



**2x660 MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT AT ASH DYKE
OF NCTPS, CHENNAI**

ANNEXURE-2

TECHNICAL SPECIFICATION
FOR

**GLASS REINFORCED PLASTIC (GRP) PIPING
(UNDERGROUND & ABOVE GROUND)**

SPECIFICATION No: PE-TS-412-100-M042



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA, INDIA

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SCOPE OF ENQUIRY

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1. PROJECT SCOPE

- i. **Bidder's scope covers Detailed Design, Engineering (including transient analysis), Manufacturing, Transportation, Site-Storage, Erection/ Commissioning, Handing over and Annual Maintenance Contract (Two years) of Glass Reinforced Plastic (GRP) piping for 2x660 MW Ennore SEZ Supercritical Thermal Power Project.**
- ii. Complete piping system with fittings (Tees, elbows, expander, reducer, end caps etc.), flanged tapping for branch pipe connections, drains, vents and instruments shall be in bidder's scope. Isolation valves, flow measuring device, instrumentation shall be supplied by BHEL with flanged ends, as free supply items.
- iii. **Bidder's scope also covers to provide Civil Design/ Civil inputs to BHEL for Civil works for below ground and above ground piping.**
- iv. Based on the bidder's civil inputs, Civil Works i.e. excavation and concrete encasing for the below ground GRP pipes shall be done by BHEL during project execution. Similarly, for above ground GRP piping, Civil Structures i.e. pedestals, trestle, thrust blocks etc. shall be provided by BHEL during project execution. It shall be Bidder's responsibility to supervise and ensure correct installation of GRP piping by coordinating with BHEL's Civil execution agency. For above ground GRP piping, saddle with supporting elements and fencing around pipe for protection shall be in bidder's scope.
- v. In case of unrestrained piping above ground, **cost of estimated thrust blocks/anchors shall be loaded** on bidder's price, during price evaluation.
- vi. **Scope of GRP piping** for this project is broadly divided into two parts: outside plant boundary area & inside plant boundary area. The details in this regard are as follows:

S. No.	Scope	System Description	Approx. Length	Pipe Size	Installation
1	Outside plant boundary area	Sea Water Intake Piping	9000 mtr	1300 Nb	Above ground
2		CT Blowdown Piping	4500 mtr	1500 Nb	Above ground
3	Inside plant boundary area	Sea Water Intake Piping header before bifurcation	45 mtr	1800 Nb	Buried and encased
4		CT Blowdown Piping – Part 1	250 mtr	1200 Nb	Buried and encased
5		CT Blowdown Piping – Part 2	550 mtr	1500 Nb	Buried and encased
6		Cooling Tower Make up piping	730 mtr	1300 Nb	Buried and encased
7		Make up piping to Clarifier	1150 mtr	800 Nb	Buried and encased

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- vii. All GRP piping outside plant boundary area shall be routed over-ground. GRP pipes in this area shall be running mainly on pedestals; however, in case of canal crossing, railway crossing & road crossings, the pipes shall be running on coal pipe conveyor trestle (with curvilinear profile). All GRP piping inside plant boundary area shall be routed under-ground. GRP pipe shall be buried and encased for the complete inside plant scope area.
- viii. Bidder to note that **the following Annexures** are attached as a part of this specification:
- Piping Flow Diagram (Scheme) is attached as Annexure-A1.
 - Piping Layout Drawing is attached as Annexure-A2.
 - Technical Datasheet to be filled by Bidder is attached as Annexures A3.
- Annexure-A1** comprises of Piping & Instrumentation Diagram for the GRP piping system. Extracts of “Sea Water Intake scheme” and “CW Blowdown scheme” are included along with Notes describing design pressure and other necessary details for Bidder’s reference.
- Annexure-A2** comprises of indicative Piping Layout drawing showing the routing details of GRP piping for this project. The drawing already attached in Annexure-1 shall be referred by the Bidder. Further, please note that detailed piping layout drawing for GRP system shall be given during the issue of enquiry for this project.
- Annexure-A3** comprises of Technical Datasheet for 1. Below Ground GRP piping, and 2. Above Ground GRP piping. Both these Technical Datasheets shall be duly filled by Bidder and submitted to BHEL for concurrence.
- ix. It is the responsibility of the bidder to visit the project site on their own to familiarize themselves thoroughly with the site conditions and to finalize detailed piping BOM (Bill of Material), pipe routing, and structural supports inputs for completing bid requirements.
- It is not the intent to specify herein all the details of design, manufacture, installation, testing etc. Bidder shall quote his standard, proven product, which shall conform in all respects to high standards of design, engineering, installation, inspection and workmanship and shall be capable of performing the required duties in a manner acceptable to the Engineer/Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.
 - The omission of specific reference to any component / accessory/ design data necessary for the intended performance of the piping system shall not relieve the supplier of the responsibility of providing such facilities to complete the supply within the quoted prices.
 - Total project completion time available to the bidder shall be One (01) year from the date of issue of the purchase order. This includes submission of all Engineering drawing documents (inc. transient analysis report) for approval, Manufacturing, Transportation, Storage, Erection / Commissioning, Testing, Trial operation and Handing over to BHEL.

