

SM/PAO-Pur
m

John/E/Pur, m,
Date: 11/11/18

TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS

CONFIDENTIAL

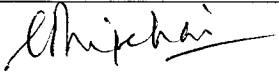
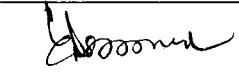
CUSTOMER : M/s. BIFPCL Bangladesh
PROJECT : Maitree 2X660MW
APPLICATION : FLUE GAS DESULPHURIZATION
SYSTEM
TECH SPECIFICATION NO : BIFPCL: MAI: FGD: CSRLP - 2: R00



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

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

TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS

Department	Prepared	Checked	Approved
FGD		 (G. RAJENDIRAN)	 K. Meenakshi Sundaram
Revision – 00		COMMENTS : ----	

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.



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

BIFPCL:MAI:FGD:CSRLP-2:R00

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 Annexure-6 : RC pump suction/discharge piping arrgt. Drawing No : 1-FW-753-01027

	TECHNICAL SPECIFICATION FOR CARBON STEEL RUBBER LINED PIPES & FITTINGS - MAITREE 2X660MW
BIFPCL:MAI:FGD:CSRLP-2: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 4. The Quantity specified in the table are indicative only. The actual quantity may vary $\pm 5\%$ 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-2: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 without 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 is in vendor's scope.
- 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 800 NB.
- 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-2: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" b. "Not considered in scope of work"



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

BIFPCL:MAI:FGD:CSRLP-2:R00

S.No	Description
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-2:R00	

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.



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

BIFPCL:MAI:FGD:CSRLP-2:R00

S.No	Description
2.	In case of failure of the equipment to meet the guarantee, BIFPCL/BHEL reserves the right 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

RUBBER LINING PIPE STEEL FABRICATION INSPECTION RECORD		PROJECT ITEM		MAITREE		INSPECTOR(BHEL)			INSPECTOR ()			PAGE
MARKING NO.		ORDER NO.										
		DWG.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 Pipes & flanges-1 Set**

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1.	Pipe	200	SCH-20	5	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.		350	SCH-10	40	m	
3.		600	7.9T	6	m	
4.		750	7.9T	4	m	
5.		800	7.9T	8	m	
6.		1100	9.5T	185	m	
7.		1200	9.5T	10	m	
8.		1350	11.9T	12	m	
9.		1550	12.7T	22	m	
10		1600	12.7T	35	m	
11	Slip On Flange	200	#150	5	m	
12		350	#150	96	m	
13		600	#150	10	no	
14		750	#150	14	no	
15		800	#150	20	no	
16		1100	#150	140	no	
17		1200	#150	10	no	
18		1350	#150	6	no	
19		1550	#150	12	no	
20		1600	#150	28	no	
21	Flanged Stub (branch nozzle - 100 mm length)	25	#150	6	no	
22		50	#150	12	no	

23		80	#150	44	no	
24		100	#150	34	no	

Note:

- 1) Length mentioned is the finished product dimension.
- 2) Refer drg. No: 1-FW-753-01027 Rev.00

Annexure-1: FGD Package - CSRL Piping System BOQ

TABLE-2 – Rubber Lined Mitre Bends – 1 Set

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	90° Miter bend (3 - piece, 2 - joints)	1100	9.5T	10	no	R = 1120 mm
2		1600	12.7T	8	no	R = 1625 mm

Annexure-1: FGD Package - MSRL Piping System BOM

TABLE-3– Rubber Lined Reducers – 1 Set

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Concentric Reducer	1100x800	9.5T	10	no	L=610 mm
2	Eccentric Reducer	600x500	7.9T	5	no	L=508 mm
3		800x600	7.9T	5	no	L=610 mm
4		1100x750	9.5T	10	no	L=610 mm
5		1200x800	9.5T	4	no	L=711 mm
6		1550x1350	12.7T	4	no	L=812.8 mm
7		1600x1200	12.7T	4	no	L=812.8 mm
8		1600x1550	12.7T	4	no	L=812.8mm

Annexure-1: FGD Package - MSRL Piping System BOM

TABLE-4– Rubber Lined blind flanges – 1 Set

Sl. No.	Description	Size (in NB)	Sch / Thk / Rating (min.)	Qty	Unit	Remarks
1	Blind flange	1100	#150	4	no	
2	Flanged man hole cover (hinged)	800	#150	2	no	

