-1:R00

- 2.1.3 The BOQ is arrived at as per actual requirement of pipeline, however in the course of field erection adjustment spool pieces may be required to complete the pipe line. These adjustment spools requirements will be supplied by vendor as per field requirement with out any additional price implication.
- 2.1.4 Bidder shall submit the detailed bill of quantity (BOQ) / Billing Break Up (BBU) after receipt of BHEL Drawings within Ten (10) days from the receipt of LOI.
- 2.1.5 Rubber lining work including surface preparation for metal pipe. Rubber as per specification is in vendor's scope.
- 2.1.6 Painting work including surface preparation of the outer surface of piping
- 2.1.7 Test and inspection as per the applicable standards.

2.2 Scope of the Purchaser is as follows:

- 2.2.1 Bill of Quantity excluding fasteners and gaskets. (Refer Annexure-1-BOQ)
- 2.2.2 Fabrication drawings will be provided by BHEL after award of contract.
- 2.2.3 On award of contract to the successful bidder BHEL will issue fabrication drawings for which vendor shall submit BBU. BHEL will issue necessary P.O amendment on receipt of BBU from the vendor with out any price impact.

3.0 QUALIFICATION REQUIREMENT

The Qualification requirements for Carbon Steel Rubber Lined (CSRL) Pipes & Fittings are detailed below and Bidders should meet the same. Offers of bidders who do not meet qualification requirement will not be considered for evaluation:

- Bidder should have manufactured & supplied the CSRL Pipes & Fittings for slurry handling application of size minimum 300NB.
- References for such two different projects shall be furnished. The application shall be in any of power plant / industrial / process plant.
- The installed pipe & fittings should have been in successful operation for not less than one year as on date of techno commercial bid opening.
- The bidder shall submit documentary evidence for manufacturing & supply of the aforesaid requirements such as: PO copy, approved drawings / documents, delivery challan, etc.

General Conditions:

- Bidder to submit duly signed copy of the documentary evidence.
- Bidders who defaulted, in any of the previous tenders floated by BHEL are not permitted to respond. Such offers, if found later, will not be considered for evaluation.



TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS - MAITREE 2X660MW

BIFPCL:MAI:FGD:CSRLP-1:R00

- After receipt of offers, during scrutiny, if any vendor found to have been banned by BHEL (or) found submitted any false document, then their offer will be summarily rejected at any stage.
- Bidder to make provision in case BHEL decides to visit the reference plant furnished by the bidder for meeting the PQR requirements.

4.0 DESIGN CONDITIONS

4.1 Design pressure and temperature.

4.1.1 The design pressure & temperature are 11.0 kg/cm² and 80 Degree C

4.2 Design Considerations

- 4.2.1 For steel pipes up to 500NB seamless steel pipes (or) ERW Pipes, forged flanges, and elbows shall be used. Pipe of sizes above 500NB, can be fabricated from plates.
- 4.2.2 If ERW pipes are used, the weld bead on the inner surface of the pipe shall be flushed to inside diameter for proper rubber lining.
- 4.2.3 The BOQ is arrived at as per actual requirement of pipeline, however in the course of field erection adjustment spool pieces may be required to complete the pipeline. These adjustment spools requirements will be supplied by vendor as per field requirement with out any additional price implication.

5.0 TECHNICAL SPECIFICATION OF RUBBER LINED PIPE

Refer **Annexure: 2- Technical Specification of Piping fabrication & Rubber Lining** for Physical & Chemical Properties, Surface Preparation, Liner application, Curing, Testing requirements etc.

6.0 GENERAL REQUIREMENTS:

S.No	Description
1.	Bidder to strictly follow & adhere to the drawings, specifications
2.	Suppliers shall suitable specify their delivery schedule along with the offer.
3.	Unless otherwise specified, flanges shall be in accordance with ANSI B16.5 Class 150.
4.	Bidder shall submit the signed and stamped copy of all the pages, which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer. a. "Accepted without deviation and considered in scope of work"



**TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS -
MAITREE 2X660MW**

BIFPCL:MAI:FGD:CSRLP-1:R00

S.No	Description
	b. "Not considered in scope of work"
5.	Bidder shall visit BHEL Ranipet for pre bid meeting as intimated by BHEL.
7.0	PACKING AND FORWARDING
1.	Packing shall be as per relevant clause of product packing .
8.0	SUPERVISION OF ERECTION
1.	The erection of CSRL Piping will be done by BHEL. However, the bidder shall depute their representative to supervise the erection of piping.
2.	Bidder to consider minimum thirty (30) days excluding holidays, travel, and weekly offs. A minimum of five (05) visits for the supervision of erection shall be considered and quoted as lumpsum.
3.	However, number of visits & duration shall be mutually discussed & finalized during erection stage. Bidder to confirm.
4.	All required travel expenditure, such as VISA fee, work permit (if any), boarding & lodging, insurance, other statutory requirements, etc. shall be borne by the bidder
9.0	INSPECTION & TESTING
1.	MQP (Manufacturing Quality plan) shall be submitted by the bidder along with the technical offer. Above mentioned item-wise inspection requirement is tentative only and shall be mutually discussed and finalized during detail engineering and approved by BHEL.
2.	Inspection of components and witness of testing shall be as per approved MQP
3.	Bidder shall offer fabricated pipes & fittings for inspection prior to rubber lining. Only after the clearance from BHEL, the rubber lining work shall commence. Necessary material test certificates, inspection reports, hydro test reports, etc. shall be submitted to BHEL for review & approval.
4.	Test certificates shall be issued for each lot of raw material used in the lining rubber, corresponding to specific weight and traction resistance.
5.	Testing of Rubber Lining shall be done in accordance with the Annexure: 2 of the Technical Specification and relevant international codes.

	TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS - MAITREE 2X660MW BIFPCL:MAI:FGD:CSRLP-1:R00
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S.No	Description
6.	Bidder should furnish performance guarantee as per applicable standard guarantee for the manufacture, material and safe operation of the equipment.
7.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
8.	Bidder to arrange all calibrated gauges, Instruments during inspection at works. All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
9.	Bidder may refer Annexure-3- Typical Quality Plan for Inspection & Testing Requirement.
10.0	PAINTING
1.	For painting requirement, bidder to refer Annexure-4-Painting Specification
11.0	PERFORMANCE GUARANTEE
	The lining shall be guaranteed for uninterrupted operation of FGD Plant. 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.
12.0	WARRANTY
1.	The warranty period shall begin on the date of taking over by BIFPCL or date of issuance of the provisional acceptance certificate for the unit-1 (23.08.2020) and for the unit -2 (23.02.2021) and shall end after twenty-four (24) months respectively. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.
2.	In case of failure of the equipment to meet the guarantee, BIFPCL/BHEL reserves the right



**TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS -
MAITREE 2X660MW**

BIFPCL:MAI:FGD:CSRLP-1:R00

S.No	Description
	to reject the equipment. However, BIFPCL/BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement.
13.0	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, and all such information, which are necessary to fully understand the offer for techno – commercial evaluation. As a minimum requirement, the following information shall be furnished to fully describe the scope of work and services offered. a. Bill of Quantity (BOQ) b. Technical Data sheet of Rubber Lining. c. Surface preparation and application procedure for Rubber lining d. Procedure for shop / site performance tests e. Time schedule for delivery. f. Typical manufacturing Quality Plan. g. Make of all bought out items. h. Deviation & clarification list (As per Annexure-5 –Format) The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified here under. However, as minimum the following shall be submitted. 1. Technical datasheet. 2. Bill of quantity as per BHEL drawing 3. Manufacturing Quality Plan 4. Operation & Maintenance Manual 5. Transportation and Storage Specification 6. Shop Inspection Specification 7. Shop Inspection Report 8. Supply Item List for Package Verification at Site 9. Packing List 10. Sub-Vendor List 11. Manufacturing Schedule 12. Progress Report

PIPE PREFABRICATION		PROJECT ITEM	JOB NO.	DRAWING NO.	PIECE NO.		
MARKING NO.			INSPECTION ITEM		CHECK	WELD INS	
			TACK - WELDING BEVELING		MATERIAL BEVELING – V TYPE GROOVE 30° 0 ~ 5° TACK WELDING DIMENSION FLATNESS PIPE, TEE & ELBOW α = 1.5 mm ≤ 100NB α ≤ 2.0 mm 125 to 250NB α ≤ 3.0 mm 300 to 600NB α ≤ 3.0 mm ≥ 600NB α ≤ 5.0 mm	FINISHED PRODUCT	
			REMOVAL OF SPATTER			CHECK	REINFORCEMENT OF WELD
			LEG LENGTH ≥ 1.41T				HEIGHT OF BEAD
			CHIPPING				SHAPE
			GRINDING				 ≤ 5R  ≥ 10R
			DIMENSION				L ≤ 1000mm ± 3.0 mm L ≥ 1000mm ± 3.0 mm
			INCLINATION OF FLANGE All size : α ≤ 2.5mm			ANGLE OF BEND θ ± 30°	
			APPEARANCE			MARKING	
			WELDING			REMARKS	
			PROCESS				
		PREHEAT					
		VOLTAGE					
		ELECTRIC CURRENT			RESULT	CHECKED BY	
		WELDING ROD					
NO	TYPE	MATERIAL	QTY	CSRL PIPE MANUFACTURER			
1				INSPECTED BY			
2				INSPECTED BY			
3							
4							
5							
6							
7				* PREFABRICATION WORK SHALL BE CARRIED OUT ACCORDING TO SPECIFICATION			

RUBBER LINING PIPE STEEL FABRICATION INSPECTION RECORD		PROJECT ITEM		MAITREE		INSPECTOR(BHEL)			INSPECTOR ()			PAGE
		ORDER NO.										
		DWG.NO.										
MARKING NO.	SHAPE DIMENSION	QTY	MATERIAL	BEVELING	TACK- WELDING	ANGLE OF FLANGE	ANGLE OF BEND	APPEARA NCE	RESULT	CHECK	REMARKS	

14.0 ANNEXURES:

Annexure-1: FGD Package - CSRL Piping System BOQ

TABLE-1- Rubber Lined Flanged Pipes-1 Set

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Pipe	50	SCH-40	275	m	These BOQ is indicated in running meter of CSRL Pipes. These items shall be fabricated as segmental pipes and rubber lined as per the BHEL Drawing with necessary flanges and stubs. The required quantity of flanges indicated in the table for pipe segment fabrication.
2		65	SCH-40	25	m	
3		80	SCH-40	465	m	
4		100	SCH-40	1240	m	
5		125	SCH-40	1600	m	
6		150	SCH-40	2060	m	
7		200	SCH-20	472	m	
8		250	SCH-20	500	m	
9		300	SCH-20	410	m	
10		350	SCH-10	180	m	
11		400	SCH-10	30	m	
12		500	SCH-10	45	m	
13	Slip On Flange	25	#150	10	no	
14		40	#150	6	no	
15		50	#150	500	no	
16		65	#150	24	no	
17		80	#150	530	no	
18		100	#150	1010	no	
19		125	#150	760	no	
20		150	#150	1734	no	
21		200	#150	276	no	
22		250	#150	320	no	
23		300	#150	162	no	
24		350	#150	384	no	
25		400	#150	36	no	
26		500	#150	36	no	
27	Flanged Stub (branch nozzle - 100 mm length)	25	#150	13	no	
28		50	#150	346	no	
29		80	#150	8	no	
30		100	#150	8	no	

Note:

1) Length mentioned in the table is the finished product dimension.