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During bid submission, bidder will submit its Methodology (with time & activity schedule) to execute the project, which shall be technically evaluated by BHEL.

5. General Arrangement drawings/ Isometrics/ Material Specification/ Design Calculations/ Installation procedures/ Pipe support details/ Materials test certificates etc. for complete GRP piping shall be approved by BHEL/ Customer.
6. BHEL's / CUSTOMER'S representatives shall be given access to the shop in which the products are being manufactured or tested and all test records shall be made available to them. Pipe and fittings shall be tested as per approved Quality Plan.
7. During Project execution stage, **fixed area** (an open space) inside plant boundary for storage and material handling purpose shall be provided. However, construction of any covered storage in the allotted handling area, if required, shall be in Bidder's scope.
8. BHEL/ CUSTOMER shall provide Statutory approvals/ clearances to the successful bidder during contract stage. However, the responsibility to generate all the documents related to Statutory approval shall be on the Bidder.
9. In case of any deviation from this Technical Specification and Technical Requirements, Bidder shall indicate the same in the Schedule of Deviations. In the absence of duly filled schedules, it will be assumed that the bid strictly conforms to the specification.
10. The bids shall be in English language and SI Units.

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PROJECT INFORMATION

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INTRODUCTION

TANGEDCO has planned to establish 2 x 660 MW Coal Based Super Critical Thermal Power Plant in Vayalur Village Near Ennore Port. Plant will be set up in existing Ash Dyke of NCTPS by reclamation of some portion of the Ash Dyke. TNEB is presently having about 1100 acres of land for Ash Dyke purpose. Due to improved Dry Fly Ash Collection, it is proposed to reclaim 500 acres of the above land for setting up of this proposed Power Plant.

A Project Information & Location

Project Title	:	Ennore SEZ project of 2 x 660 MW Coal Based Super Critical Thermal Power Project at ash dyke of NCTPS
Plant capacity	:	1320 MW (2 units of 660 MW each)
Type of project	:	Green field
Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
Plant site location	:	Ash dyke of North Chennai Thermal Power Station (NCTPS)
Location co-ordinates	:	80° 18' E to 80° 19' E Longitude 13° 17' N to 13° 18' N Latitude
Nearest Village	:	Vayalur
Nearest Town & City	:	Chennai (35 Km)
State Capital	:	Chennai (35 Km)
Nearest Railway Station	:	Athipattu Pudunagar (~5 Km)
Nearest Airport	:	Chennai (~60 Km)
Nearest Seaport	:	Ennore (~5 Km)
Nearest Road access	:	All weather road from Pattamandri on the Thiruvottiur – Ponneri district highway

B Meteorological Condition

Climate	:	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
Site Elevation	:	(+) 10.0 Meter above Mean Sea Level
Ambient Temperature		
a) Annual Maximum Mean Temperature	:	32° C



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- b) Annual Minimum Mean Temperature : 24° C
c) Design ambient temperature : 35° C

Relative Humidity

- a) Maximum : 100%
b) Minimum : 36%
c) Design : 75%

Annual Rainfall

- Maximum : 2540 mm
Average : 1600 mm
Minimum : 1175 mm

- Prevailing Wind Direction** : November to January – From NW & NE
February to March – From East & SE
April to May – From South & SE
June – From SW
July to August – From NW
September to October – From SE & SW

- Wind Speed** : 11.8 kmph (Avg), 50m/s max)

- Seismic zone** : Zone: III as defined in IS:1893-2002

- Design ambient temperature** : 50° C

For Electrical equipments

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TECHNICAL REQUIREMENTS

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1. TECHNICAL REQUIREMENTS

Technical specification document are minimum requirements, which the bidder should follow. However, the bidder shall also include & provide any additional requirements, if so warranted to meet tender requirements including guarantees as well as those required for smooth & trouble free operation of the system/ plant.

2. CODES & STANDARDS

The latest revision/ version of the following or equivalent standards shall be complied as a minimum requirement. It shall be responsibility of the Bidder to comply all the applicable Indian/International codes, best practices for complete Design, Engineering, Manufacturing, Delivery, Erection / Commissioning, Testing and Trial operation.