Note:

- 1) Length mentioned is the finished product dimension.
- 2) Refer drg. No: 1-FW-753-01027 Rev.00

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 -2

PIPE SPECIFICATION			
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

ANNEXURE -2

5. 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

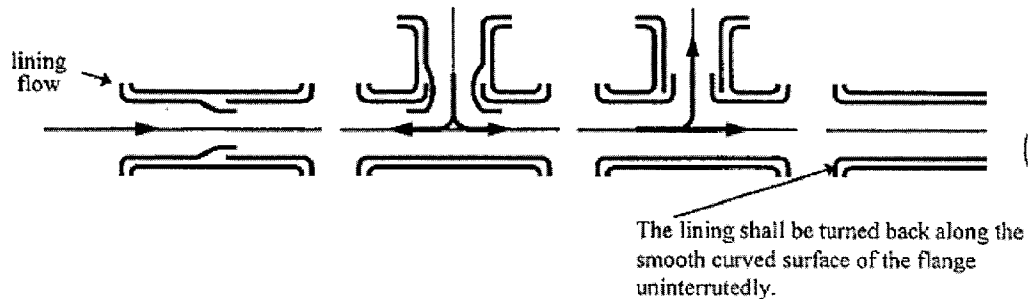
9.4 The rubber stock shall be rolled out over the entire face of the flange where possible. No seam will be allowed at the junction of the pipe or flange. A seam will be permitted on the flange face, provided the seam is buffed smooth.

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 rubberstock.

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 change if the following phenomena are detected during warranteeperiod.

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

TECH SPECIFICATION : BIFPCL: MAI: FGD:CSRLP-2: R00

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

FABRICATION PROCEDURE FOR RUBBER LINED PIPE

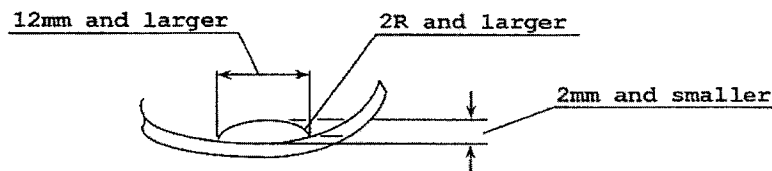
SCOPE

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

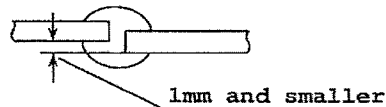
1. Materials

(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

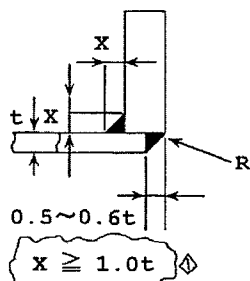
Pipe Size	3" & Sm.	Smooth Bend ($R=3 \times D$)
Pipe Size	4" to 20"	Long Elbow ($R=1.5 \times D$)
Pipe Size	22" & La.	Short Elbow ($R=1 \times D$) or Miter Bend
		D = outside diameter

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

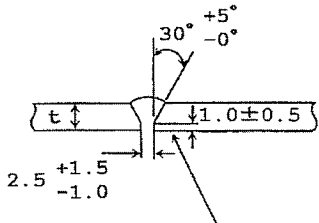
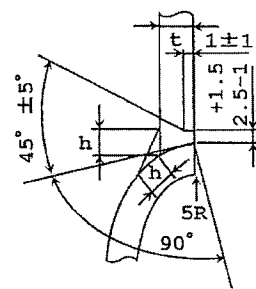
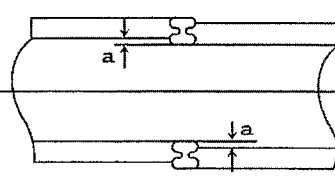
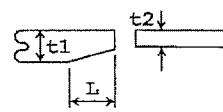
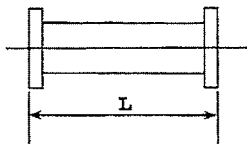
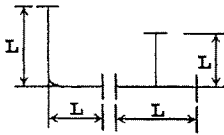
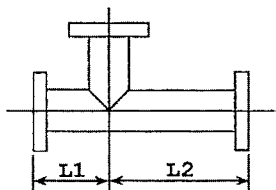
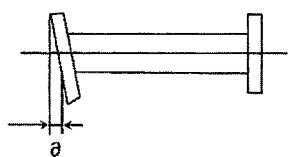
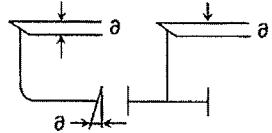
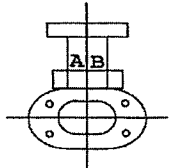
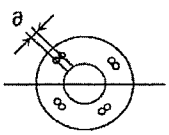
Item	Notice	Remarks
Pipe Joint	 After the weld on the outside, this interior surface shall be cleaned, welded by one layer and ground to the smooth one.	1. When short pipe is to be added to elbow, tee or reducer this procedure shall be acceptable 2. This pipe joint shall be applied only to the 20" and 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,  $L = 10 \times (t1 - t2)$ or larger