Annexure-1: FGD Package - CSRL Piping System BOQ**TABLE-2 – Rubber Lined Flanged Elbows & Bends – 1 Set**

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Flanged 90° Elbow (1.5D)	50	SCH-40	59	no	A/L- 110mm
2		65	SCH-40	6	no	A/L- 130mm
3		80	SCH-40	110	no	A/L- 150mm
4		100	SCH-40	165	no	A/L- 190mm
5		125	SCH-40	99	no	A/L- 195mm
6		150	SCH-40	486	no	A/L- 235mm
7		200	SCH-20	48	no	A/L- 310mm
8		250	SCH-20	42	no	A/L- 385mm
9		300	SCH-20	21	no	A/L- 465mm
10		350	SCH-10	96	no	A/L- 533mm
11		400	SCH-10	3	no	A/L- 609mm
12		500	SCH-10	14	no	A/L- 762mm
13	Flanged 45° Elbow (1.5D)	50	SCH-40	12	no	A/L- 90mm
14		80	SCH-40	3	no	A/L- 110mm
15		100	SCH-40	9	no	A/L- 125mm
16		125	SCH-40	23	no	A/L- 145mm
17		150	SCH-40	20	no	A/L- 165mm
18		200	SCH-40	3	no	A/L- 200mm
19		400	SCH-10	3	no	A/L- 340mm
20	Flanged 84° Elbow (1.5D)	50	SCH-40	5	no	A/L- 100mm
21		80	SCH-40	68	no	A/L- 145mm
22		100	SCH-40	95	no	A/L- 171mm
23		125	SCH-40	3	no	A/L- 171.5mm
24		150	SCH-40	3	no	A/L- 206.9mm
25		400	SCH-10	3	no	A/L- 548.9mm
26	Flanged 60° Elbow (1.5D)	150	SCH-40	3	no	A/L- 202mm
27		200	SCH-20	3	no	A/L- 249mm
28		250	SCH-20	16	no	A/L- 296mm
29	Flanged Bend - special (1.5D)	100 (64°)	SCH-40	18	no	A/L- 190mm
30		100 (75°)	SCH-40	36	no	A/L- 190mm
31		200 (40°)	SCH-20	2	no	A/L- 310mm
32		250 (75°)	SCH-20	18	no	A/L- 385mm

Note:

1) A/L –Arm Length

Annexure-1: FGD Package - MSRL Piping System BOM**TABLE-3– Rubber Lined Flanged Tees – 1 Set**

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Flanged Equal Tee	50	SCH-40	4	no	A/L- 110mm
2		65	SCH-40	2	no	A/L- 125mm
3		80	SCH-40	28	no	A/L- 130mm
4		100	SCH-40	8	no	A/L- 160mm
5		125	SCH-40	6	no	A/L- 180mm
6		150	SCH-40	11	no	A/L- 200mm
7		200	SCH-20	4	no	A/L- 240mm
8		250	SCH-20	7	no	A/L- 270mm
9	Flanged Unequal Tee	65x50	SCH-40	3	no	A/L- 125mm
10		80x50	SCH-40	18	no	A/L- 130mm
11		100x50	SCH-40	10	no	A/L- 160mm
12		100x80	SCH-40	7	no	A/L- 160mm
13		125x100	SCH-40	3	no	A/L- 180mm
14		250x150	SCH-20	3	no	A/L- 270mm
15		400x250	SCH-10	9	no	A/L- 365mm
16		500x250	SCH-10	5	no	A/L- 445mm
17	Flanged 84° Tee	125x100	SCH-40	3	no	A/L- 180mm
18		50x50	SCH-40	5	no	A/L- 110mm
19		100x80	SCH-40	5	no	A/L- 160mm

Note:

1) A/L –Arm Length

Annexure-1: FGD Package - MSRL Piping System BOM**TABLE-4– Rubber Lined Flanged Reducers – 1 Set**

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Flanged Concentric Reducer	40x25	SCH-40	5	no	A/L- 120mm
2		80x40	SCH-40	5	no	A/L- 150mm
3		80x50	SCH-40	5	no	A/L- 150mm
4		80x65	SCH-40	2	no	A/L- 150mm
5		100x50	SCH-40	16	no	A/L- 165mm
6		100x65	SCH-40	5	no	A/L- 165mm
7		100x80	SCH-40	2	no	A/L- 165mm
8		125x50	SCH-40	3	no	A/L- 195mm
9		125x80	SCH-40	5	no	A/L- 195mm
10		125x100	SCH-40	21	no	A/L- 195mm
11		150x80	SCH-40	5	no	A/L- 210mm
12		150x100	SCH-40	5	no	A/L- 210mm
13		150x125	SCH-40	7	no	A/L- 210mm
14		200x100	SCH-20	2	no	A/L- 225mm
15		200x125	SCH-20	3	no	A/L- 225mm
16		200x150	SCH-20	2	no	A/L- 225mm
17		250x100	SCH-20	7	no	A/L- 265mm
18		250x150	SCH-20	2	no	A/L- 265mm
19		350x200	SCH-10	3	no	A/L- 415mm
20		350x250	SCH-10	2	no	A/L- 415mm
21		350x300	SCH-10	3	no	A/L- 415mm
22		500x400	SCH-10	2	no	A/L- 600mm
23	Flanged Eccentric Reducer	40x25	SCH-40	5	no	A/L- 120mm
24		80x40	SCH-40	5	no	A/L- 150mm
25		80x50	SCH-40	5	no	A/L- 150mm
26		100x50	SCH-40	3	no	A/L- 165mm
27		100x80	SCH-40	5	no	A/L- 165mm
28		125x80	SCH-40	4	no	A/L- 195mm
29		125x100	SCH-40	2	no	A/L- 195mm
30		150x80	SCH-40	9	no	A/L- 210mm
31		150x100	SCH-40	3	no	A/L- 210mm
32		150x125	SCH-40	5	no	A/L- 210mm
33		200x150	SCH-20	2	no	A/L- 225mm
34		250x200	SCH-20	18	no	A/L- 265mm
35		350x250	SCH-10	3	no	A/L- 415mm
36		350x300	SCH-10	88	no	A/L- 415mm
37		400x250	SCH-10	5	no	A/L- 445mm
38		500x400	SCH-10	5	no	A/L- 600mm