1	IS 14402	GRP pipes, joints, and fittings for use for sewerage, industrial waste and water.
2	IS 5382	Rubber sealing rings for gas mains, water mains and sewers
3	IS 13916	Installation of GRP Piping system – code of practice
4	IS 6746	Unsaturated polyester resin systems - specification
5	IS 11273	Woven roving fabrics of ‘E’ glass fiber
6	IS 11320	Glass Fiber roving for the reinforcement of Polyester and of epoxide resin system
7	IS 11551	Glass fiber chopped strand mat for the reinforcement of epoxy, phenolic and polyester resin system
8	IS 1367 (Part 1 to 20)	Technical supply conditions for threaded steel fasteners
9	AWWA C950	Standard for fiberglass pressure pipe
10	AWWA M45	Fiberglass pipe design
11	ASTM D 638	Standard Test Method for Tensile Properties of Plastics
12	ASTM D 695	Standard test method for compressive properties of rigid plastics
13	ASTM D 1599	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
14	ASTM D 2105	Standard Test Method for Longitudinal Tensile Properties of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting- Resin) Pipe and Tube
15	ASTM D 2290	Standard Test Method for Apparent Hoop Tensile Strength of

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		Plastic or Reinforced Plastic Pipe
16	ASTM D 2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
17	ASTM D2992	Standard practice for obtaining hydrostatic or pressure design basis for “Fiberglass” Pipes and Fittings.
18	ASTM D2563	Standard practice for classifying visual defects in glass reinforced plastic laminate parts.
19	ASTM D 2996	Standard specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
20	ASTM D 3517	Standard Specification for “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pressure Pipe
21	ASTM D 3567	Standard practice for determining dimensions of “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pipe and Fittings
22	ASTM D 3681	Standard Test Method for Chemical Resistance of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting -Resin) Pipe in a Deflected Condition
23	ASTM D 3754	Standard Specification for “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Sewer and Industrial Pressure Pipe.
24	ASTM D 3839	Standard guide for underground installation of “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pipe.
25	ASTM D 4161	Standard Specification for “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
26	ASTM D 5365	Standard Test Method for Long-Term Ring-Bending Strain of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting- Resin) Pipe
27	ASTM D2583	Standard Test method for Indentation hardness of rigid plastics by means of a Barcol Impressor.
28	ASTM D5421	Standard specification for contact molded “Fiber glass” (Glass-Fiber-Reinforced Thermosetting- Resin) flanges.
29	ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
30	BS EN 1796	Specification for GRP pipes, joints and fittings for use for Water Supply or Sewerage

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2.0 DESIGN REQUIREMENTS

a) Nominal Diameter

The nominal diameter of the pipe shall be as specified in the specification. The inside diameters and tolerances on diameters for the specified nominal diameter shall conform to the requirements stated in IS: 14402 / AWWA C 950 / ASTM D3517.

b) Length

Pipes shall be supplied in nominal lengths of 6m/9m/12m as per requirements. The tolerances on nominal lengths shall be as per relevant IS / AWWA / ASTM standards to which they are supplied.

c) Wall Thickness

The average Wall thickness of the pipe shall not be less than the minimum wall thickness published in the latest manufacturer's catalogue. However, minimum wall thickness in these published wall thicknesses of manufacturer shall conform to the tolerance limit as given in relevant IS / AWWA / ASTM standards to which GRP pipes are supplied.

Contractor shall submit design calculations as per AWWA M 45 & AWWA C 950 to establish the adequacy of pipe size, pressure class and stiffness class selected for the GRP pipes.

d) Pressure Class

Design Pressure of piping system is mentioned in the P&ID attached as Annexure-A1. GRP pipes shall have adequate pressure class based on the given design pressure of pipes.

e) Stiffness Class

GRP pipes specified should have a minimum Stiffness Class of 5000 N/m² to take care of the uncertainties of various loading conditions in different terrains. However, the actual stiffness class calculations as per AWWA-M-45/ relevant code shall be submitted to BHEL for approval.

f) Hoop and Longitudinal tensile strength

GRP pipe system shall meet the minimum hoop tensile strength and minimum longitudinal tensile strength requirements specified in IS 14402 / AWWA C 950 / ASTM D3517 for the considered pressure class based on the design pressure requirements mentioned in Annexure-A1. Wherever restrained joints are to be used in piping to avoid thrust blocks, (e.g. at elevated structures), bi-axial GRP pipes shall be installed by the Bidder.

g) Transient Analysis

Transient analysis for the system shall be done by a reputed institute/ consultant like IITs, IISc, etc. and the report shall be submitted for approval by BHEL.