Table 2. Allowances for Piping Components

D : Nominal Dia.

: Tolerance

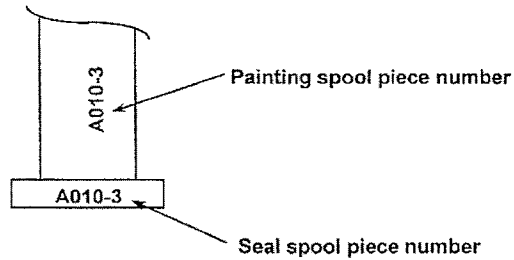
Unit : mm

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

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]

[illegible]



*Approval given by the contractor of its responsibility specified in the Contract.

ANNEXURE-3-TYPICAL QUALITY PLAN FOR INSPECTION & TESTING

PROJECT: BIFPCL MAITREE STPP PACKAGE: 2X660 MW MAIN-SUPPLIER: BHEL-PIPING CENTRE BHEL CUSTOMER Nos: 7328, 7329, 7330, 7331 & 7332														
MANUFACTURING QUALITY PLAN														
ITEM : PLATE FORMED PIPES (CS & AS) Q.P. No.: 7328QPC18 Rev-02 Dt- 28.08.2018														
SUB-SYSTEM: Piping														
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	D*	** 10		11		
1.00	RAW MATERIAL													
1.10	Plate : SA515 & SA387, Grade&Class as per drg	Co-relation & verification of Mill TCs for a) Chemical Composition. b) Mech. Properties c) Heat Treatment d) NDT e) Dimension & Surface finish	Major	Verification	100%	100%/10%	Material Spec		Mill TCs	✓	P	V	V	
1.20	Pipe, Plate, Rods & Forgings : for attachments : as per drg	Chemical, Mech. Tests	Major	Verification	100%	100%/10%	BHEL Drawing , Material Spec.		GC	✓	P	V	V	
1.30	PMI for all alloy steel	Chemical Composition.	Major	Spectro/X-Ray fluorescence	Each Plate	100%/10%	Material Spec		Test Report	✓	P	W	V	
2.00	IN-PROCESS INSPECTION													
2.10	Material receiving inspection	Marking & transfer of identification	Major	Visual	100%	100%/-	As per drg.		HC		P	V	--	Note 1
2.20	Cutting & Edge Preparation	a) Dimension b) NDT for Edge preparation	Minor	Measurement	100%	100%/-	As per drg.		HC		P	V	--	HC - History Card
2.30	Rolling to form Pipe By cold forming process	Profile & dimensions	Major	Template check & Measurement	100%	100%/-	ASME Sec V / ASME B31.1 cl 136.4.4		Report	✓	P	V	--	Note 2
2.40	Welding	Procedure & Performance Qualification details	Major	Verify	100%	100%/-	ASME Sec. IX		WPS , PQR		P	V	--	WPS, PQR shall be approved by BHEL.
2.41	Back chip after root run for LS joints (if applicable)	NDE	Major	LPI	100%	100%/-	ASME Sec. V /ASME B 31.1 Cl. 136.4.4		H.C. LPI Report	✓	P	W	--	
2.42	Weldment with test coupon@4.	Weld profile & surface defects	Major	Visual	100%	100%/-	ASME B31.1 cl 136.4.2		HC	✓	P	V	--	@4: One Test Coupon for each 61m of
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														
VIVEKANANDA YELLU, Dy.MGR/QA														
MAIN-SUPPLIER														
PAGE 01 OF 03														
Engg.Div/ QA&I														
FOR BIFPCL USE:														
REVIEWED BY														
APPROVED BY														
APPROVAL SEAL														



*Approval doesn't absolve contractor of its responsibility specified in the Contract.