Annexure-1: FGD Package - MSRL Piping System BOM**TABLE-5– Rubber Lined blind flanges – 1 Set**

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Blind flange	25	#150	6	no	
2		50	#150	6	no	
3		80	#150	8	no	
4		100	#150	8	no	
5		150	#150	12	no	
6		200	#150	6	no	
7		250	#150	6	no	

ANNEXURE -2

<u>PIPE SPECIFICATION</u>			
ITEM	Size	Thickness	Specification
PIPING	DN25 - DN50	SCH40	A53-B SML PE (I:R/L) ASME
	DN65 - DN150	SCH40	A53-B SML / E.R.W BE (I:R/L) ASME
	DN200 - DN300	SCH20	A53-B SML / E.R.W BE (I:R/L) ASME
	DN350 - DN400	SCH10	A53-B SML / E.R.W BE (I:R/L) ASME
	DN450 - DN500	SCH10	A53-B SML / E.R.W BE (I:R/L) ASME
	DN550 - DN1000	7.9T	A134(A283-C) EFW BE (I:R/L) ASME
	DN1100 - DN1200	9.5T	A134(A283-C) EFW BE (I:R/L) ASME
	DN1350 - DN1500	11.9T	A134(A283-C) EFW BE (I:R/L) ASME
	DN1600 - DN1800	12.7T	A134(A283-C) EFW BE (I:R/L) ASME
FITTING	DN25 - DN50	Suit to PIPE	BW A234-WPB (I:R/L) ASME-B16.9
	DN65 - DN150	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9
	DN200 - DN300	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9
	DN350 - DN500	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9
	DN550 - DN1000	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9
	DN1100 - DN1200	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9
	DN1350 - DN1500	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9
	DN1600 - DN1800	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9
MITER BEND	DN1350 - DN1500	Suit to PIPE	90 BW A134(A283-C) (I:R/L)
	DN1600 - DN1800	Suit to PIPE	90 BW A134(A283-C) (I:R/L)
FLANGE	DN25 - DN600		SO A105 ASME150 SO FF (I:R/L) ASME-B16.5
	DN650 - DN1800		SO A105 AWWA CL.B SO FF (I:R/L) AWWA-C207

ABBREVIATIONS

SML-Seamless

ERW- Electric Resistance Weld

PE-Plane End

I: R/L-Inner surface Rubber Lines

BE-Bevel End

BW-Butt Weld

SO-Slip On

FF –Flat Face

RUBBER LINING SPECIFICATION:

1. All pipes with flanges and all flanged fittings of the sizes NB25 and above are to be lined with **4mm thick Chlorobutyl Rubber Lining**.
2. Chlorobutyl Rubber shall be used for lining and the lining shall conform to BS: 6374
3. The number of plies of lining shall be decided by vendor.
4. Properties of Chlorobutyl Rubber shall be as below:

Physical Properties				
Test Item	Unit	Standard Value	Value	Test Method
Tensile Strength	kg/cm ²	>=	70	ASTM D412
Elongation at Break	%	>=	350	ASTM D412
Hardness	Shore A		55±5	ASTM D2240
Adhesive Strength	kg/cm ²	>=	20	ASTM D429
Specific Gravity	1.3 ± 0.04			
Design Temperature	80 Deg C (Continuous)			
Steam Osmotic Pressure	5E ⁻⁵ mg · mm/mm ² · mmHg · day or less			

5. Rubber lining to be applied after all processes like machining, cutting, welding, grinding, etc. Rubber material components shall be as per the following

Contents	%
Rubber	45
Inorganic reinforcing fillet filling material	45
Metallic Oxide	2
Vulcanizing agent	3
Others	5
Total	100
Vulcanizing conditions	3 kg/cm ² G, 143 Deg C Steam, 3-4 Hrs.

6. All sharp edges to be rounded off and weld shall be finished round and smooth before applying rubber lining.
7. The lining applicator shall submit data on the physical properties and characteristics of all rubber compounds to be used, to BHEL for review and approval as well as the procedure for lining application, curing, testing and quality control.

8. Surface preparation for Rubber lining:

8.1 All metal surfaces to which rubber is to be adhered must be clean and free from surface defects. All inside weld seams shall be ground smooth, all burrs removed and all construction scars repaired.

8.2 Degreasing Oil or grease attached on the interior surface of the piping component shall be removed by heating / pre curing at 100degC for 30 minutes in an Autoclave.

8.3 All metal surfaces to be lined shall be abrasive blast cleaned to a white metal condition (SA 2 ½ Grade Surface finish) in accordance with steel structures painting council specification SSPC-SP5

8.4 Care must be exercised to avoid contamination of the freshly blasted surface

8.5 Immediately after blast cleaning all loose abrasive and dust shall be removed from the surface by brushing, blowing or vacuuming.

9. Liner application

9.1 No rubber stock shall be applied when the ambient temperature of the work is below 20° C or below the dew point of the surrounding air. Adhesive shall not be applied when the surrounding air has either a relative humidity above 85% or a temperature below 20° C. Instructions for measurement of dew point relative humidity and surface temperature are contained in SSPC-PA1-74.