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3.0 MATERIAL REQUIREMENTS

a) Resin

A thermosetting polyester resin (isophthalic resin) to be used and quality parameters shall be as per relevant IS / AWWA / ASTM standards.

b) Glass Fiber Reinforcement

Glass fiber reinforcement shall be of 'E-CR' type and shall conform to IS 11273, IS11320 or IS11551 as appropriate or relevant ASTM standards.

c) Wall Composition

Majority of the piping is above ground, hence, GRP pipes must be provided with UV (ultraviolet) stabilizers in the resin system so that there should not be any degeneration in the pipe surface due to ultraviolet light.

Structure of pipe shall have chemical resistant liner, reinforced structural layer and outer surface layer. Overground GRP pipes (as applicable) shall be provided with flame retardant in the resin coat of outer surface layer.

d) Other Materials

Other materials used in the manufacturing of pipe like aggregates, fillers and additives shall be in accordance with the relevant IS / AWWA / ASTM standards.

4.0 MANUFACTURING REQUIREMENTS

The pipes shall be manufactured through Filament winding process (Continuous Filament Winding process using advancing mandrel method or Helical Filament Winding process for biaxial pipes as per design requirement) by winding continuous glass fiber filaments saturated with liquid resin or pre-impregnated with partially cured resin (subsequent heating may be required to polymerize the resin system) onto the outside of a mandrel in a predetermined pattern under controlled tension as described in ASTM D 2996 to result in a corrosion resistant, composite structure to meet the operating conditions.

5.0 GRP FITTINGS & SPECIALS

All GRP fittings, such as bends/ elbows, ends, tees, spools, flanges and reducers etc. shall be equal to or superior in performance to pipe of the same classifications and shall be smoothly finished internally.

All GRP fittings are to be manufactured in factory, unless agreed both by BHEL and Bidder. Bidder to mention the same clearly in the bid. Dimensions of the fittings shall be as per relevant standards, and drawings shall be submitted by Bidder to BHEL for approval.

Complete pipes to be installed by Bidder must be new & unused. The same must not have been manufactured more than 6 months before the date of placement of order.

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(a) Fittings made from straight pipe

Fittings shall be fabricated from complete pipes or portions of straight pipe complying with IS 14402 / ASTM standards, as applicable for the pipe classifications. The fitting shall comply with the declared design requirement and be suitably mitred. The mitre shall be over wrapped externally and internally with liner, woven roving and/or chopped strand mat to ensure the longitudinal and circumferential tensile strength is at least equal by design to that of the pipe with which the fittings are to be used. All fittings shall have sufficient end length of pipe to accommodate over wrapped length of fitting and pipe.

(b) Fittings made by Moulding

Moulded GRP fittings shall be made by hand lay-up, contact moulding, hot or cold press moulding or tape winding with internal liner.

6.0 JOINTING & INSTALLATION

GRP pipeline shall have a jointing & installation system that shall provide for fluid tightness for the intended service condition in line with relevant AWWA/ ASTM/ IS code mentioned above.

As per scope, Bidder has to provide Civil Design/ Technical inputs to BHEL for below ground and above ground piping. Bidder shall submit detailed installation procedure for BHEL's approval. It is Bidder's responsibility to ensure correct installation & proper quality of complete GRP system with also ensuring coordination with the BHEL's civil execution agency. Bidder shall be deemed responsible for any possible defect (like leakage through joints, excessive Ovality or dislocation of joints & pipe spools) found in GRP piping during hydro testing / commissioning/ charging of the system after erection.

(a) Above ground Piping

Based on Bidder's civil inputs, Civil Structures i.e. pedestals, trestle structure below coal conveyor, thrust blocks etc. shall be provided by BHEL for above ground GRP pipes. Saddle arrangement along with other supporting elements shall be in Bidder's scope.

GRP pipes and fittings shall be joined with restrained or unrestrained joints as per the applicable standards. In case restrained joints are used in above ground piping, bi-axial GRP pipes are to be installed by the Bidder.

In case of unrestrained over ground piping, thrust blocks/ anchors shall be provided by BHEL at bends, reducers, branch offs, Tee-offs, expanders and terminal points of other suppliers apart from at points in straight run, as per design/ code requirements for large sizes. For above ground installation, support span for GRP piping shall be 6m (approx.). The final selection shall be as per mid span deflection criterion/ Axial stress criterion of AWWA/ other relevant code. Pipes shall be wrapped with elastomer sheets/ rubber sheets before clamping on supports. Proper Fencing shall be provided by Bidder around above ground GRP piping installed on pedestals.

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However, it must be noted that in case of unrestrained piping above ground, cost of estimated thrust blocks/anchors shall be loaded on Bidder's price, during price evaluation. For indicative GRP piping layout, Bidder is requested to refer Annexure-A2.