CONTRACTOR'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN						PROJECT: BIFPCL MAITREE STPP PACKAGE: 2X660 MW MAIN-SUPPLIER: BHEL-PIPING CENTRE BHEL CUSTOMER Nos: 7328, 7329, 7330, 7331 & 7332					
BHEL PIPING CENTRE, CHENNAI PROCUREMENT OF MATERIAL, FABRICATION & SUPPLY BY APPROVED SUB-CONTRACTORS		ITEM : PLATE FORMED PIPES (CS & AS) Rev-02 Dt- 28.08.2018		SUB-SYSTEM: Piping		Q.P. No.: 7328QPC18 Rev-02 Dt- 28.08.2018							
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	D*	**	10	11
2.50	Pipe after rolling	Profile & Dimensions	Major	Visual & Measurement	100%	100%/--	As per BHEL Drawing		HC	✓	P	V	--
2.60	NDE for Weld												
2.61	Butt joints for LS & CS	Soundness	Major	RT	100%	100%/10%	ASME Sec V / ASME Sec VIII UW-51		Report	✓	P	V*	V
2.62	Fillet joints	Soundness	Major	MPI / LPI	100%	100%/10%	ASME Sec V / ASME B31.1 cl 136.4.3/ cl 136.4.4		Report	✓	P	V	V
2.63	Full penetration nozzle joints (OD > 114.3mm)	Soundness	Critical	RT / UT\$\$	100%	100%/10%	ASME Sec V / ASME B31.1 cl 136.4.5/ cl 136.4.6		Report	✓	P	V*	V
2.64	Weld repair	Soundness	Major	RT	100%	100%/--	ASME Sec V / ASME Sec VIII UW-51		Report	✓	P	V*	V
2.70	Post Weld Heat Treatment	ROH, ROC, Soaking temp & Soaking time	Critical	Review of HT charts	100%	100%/--	PWHT at 680°C - 750°C; Soaking time : 1 hr/25 mm ; minimum 1 hr		HT chart	✓	P	VS	V
2.80	NDE after PWHT	NDE on long seam weld	Minor	MPI	100%	100%/--	ASME Sec V / ASME B31.1 cl 136.4.3		Report	✓	P	V	V
3.00	Mechanical tests on test coupon	a) Transverse Tension test for weld seam b) Guided bend test (Face & Root)	Major	Mechanical	100%	100%/--	ASME Section IX, QW 150		Report	✓	P	W	V
3.20	NDE on site weld Edge preparation	Discontinuities	Minor	LPI	100%	100% / Random	ASME Sec V / ASME B31.1 cl 136.4.3		Report	✓	P	V	V
4.00	FINAL INSPECTION	a) Dimensions b) Hydrotest (as applicable)	Major	Measurement	100%	100%/10%	BHEL Drawing		HC	✓	P	W	W
			Major	Visual	100%	100% / Random	BHEL Drawing & ASME		Report	✓	P	W	W
										DOC.NO.Maitree-00-CF-QA-732814-PC-00 REV..CAT...			