9.2 The rubber stock shall be joined with a 45 degree skived edge overlapping at least 3-6 times of the rubber thickness (max 32mm)

9.3 No circumferential seams are allowed within the pipe bore of straight-run pieces unless the bead shall be finished

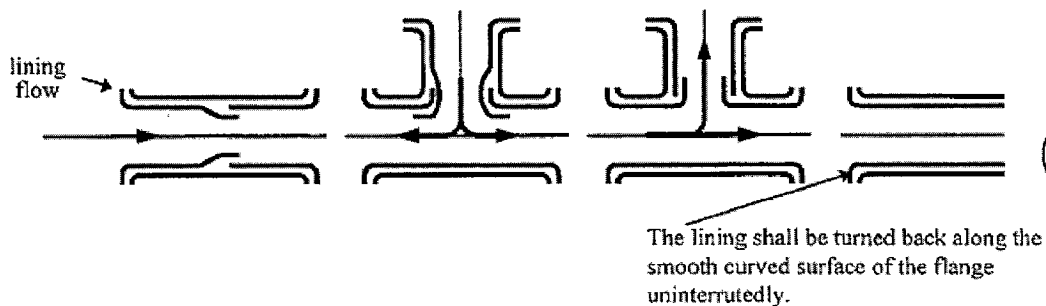
9.4 The rubber stock shall be rolled out over the entire face of the flange where possible. No seam will be allowed at the junction of the pipe or flange. A seam will be permitted on the flange face, provided the seam is buffed smooth.

9.5 The rubber lining work shall be done by generally accepted techniques and tools that no air is trapped and air behind the lining should be removed completely.

9.6 The fitting shall be furnished with the flange ends, with the liner overlaying the flange face inside the bolt circle

10. Rubber jointed portions

10.1 The joint of two rubbers (if applicable) shall conform to the following



10.2 The arrow shall be painted on the outside of the pipe with white paint in accordance with the direction of the flow

11. Vulcanization

11.1 All rubber lining pipes shall be vulcanized by the saturated steam in a Autoclave. The required pressure, temperature and vulcanizing hours shall be chosen for the vulcanization of each rubber lining by Vendor to achieve desired properties.

11.2 If the hole to ventilate the air behind the lining is to be necessary to avoid air pockets, it shall be made by the fabrication of the rubber lining.

12. Curing

12.1 The curing procedure used shall be the responsibility of the vendor.

12.2 The method used shall assure complete cure of the rubber stock and procedure the desired physical properties.

13. Patch Repairing

13.1 Where patch repairing is required rubber lining will be removed up to a point where lining is satisfactory and has firm adhesion to the metal. The metal will be cleaned lining edge skived to 45 degree cement applied and rubber stock.

13.2 The decision as to whether patching or relining is required shall be by mutual agreement between BHEL and the contractor.

13.3 No patches are permitted on flanges faces

13.4 All cured patches shall meet the requirements specified for the original lining material.

13.5 The manufacturer shall replace or repair the damaged faulty ones with free of charge if the following phenomena are detected during warrantee period.

(1) Rubber material deterioration (drop in tensile strength and hardness.)

TECH SPECIFICATION : BIFPCL: MAI: FGD: MSRLP: R00

- (2) Swelling
- (3) Blister
- (4) Cracks
- (5) Separation
- (6) Remarkable abrasion
- (7) Carbonization
- (8) Poor bonding strength

FABRICATION PROCEDURE FOR RUBBER LINED PIPE

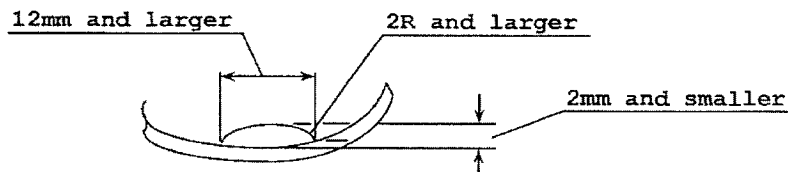
SCOPE

This specification applies to the general requirements of metal preparation and rubber linings to the interior surface of shop fabricated piping

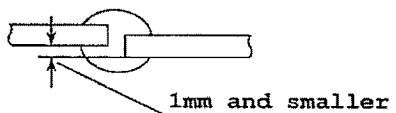
1. Materials

(1) Pipe and Fittings

The pipe and fittings are ordered with several manufacturing method and bead for longitudinal seam in case of electric arc weld shall be supplied within following value.



* Beam for circumferential



(2) Elbows

Pipe Size	3" & Sm.	Smooth Bend ($R=3 \times D$)
Pipe Size	4" to 20"	Long Elbow ($R=1.5 \times D$)
Pipe Size	22" & La.	Short Elbow ($R=1 \times D$) or Miter Bend

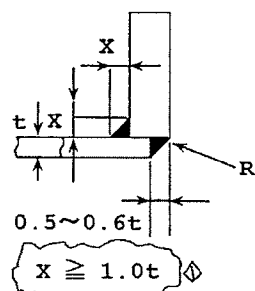
D = outside diameter

2. Piping Fabrication

The satisfactory finish of rubber lining depends upon the quality of the weld, therefore the weld shall be carried out carefully.

- (1) The piping materials shall be welded continuously, and defects, such as blowhole, incomplete penetration, slag inclusion and undercut shall not be permitted.