(b) Below ground Piping

Based on Bidder's civil inputs, Civil Works i.e. excavation and concrete encasing for the below ground GRP pipes shall be done by BHEL during project execution.

GRP pipes and fittings shall be joined with unrestrained sleeve couplings (Double REKA joint) or un-restrained double 'O' ring Bell-Spigot joints. Below ground GRP piping shall be concrete encased (BHEL's scope), piping shall be designed for minimum earth cover required above pipe crown as 1 meter or 1 time the diameter of pipe, whichever is more.

For indicative GRP piping layout, Bidder is requested to refer Annexure-A2.

(c) Erection Sequence

Bidder shall submit a detailed chart of erection sequence along with the bid, which is to be followed during installation of GRP pipes within stipulated time frame as per scope of specification.

(d) Flanged Joint

Flanged joints shall be used for connecting GRP pipes with Valves and Terminal ends (Flange details shall be as per AWWA). Flanged joints shall be used with EPDM gasket and hot dip galvanized bolts. The flanged joint is made from the same material as the pipe.

(e) Rubber Gaskets

Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382/ ASTM F 477. Rubber gaskets for use with flanged joints shall conform to IS 5382 or equivalent.

(f) Dewatering

Flooded trench condition shall be avoided as far as possible during erection of GRP Pipes. Suitable mitigation measures to prevent floatation of pipes shall be taken by Bidder, by considering suitable dewatering process.

7.0 TESTING

All piping & fittings shall be tested at shop as per Quality Plan (approved by BHEL/ Customer). Other components such as valves shall also be tested as per their approved QP.

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(A) TYPE TESTS

- The Long term type tests (HDB & strain corrosion) should have been conducted by the manufacturer or its technology provider on GRP pipes at an independent laboratory or duly approved by accredited third party agency. Bidder shall submit these type test reports to BHEL during contract. In case the Type Test Certificate is more than Three (03) years old, Type Test shall be performed as per applicable standard.
- The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days' notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

(B) Field Hydrostatic Tests

The pipeline shall be hydro tested in stretches of suitable length at 1.5 times the maximum working pressure or 1.1 times the design pressure, whichever is higher.

8.0 MARKING FOR PIPE & FITTING

The marking on pipe shall include the following:

- Standard mark for the pipes conforming to IS / AWWA / ASTM standards to which they are supplied.
- The manufacturer's name or trademark.
- The nominal pipe diameter
- Class of pipe (Pressure & Stiffness)
- Batch no. or date of manufacture
- Color bands for over ground piping

9.0 TRANSPORTATION, DELIVERY & SITE STORAGE

- As per scope, complete GRP pipe transportation, delivery and site storage and handling at site is in bidder's scope. Bidder shall have to submit a write up for safe transportation and site storage in the contract stage. In case of transport by ship, packing shall be sea worthy so as to ensure safe delivery till site.
- Inside plant boundary, open space shall be provided during execution stage for the material storage requirement. However, construction of any covered storage on the material handling area for the protection of material shall be in Bidder's scope.

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- c. As the complete installation of GRP pipe is in Bidder's scope, it shall be his responsibility to arrange all type of material handling requirements and storage for safe transportation and erection of GRP pipes inside & outside plant boundary area.
- d. The material being delivered at site shall be jointly inspected by the BHEL's/ Bidder's representatives. Defective or damaged pipe shall be rejected or in case of minor damage, repair of the pipe may be allowed to the satisfaction of BHEL.

10.0 ANNUAL MAINTENANCE CONTRACT

Annual Maintenance Contract (AMC) of the system for 2 years after successful commissioning or handing over. In case, due to unforeseen circumstances, if commissioning/ handing over is delayed beyond 2 months after acceptance of hydro-testing of both the systems by BHEL, AMC shall start after two months from acceptance of hydro-testing of both the systems. Bidder shall maintain the GRP system for the period (Max 2 months) between hydro-testing & commissioning/ handing over as part of the contract.

AMC covers the following:

- a. Round the clock monitoring of pipe installation for any leakage / rupture / Damage of the pipeline at site,
- b. Repairing the damaged pipes/joints, replacing the damaged part of piping/joints/fittings/supports with new ones wherever necessary including civil works for restoring site to original conditions.
- c. Recharging, testing and re-commissioning the entire pipe installation to the satisfaction of the employer.
- d. All material (temporary & permanent), manpower (including skilled & unskilled labor), machineries, testing equipment, fixtures, maintenance tools & tackles consumables etc. for repair, maintenance, re-erection/ re-commissioning of any or whole portion of piping system shall be in bidder scope.