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)
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	D*	** 10			11	
5.00 DOCUMENTATION	Inspection clearance	e) 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	W	IR - Inspection Report	
		d) Surface preparation & Painting	-do-	Visual & Measurement	100%	100% / Random	Customer approved Painting specification	HC, IR	✓	P	V	V		
		e) Identification, Marking & Colour coding	-do-	Visual	100%	100% / Random	BHEL Drawing, PO	-		P	V	V		Note 6
		f) End protection	-do-	Visual	100%	100% / Random	BHEL Drawing, PO	-		P	V	V		Note 7
		Documentation	Critical	Verification	100%	100% / -	All reports as required in this QP			P	V	--		
		Despatch Clearance	Critical	Verification	100%	100% / -	Also refer Note 8	MDCC		P	V	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-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,

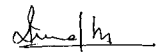
Shri. V Raghupathy, SM/FGD-Purchase
Kind Attn: Shri M Venkateswarlu, Mgr/QA

BAP: QA: MAITREEI: CSRL: 81
Dt. 28-11-2019

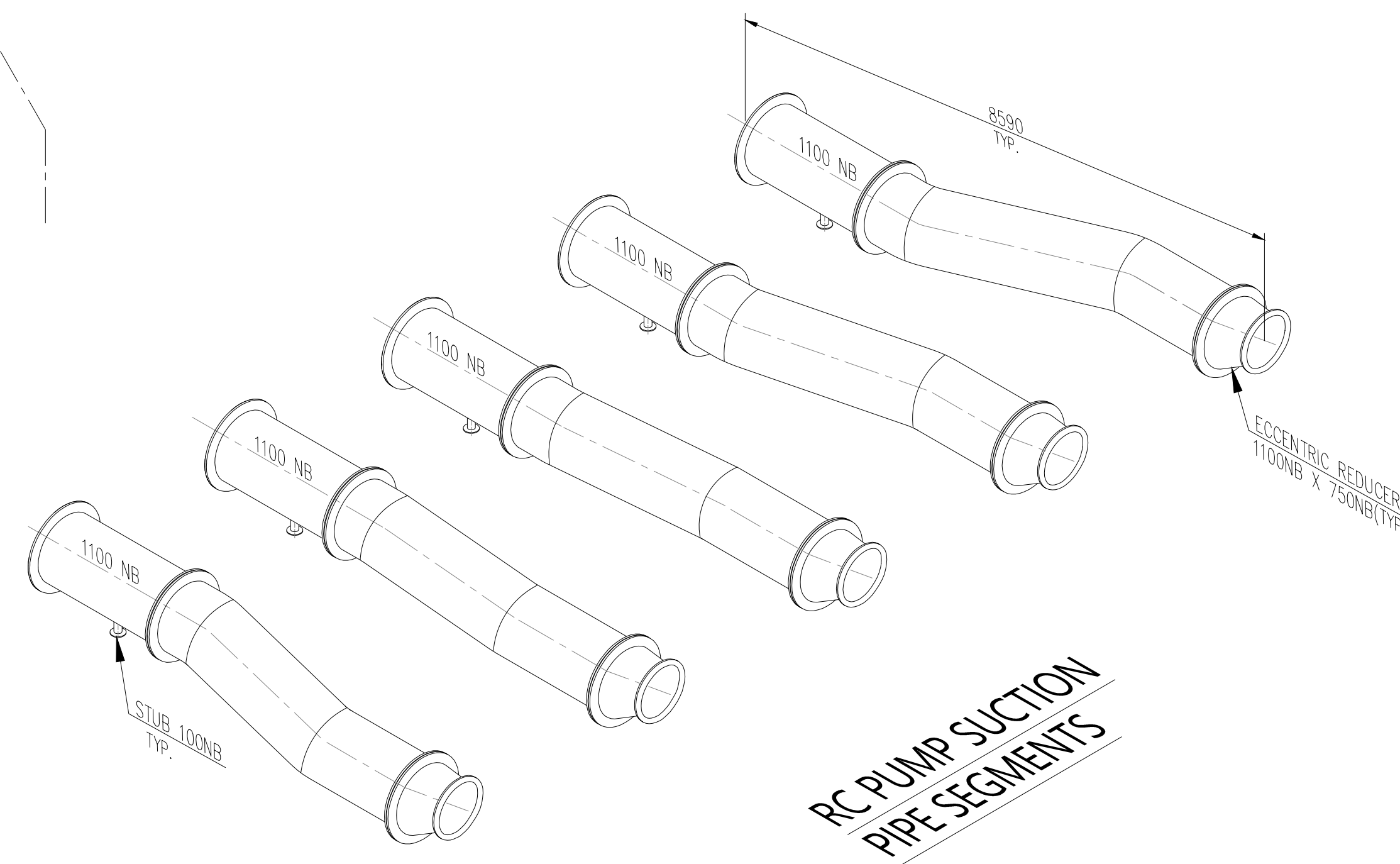
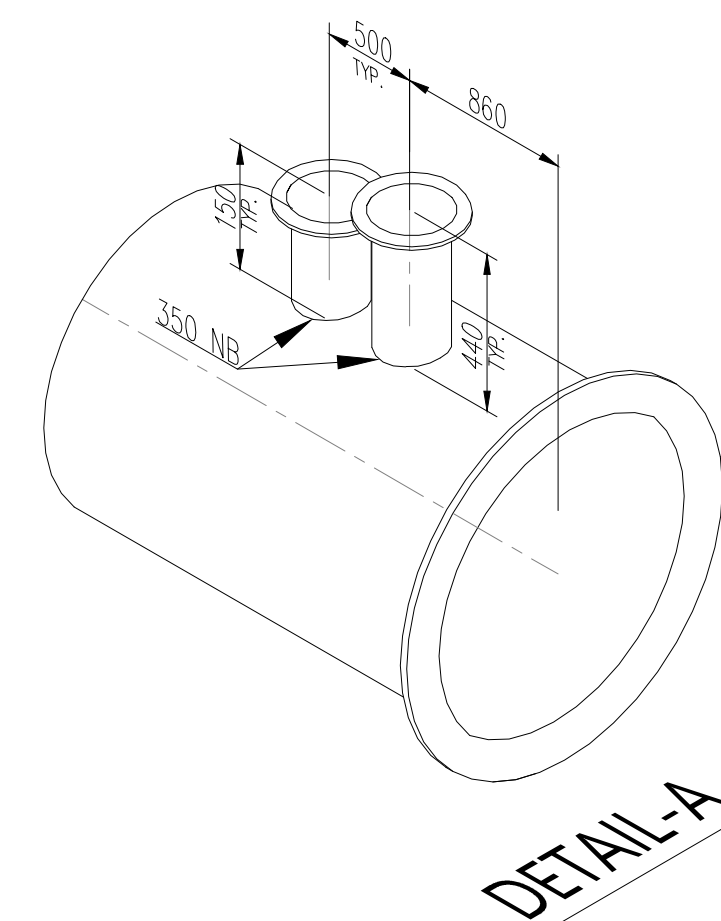
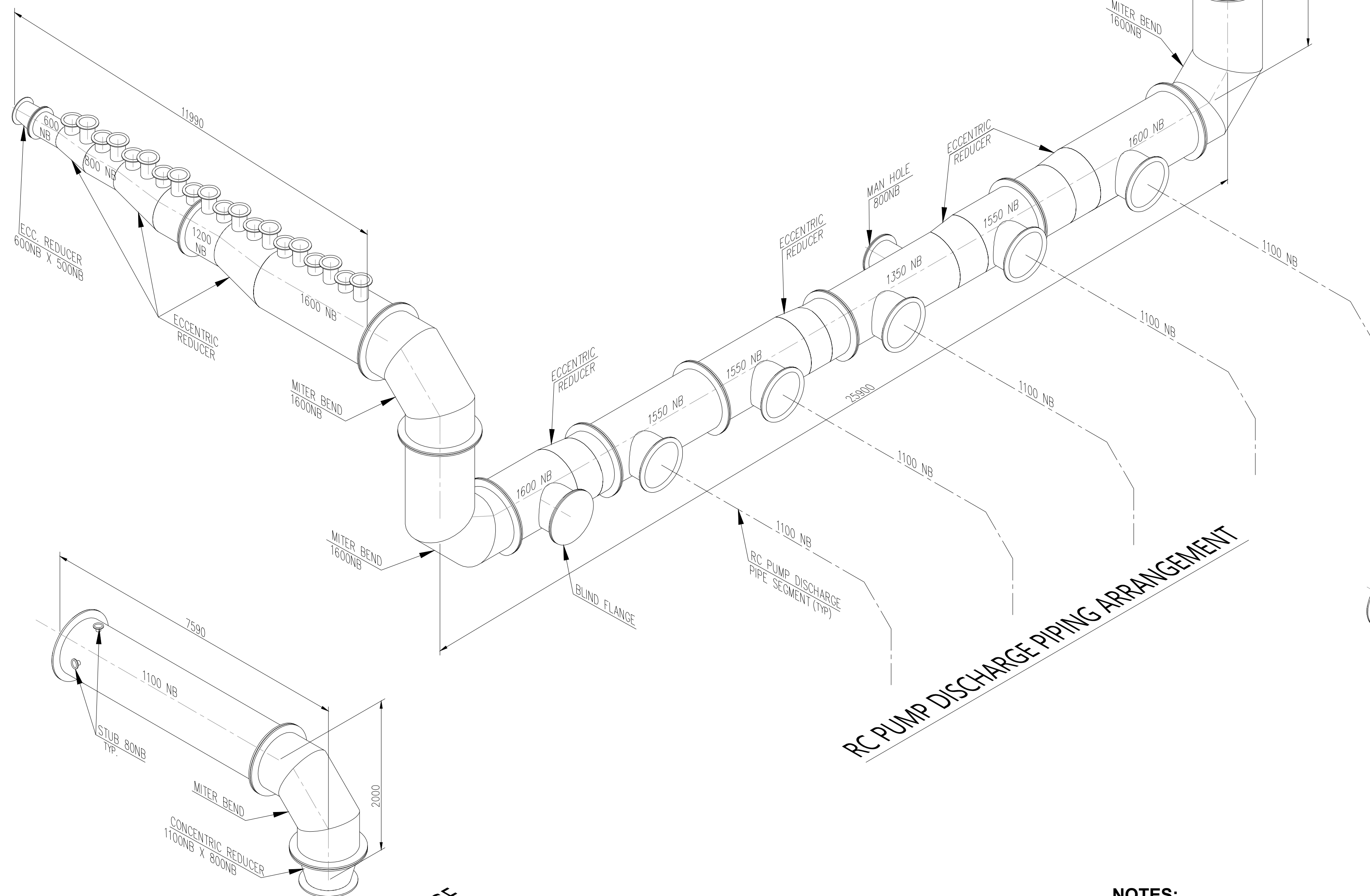
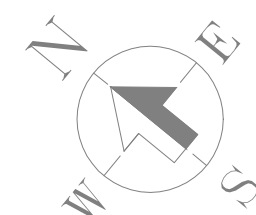
Ref: ENGG SPEC: BIFPCL: MAI: FGD: CSRLP-2: R00 and Drawing No: 1-FW-753-01027, Rev: 00
INDENT No: (RFW90568), (RFW90569), (RFW90570), (RFW90571) and (RFW90572) Dated
09.11.2019