- (2) The method of the weld shall be the electric arc weld and the welding rod D4316 or AWS.
- (3) The weld of the flange shall conform to the following:



finish by grinding
after the weld

4" $\geq$ D R $\geq$ 3 mm

6" $\geq$ D R $\geq$ 5 mm

D = outside diameter

- (4) The surface that the rubber lining is to be applied on shall be ground to a smooth curved one.
- (5) The bend shall be finished by the following step.
- The bead scale and the spatter shall be taken off completely.
 - The bead shall be ground to a smooth surface until it has the same alignment as the base metal.
- (6) The edge or the corner shall be ground to a smooth convex surface with a 3mm or larger (4" & Sm.) and a 5mm or larger (6" & La.) radius or to a smooth concave surface with a 10mm or larger radius.
- (7) When a pinhole is found on the weld line, pinhole zone shall be taken off, then welded again and ground completely.
- (8) As a rule the pipe joint shall be welded to the exterior and interior surface. The same treatment as (4) and (5) shall be completed.
- (9) After the finish by grinding, the identification mark number shall be punched on the outside of the flange.
- (10) In course of field piping assembly, short pipes for piping adjustment are always required. These adjusting parts (short pipes) shall be fabricated at the field or fabricated at the shop in accordance with the information of the actual adjusting dimension from site in accordance with (1) - (9), then applied to the rubber lining works.

Table 1. Notes for weld of Piping Materials

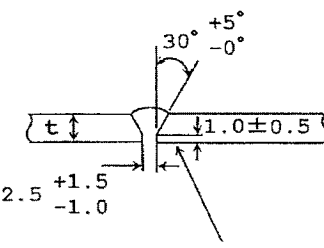
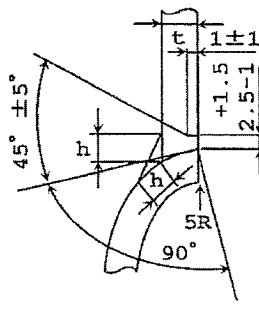
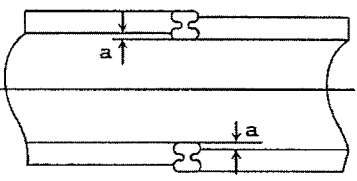
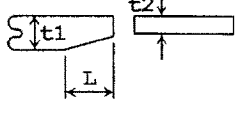
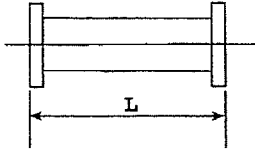
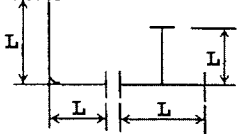
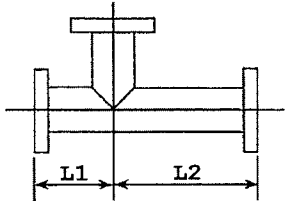
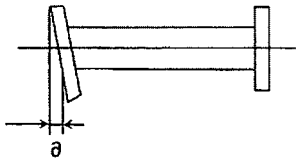
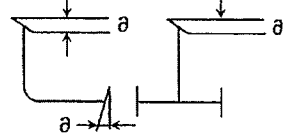
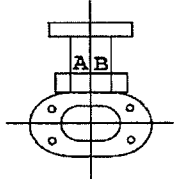
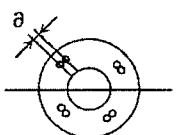
Item	Notice	Remarks
Pipe Joint	 After the weld on the outside, this interior surface shall be cleaned, welded by one layer and ground to the smooth one.	1. When short pipe is to be added to elbow, tee or reducer this procedure shall be acceptable 2. This pipe joint shall be applied only to the 20" and larger pipes.
Branch	 This edge shall be ground to a smooth curved surface with a 5mm or larger radius.	1. The edge Preparation of the branch pipe end shall be made on the interior surface as shown in the figure.
Misalignment	 The misalignment, a, shall not be more than 1 mm. The interior surface shall be ground to the smooth one.	For two walls with different thickness,  $L = 10 \times (t_1 - t_2) \text{ or larger}$

Table 2. Allowances for Piping Components

D : Nominal Dia.

: Tolerance

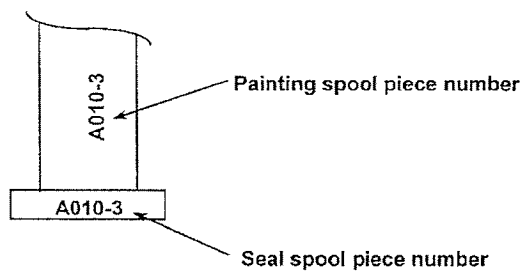
Unit : mm

Item	Sketch	Allowance ($\varnothing$)	Remarks
Pipe length		$L \leq 1000,$ $\varnothing = \pm 3$ $L > 1000,$ $\varnothing = \pm 3$	These allowances shall be applied to bend and T pipe 
T Pipe length		$L1, L2$ $\varnothing = +1$ -2	
Flange declination		$4'' \text{ \& Sm.}$ $\varnothing \leq 1.5$ $5'' \text{ \& La.}$ $\varnothing \leq 2.0$	These allowances can be applied to flanges of bend and T pipe. 
Bolting holes of one flange	T pipe and bend 	$\varnothing = A - B$ $\varnothing \leq \pm 2$	
Bolting holes of two flanges	Straight pipe, bend and T pipe 	$\varnothing \leq 2.0$	

3. Marking Procedure

3.1 Painting and stamp

Spool piece number shall be painted on the outer pipe surface and put a seal at the flange.



4. Inspection

4.1 Inspection Record

The final inspection record shall be recorded in the PC form Attachment-2,

4.2 Repair

The weld defect found by visual inspection or other test/inspection is fully removed by using a grinder or by air gauging, and then welded again under the same condition as that for final welding.

The corresponding test/inspection is reformed after completion of the repair to check for absence of defect.