Bidder shall quote AMC price for Four (04) years, however, BHEL will first place AMC order for Two (02) years. The remaining Two (02) years AMC shall be placed, if required, as per project requirement.

11.0 QUALITY ASSURANCE

The Quality Plans enclosed with this specification specify minimum quality control requirement. During contract stage bidder shall furnish these Quality Plans duly signed & stamped for their compliance. Quality plans shall be approved by BHEL and End Customer (if required). All inspection and testing shall be carried out by BHEL and CUSTOMER (if required). In case inspection is by both BHEL and CUSTOMER, then the inspection can be carried out jointly or separately.

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12.0 DRAWINGS AND DOCUMENTS

A. The bidder shall furnish the following documents (2 sets) along with the bid:

- i. Compliance certificate (as enclosed).
- ii. Schedule of deviations, if any (as per compliance certificate).
- iii. Pipe thickness, stiffness and other calculations as per relevant code.
- iv. Methodology (with time & activity schedule) to execute the project.
- v. Quality Plan - duly signed & stamped.
- vi. Bidder's Field Quality Plan - duly signed & stamped.
- vii. Relevant Catalogs with detailed technical information.
- viii. Un-price schedule of prices & unit prices as per NIT.

B. The successful bidder shall furnish the following documents (2sets) to BHEL during the contract stage viz. after the award of contract:

- i. Pipe thickness, stiffness and other calculations as per relevant code.
- ii. GA drawings of Pipe with marking details and dimensions.
- iii. GA drawings of Coupling with marking details and dimensions.
- iv. GA drawings of Rubber gasket & center register dimensions.
- v. Transient Analysis report for BHEL's approval.
- vi. Methodology (with time & activity schedule) to execute the project.
- vii. Detailed Installation, Jointing & Storage procedure for above & below ground GRP piping.
- viii. Civil Design/Technical inputs for above/below ground GRP piping.
- ix. Quality Plan - duly signed & stamped.
- x. Bidder's Field Quality Plan - duly signed & stamped.
- xi. Type test Reports of Hydrostatic design basis & Chemical resistance test.

	QUALITY PLAN	CUSTOMER: TANGEDCO	PROJECT: 2X660 MW Ennore SEZ STPP	PO No.:	-
		BIDDER/VENDOR: -	SPEC. NO : PE-TS-412-100-M042	QP No.:	PE-QP-412-100-M053 Rev-0A
		SYSTEM: GRP PIPING SYSTEM	ITEM: GRP PIPES & FITTINGS	Issue Date :	09.06.2017

S.No	Component/ Operation	Characteristics Checked	Category	Type/ Method of Check	Extent of Check	Reference Document/ Standard	Acceptance Norms	Format of Records	Agency			Remarks
1.0	2	3	4	5	6	7	8	9	P	W	V	11
1.0	Raw Material Control											
1.1	Polyester Resin (ISO PHTHALIC)	1.Relative Density	MA	Physical & Chemical	1 sample for every Batch	IS 6746:1994, ISO 2555, ISO 2535, ISO 584, ASTM D 2196, ISO/R 3251, FTEC & VENDER SPEC	1.11 + / - 0.01	MANUFACTURERS TEST REPORT	2	1	1	Test certificates of the Raw material supplier to be reviewed by BHEL/BHEL Authorised Representative.
		2.Viscosity	MA				600 cps + / - 20 %		2	1	1	
		3.Acid Value	CR				11 + / - 4 mgKOH / gm		2	1	1	
		4.Volatile Content	MA				37 + / - 3 % by mass		2	1	1	Test certificates of Vender tested samples to be verified and Two samples from Lot of 100MT to be Witnessed by BHEL/BHEL Authorised Representative/
		5.Gel Time	MA				18 minutes+ / - 20 %		2	1	1	
		6. Reactivity	MA				<40 min@ 25-exotherm peak		2	1	1	
		7. Exotherm peak	MA				140 - 180 deg cen		2	1	1	
		8. appearance	MA				clear no hage		2	1	1	
1.2	Fiber Glass	1.Roving Weight (Tex)	MA	Physical & Chemical	One sample from every Lot of 10MT per Type	IS 11320 & vendor spec	600 gm/ km+ / -10% 1200/2400/4400/4800 gm/km + / - 8%	MANUFACTURERS TEST REPORT	2	1	1	Test certificates of the Raw material supplier to be reviewed by BHEL/BHEL Authorised Representative.
		2.Moisture Content	MA				Max 0.3 %		2	1	1	
		3.Loss on Ignition	MA				+ / -20% OR 0.2% FROM THE NOMINAL VALUE STATED BY SUPPLIER (WHICHEVER IS GREATER TOLERANCE)		2	1	1	Test certificates of Vender tested samples to be verified and One samples from Lot of 20MT per Type to be Witnessed by BHEL/BHEL Authorised Representative.
		4.Conductivity	MA				Max 12.5 mS/m		2	1	1	
1.3	Silica Sand	1.Sieve Analysis (Particle Size)	MA	Physical , Chemical & Visual	One Composite Sample from every lot of 20MT	IS 14402 & vendor spec	0.05 - 0.8 mm	MANUFACTURERS TEST REPORT	2	1	1	Test certificates of the Raw material supplier to be reviewed by BHEL/BHEL Authorised Representative.
		2.Moisture Content	MA				Max 0.1%		2	1	1	
		3.Loss on Ignition	MA				Max 0.5%		2	1	1	
		4.Wettability	MA				Max 200 Seconds		2	1	1	Test certificates of Vender tested samples to be verified and One samples from Lot of 40MT to be Witnessed by BHEL/BHEL Authorised Representative.
		5.Carbonate Content	MA				Max 2.5%		2	1	1	
		6.Microscopic observation	MA				ROUND / OVAL PARTICLES FREE FROM SHARP EDGES		2	1	1	
1.4	Rubber Gasket	1.Shore "A"Hardness	MA	Physical & Visual	5 % for dimensional & 25 % for Physical Appearance in every Lot	IS 5382 & vendor spec	50 + 5 / - 4	TEST CERTIFICATES REPORT	2	1	1	
		2.Dimension Check	MA				As per IS 5382:1985 CI 3.6 & Approved Drawings		2	1	1	
		3.Material of Construction	MA	Compliance certificate	100%		EPDM (Type 2)	Compliance certificate of Sub-vender	-	-	1, 2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURES		
	DATE		BIDDER/VENDERS COMPANY SEAL