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.

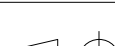


R K Madhu
Dy. Mgr(QA)



NOTES:

1. THE CSRL PIPING ARRANGEMENT SHOWN IS FOR REFERENCE ONLY. DETAILED FABRICATION PIPE SEGMENT DRAWING WILL ISSUED AFTER ORDER.
2. FOR TECHNICAL SPECIFICATION REFER – BIFPCC/MAI/FGD/CSRLP-2;R00

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be reproduced or used in any way detrimental to the interest of the company.	TYPE OF PRODUCT		FLUE GAS DE-SULPHURIZATION (FGD)									
	OR NAME OF		MAITREE STPP, BANGLADESH									
	CUSTOMER/PROJECT											
			BHARAT HEAVY ELECTRICALS LTD.,		DRN	NAME S.VENKAT		SIGN sdh	DATE 09.11.19	NO. OF VAL		
			UNIT: BOILER AUXILIARIES PLANT, RANIPET - 632 406.		CHD	S.VIVEK		sdh	09.11.19			
				APPD	G.RAJENDIRAN		sdh	09.11.19				
DEPT		GRADE OF UTD.O.LIM.	SCALE		WEIGHT (KG).		REF. TO ASSY/OLD DRG.		ITEM NO.	NO. OF ITEMS		
FGD												
CODE		PR:QA:500										
TITLE					CARD CODE		DRAWING NO.		RE			
RC PUMP SECTION / DISCHARGE PIPING (CSR) ARRANGEMENT FOR UNIT-1 ABSORBER					U 01		1-FW-753-01027		00			
									SHEET 01 OF 02			