Base material	P No.	P-1
	Standard	A53-B STD~SCH20 A134(A283C) 7.9T~9.5T
	Thickness	STD~9.5T
Applicable standard		ASTM Standard
Welding	Cutting	Machining or gas cutting
	Beveling	Machining, grinder finishing or gas cutting
	Welding procedure	SMAW + GTAW, SMAW
	Welding rod	GTAW : SMAW :
	Drying of welding rod	BI-14 ---- 70°C~100°C for 0.5 to 1 hour
	Welding reinforcement (mm)	Within 3mm
	Sagging (mm)	Finish sagging to less than 0.2 mm by using a grinder.
Heat-treatment		—
Cleaning	Inner surface	Finishing with a grinder
	Outer surface	Cleaning with a grinder or wire brush
Test/inspection	Materials inspection	
	Beveling inspection	Ditto
	Tack-welding inspection	Ditto
	Finishing (appearance, dimension, inspection)	Ditto
	Pressure-proof test	—
	Liquid penetrant inspection	—
	Radiographic test	—
Remark		

[illegible]



PAGE 01 OF 03



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CONTRACTOR'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN					PROJECT: BIFPCL MAITREE STPP				
BHEL PIPING CENTRE, CHENNAI PROCUREMENT OF MATERIAL, FABRICATION & SUPPLY BY APPROVED SUB-CONTRACTORS		ITEM : PLATE FORMED PIPES (CS & AS)					PACKAGE: 2X660 MW				
		SUB-SYSTEM: Piping					MAIN-SUPPLIER: BHEL-PIPING CENTRE BHEL CUSTOMER Nos: 7328, 7329, 7330, 7331 & 7332				
Q.P. No.: 7328QPC18 Rev-02 Dt: 28.08.2018		ACCEPTANCE NORMS		8		FORMAT OF RECORDS		AGENCY		REMARKS	
REFERENCE DOCUMENT		7		8		9		M C B		11	
QUANTUM OF CHECK		6		10		D*		M C B		11	
TYPE OF CHECK		5		6		7		8		9	
CLASS		4		5		6		7		8	
CHARACTERISTICS		3		4		5		6		7	
COMPONENT & OPERATIONS		2		3		4		5		6	
S.No		1		2		3		4		5	
2.50		Pipe after rolling		Profile & Dimensions		Major		Visual & Measurement		100%	
2.60		NDE for Weld		Soundness		Major		RT		100%	
2.61		Butt joints for LS & CS		Soundness		Major		MPI/LPI		100%	
2.62		Fillet joints		Soundness		Critical		RT / UTSS		100%	
2.63		Full penetration nozzle joints (OD > 114.3mm)		Soundness		Major		RT		100%	
2.64		Weld repair		Soundness		Critical		Review of HT charts		100%	
2.70		Post Weld Heat Treatment		ROH, ROC, Soaking temp & Soaking time		Minor		MPI		100%	
2.80		NDE after PWHT		NDE on long seam weld		Major		Mechanical		100%	
3.00		Mechanical tests on test coupon		a) Transverse Tension test for weld seam b) Guided bend test (Face & Root)		Minor		Mechanical		100%	
3.20		NDE on site weld Edge preparation		Discontinuities		Major		LPI		100%	
4.00		FINAL INSPECTION		a) Dimensions b) Hydrotest (as applicable)		Minor		Measurement Visual		100%	
VIVEKANANDA YELLU, Dy. MGR/QA		MAIN-SUPPLIER		AGM/Q		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. M: MANUFACTURER / SUB-SUPPLIER, C: BHEL / BHEL AUTHORISED INSPECTION AGENCY, B: BIFPCL. P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: BIFPCL HOLD POINT MARKED AS "W" IN COLUMN - B		BHEL Drawing BHEL Drawing & ASME		Note 9	
SIGNATURE		PAGE 02 OF 03		Engg Div/ QA&I		FOR BIFPCL USE:		REVIEWED BY		APPROVED BY	



CONTRACTOR'S NAME & ADDRESS
BHEL PIPING CENTRE, CHENNAI
PROCUREMENT OF MATERIAL,
FABRICATION & SUPPLY BY
APPROVED SUB-CONTRACTORS

MANUFACTURING QUALITY PLAN

ITEM : PLATE FORMED PIPES (CS & AS)

Q.P. No.: 7328QPC18
Rev-02

Dt: 28.08.2018

SUB-SYSTEM: Piping

PROJECT: BIFPCL MAITREE STPP

PACKAGE: 2X660 MW

MAIN-SUPPLIER: BHEL-PIPING CENTRE

BHEL CUSTOMER Nos: 7328, 7329, 7330, 7331 & 7332

S.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
					M	C/B				M	C	B	
1	2	3	4	5	6		7	8	9	** 10			11
		c) Positive Material Identification for all alloy Steel components (on Weld & Base material).	Major	Spectro/X-Ray fluorescence	100%	100% / Random	As per Required Material (ASME) Specn.		Report	✓	P	W	
		d) Surface preparation & Painting	-do-	Visual & Measurement	100%	100% / Random	Customer approved Painting specification		HC, IR	✓	P	V	IR - Inspection Report
		e) Identification, Marking & Colour coding	-do-	Visual	100%	100% / Random	BHEL Drawing, PO		-		P	V	Note 6
		f) End protection	-do-	Visual	100%	100% / Random	BHEL Drawing, PO		-		P	V	Note 7
5.00 DOCUMENTATION													
5.1 Inspection clearance		Documentation	Critical	Verification	100%	100% / -	All reports as required in this QP				P	V	
5.2 Despatch Clearance		Despatch Clearance	Critical	Verification	100%	100% / -	Also refer Note 8		MDCC		P	V	CHP

NOTES:

- Heat number transfer to cut piece (raw material) shall be done by Sub-Contractor in the presence of BHEL representative.
- No Post forming Heat treatment in case of Cold forming.
- The items shall be manufactured as per BHEL drawing.
- Welding Electrodes and Paints used shall be of BHEL approved make
- All items shall be inspected and cleared by BHEL & BIFPCL's TPIA.
- The finished components shall be hard punched with DU code (14 digit work order du details). Heat number, material specification, Vendor code, Inspectors seal and Statutory authorities seal. In addition, the DU code, Heat no. and Material specification shall also be paint stencilled.
- Machined ends shall be well protected using end caps to avoid transit & other damages.
- The Sub-Contractor/Vendor shall co-ordinate with BIFPCL's TPIA and obtain MDCC before despatch of finished material.
- Pressure Test / Hydro Test shall be as per ASME Standards as applicable.
- Materials shall be procured in compliance to Functional Technical Specification.
- NDT shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V.
- Gauges and measuring Instruments, with valid calibration only shall be used.
- Finished Products shall be packed to comply with Approved Packing Schedule.
- Design, Manufacturing, Construction and Testing of pressure parts will be carried out as per the applicable ASME code, meeting the Project technical specification requirement and complying with the Bangladesh Boiler Act, 1923 with amendments. Δ②

 VIVEKANANDA YELLU, DY.MGR/QA MAIN-SUPPLIER	 C VAITHIANATHAN, AGM/Q MAIN-SUPPLIER	 FOR BIFPCL USE:	DOC.NO.Maitree-00-CF-QA-732814-PC-00 REV. CAT...
			REVIEWED BY APPROVED BY APPROVAL SEAL
SIGNATURE PAGE 03 OF 03		Engg.Div/ QA&I	

Testing Requirement for Rubber Lined Pipes & Fittings:

1.0 Test sample

1.1 A test sample shall be prepared along with each autoclave load of pipe in order to determine the adhesion of the rubber to the metal and to test the durometer of the rubber. A test sample is also required whenever a different autoclave load of adhesive or rubber stock is used.

1.2 This test sample shall be prepared in the same manner as the pipe, coinciding with each lining operation i.e., surface preparation, cementing, rubber application and curing.

1.3 As for "Physical Testing Method for Vulcanized Rubber", the test piece shall be prepared and tested in accordance with as per applicable Codes like ASTM/ BS/ DIN.

1.4 The minimum acceptable adhesion shall be as per latest applicable international standard. The vendor shall submit certified test results of the post-cure, durometer hardness and adhesion test to the contractor for each sample.

1.5 Failure to meet the minimum standard of this test will be the basis for rejection of the pipe lot lined with the same batch of materials and cured in the same autoclave load with the test sample.

2.0 Rubber lining test:

2.1 Visual and electrical High frequency Spark test shall be conducted on all rubber lined pipes and fittings surface both before and after curing.

2.2 High voltage spark test of all surfaces shall be made with the voltage selected for the particular rubber compound. Spark Testing shall be done as per BS 6374 Part-V. In any case, the minimum voltage shall be 5 KV/mm of thickness. Testing and inspection methods (ITP) shall be submitted to the contractor for approval.

2.3 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.

2.4 Visual examination of all surfaces shall be made to detect blisters, wrinkles or loose places.

2.5 Minor leaks or defects detected by the above method may be repaired by patching. Total relining will be required for major defects.

2.6 Durometer hardness (Shore A scale) shall be determined after curing. Certified test results shall be submitted by the subcontractor.

2.7 Evidence of poor workmanship shall be the cause for rejection.

Annexure-4: Painting Specification

Surface Preparation	Coating Systems	No. of Coats	Generic Type	Dry Film Thickness (DFT) per coat microns	Total DFT (Microns)
SA 2.5	Primer	1	Zinc-Epoxy	80	80
	Intermediate	1-2	Epoxy-High Solid	160	160
	Finish	1	2-Comp Polyurethane	50	50
					290

Colour code:

S.No	Medium	Base	RAL	Band/Ring	RAL	Lettering/Arrow	RAL
1	Slurry	Signal brown	8002	Signal Black	9004	Signal White	9003

ANNEXURE-5:

LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT

SI No	Clause No	Page No	Description of Deviation

Note: Enlarge the table to incorporate items

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

Bharat Heavy Electricals Limited
Ranipet-632406, India.
Quality Assurance(Mech)

To,

Shri. V Raghupathy, SM/FGD-Purchase

BAP: QA: MAITREEI: CSRL: 80

Kind Attn: Shri M Venkateswarlu, Mgr/QA

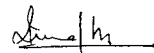
Dt. 28-11-2019

Ref: ENGG SPEC: BIFPCL: MAI: FGD: CSRLP-1: R00

INDENT No: (RFW90562), (RFW90563), (RFW90564), (RFW90565), (RFW90566),
(RFW90567), and Dated 08.11.2019

Quality department comments as follows:

1. BHEL Approved PMD Vendor is acceptable.
2. Inspection and testing shall be done as per approved Quality plan, Detailed Quality plan(Including Raw material check, In process Inspection and final inspection including Rubber lining check) to be Submitted for BHEL Approval.
3. Refer the attached Annexure-3, Sample QP (7328QPC18, Rev: 02, Dated 28.08.2018) made for fabricated Pipe. Inspection check shall be as per this QP for fabricated pipe however, Detailed QP shall be submitted in this format only adding check for rubber lining also.
4. Rubber lining check shall minimum ensure the requirements spelt out in BHEL Specification "Testing Requirement for Rubber Lined Pipes & Fittings".
5. Painting shall be as per BHEL Technical Specification Annexure-4.
6. All the Pipes will be inspected at supplier works as per approved QP/Approved Drawing/Approved datasheet and BHEL Specification.
7. Annexure 'Q' shall be part of enquiry File.



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