	QUALITY PLAN	CUSTOMER: TANGEDCO	PROJECT: 2X660 MW Ennore SEZ STPP	PO No.:	-
		BIDDER/VENDOR: -	SPEC. NO : PE-TS-412-100-M042	QP No.:	PE-QP-412-100-M053 Rev-0A
		SYSTEM: GRP PIPING SYSTEM	ITEM: GRP PIPES & FITTINGS	Issue Date :	09.06.2017

S.No	Component/ Operation	Characteristics Checked	Category	Type/ Method of Check	Extent of Check	Reference Document/ Standard	Acceptance Norms	Format of Records	Agency			Remarks
									P	W	V	
1.0	2	3	4	5	6	7	8	9	10			11
2.0	GRP PIPES											
2.1	Acceptance Tests	Dimensions (OD)	MA	Measurement	100%	IS 14402 :1996 & BS - EN 14364 : 2006 & also Technical data sheet of vendor	\$	INSPECTION REPORT	2	1	-	Two Sample from every 100 Pipes to be witnessed by BHEL +Test certificates of 100% pipes tested by Vender to be verified by BHEL/BHEL Authorised Representative.
2.2		Wall Thickness	MA	Measurement			\$	INSPECTION REPORT	2	1	-	
2.3		Workmanship	MA	Visual			IS 14402:1996;CI.9	INSPECTION REPORT	2	1	-	
2.4		Soundness of Pipe (Hydrotest)	CR	Annex C,IS 14402			IS 14402:1996;CI.12.2 (Two times Pressure Class)	INSPECTION REPORT	2	1, 4	-	
2.5		Nominal Length	MA	Measurement			As per Customer requirements	INSPECTION REPORT	2	1	-	
2.6		Marking	MA	Visual			As per Customer requirements	INSPECTION REPORT	2	1	-	
2.7		Barcol Hardness	MA	ASTM D - 2583			Min 40	INSPECTION REPORT	2	1	-	
2.8	Destructive Tests	Pipe Stiffness & Deflection	CR	Annex B,IS 14402	One sample from every 100 Pipes. (Min Two samples per Lot)		IS 14402:1996;CI.10	INSPECTION REPORT	2	1, 4	-	One sample from every 100 Pipes. (Min Two samples per Lot)
2.9		Longitudinal Tensile Strength	CR	Annex D,IS 14402			IS 14402:1996; CI.13 Table-06	INSPECTION REPORT	2	1, 4	-	
2.10		Hoop Tensile Strength	CR	Annex E,IS 14402			IS 14402:1996; CI.14 Table-07	INSPECTION REPORT	2	1, 4	-	
2.11		Composition	CR	ISO 1172, ASTM D-2584			% Resin, Glass & Sand	INSPECTION REPORT	2	1	-	
2.12	Type Tests / Long term Tests	Hydrostatic Design Basis (HDB)	MA	Annex F,IS 12709	6 Samples (3Samples for 100Hrs and 3Samples for 1000Hrs)		IS 14402:1996;CI.15	INSPECTION REPORT	2	1	4	Vendor to submit valid TEST Certificate to be vetted by BHEL . However if the conductance of test is found necessary by BHEL , material to meet delivery requirement will be supplied by vendor to site at his risk and cost till successful conductance of test.
2.13		Chemical Resistance of Pipe (Strain Corrosion test)	MA	Annex F,IS 14402			IS 14402:1996;CI.16	INSPECTION REPORT	2	1	4	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURES		
	DATE		
			BIDDER/VENDERS COMPANY SEAL

	QUALITY PLAN	CUSTOMER: TANGEDCO	PROJECT: 2X660 MW Ennore SEZ STPP	PO No.:	-
		BIDDER/VENDOR: -	SPEC. NO : PE-TS-412-100-M042	QP No.:	PE-QP-412-100-M053 Rev-0A
		SYSTEM: GRP PIPING SYSTEM	ITEM: GRP PIPES & FITTINGS	Issue Date :	09.06.2017

S.No	Component/ Operation	Characteristics Checked	Category	Type/ Method of Check	Extent of Check	Reference Document/ Standard	Acceptance Norms	Format of Records	Agency			Remarks
									P	W	V	
1.0	2	3	4	5	6	7	8	9	10			11
3.0	GRP PUSHFIT GASKETED COUPLING											
3.1	Acceptance Tests	Hydrotest	CR	Annex C,IS 14402	100%	IS 14402 :1996	IS 14402:1996;Cl.12.2 (Two times Pressure Class)	INSPECTION REPORT	2	1, 4	-	Two Sample from every 100 Coupling to be witnessed by BHEL +Test certificates of 100% couplings tested by Vender to be verified by BHEL/BHEL Authorised Representative.
4.0	GRP FITTINGS											
4.1	Acceptance Tests	Workmanship	MA	Visual	100%	IS:14402 :1996	As per Vendor SPEC/STD/APPD DWGS	INSPECTION REPORT	2	1	-	One Sample per Type & Lot to be witnessed by BHEL +Test certificates of 100% fittings by Vender to be verified by BHEL/BHEL Authorised Representative.
4.2		Dimensions	MA	Measurement			As per Approved Drawings	INSPECTION REPORT	2	1	-	
4.3		Hydrotest	MA	Visual	For Bends, Lamination joint strength may be alternatively checked at shop by hydrotesting of straight pipe (One number per size) with lamination joint at pressure twice pressure class. For other fittings, One number of fitting each type & size shall be hydro tested at shop at pressure twice pressure class.		Fittings shall not show any leakage or Burst when tested at twice pressure class for 1 min at room temperature.	INSPECTION REPORT	2	1	-	Lamination joint shall be as per manufacturer standards and Pipe will be offered for testing after completion of lamination joint. Samples as per Col.6 to be selected by BHEL/BHEL Authorised Representative.
5.0	PACKING											
5.1	Acceptance Tests	Workmanship	MA	Visual	100%	IS 14402 :1996	As per SPEC/STD/ARPPD DWGS	INSPECTION REPORT	2	-	-	Compliance certificates for packing to be submitted by Vendor.
		Dimensions	MA	Measurement			As per Approved Drawings	INSPECTION REPORT	2	-	-	

Notes :

1. In case of Long Term tests are required to be carried out as per IS14402, the dispatches to be made pending the test results to meet delivery requirement.
2. Factory Hydro Test for Pipes, Couplings & Fittings will be done at pressure Twice the pressure class & Holding Time of One Minute as per IS:14402.
- 3.P = Performed by,W = Witnessed by,V = Verified by,1= BHEL /BHEL Authorised Representative, 2 = Vendor , 3 = sub vendor , 4= Customer / Customer Representative; MA = Major , CR = Critical , IS - Indian Standard
4. BHEL /Customer or Authorised Representative may witness at any stage as deemed necessary during the contract execution.
5. Samples selected by BHEL for HYDRO test will only be identified by marking.
6. Lot size is the quantity offered in one inspection call/one inspection visit.

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURES		
	DATE		
			BIDDER/VENDERS COMPANY SEAL

	COMPLAINCE SHEET	SPECIFICATION NO. PE-TS-412-100-M042	
		REV. NO.: 0A	DATE: 08.06.2017
		Sheet 1 of 1	

I hereby comply/not comply (*) to all the requirements of this technical specification in totality.

- In case the bidder does not comply with the technical specification, the deviations shall be explicitly listed in the technical deviation sheet of GCC. Deviations listed in technical deviation sheet shall only be considered.

Name of Bidder / Authorized Representative: -

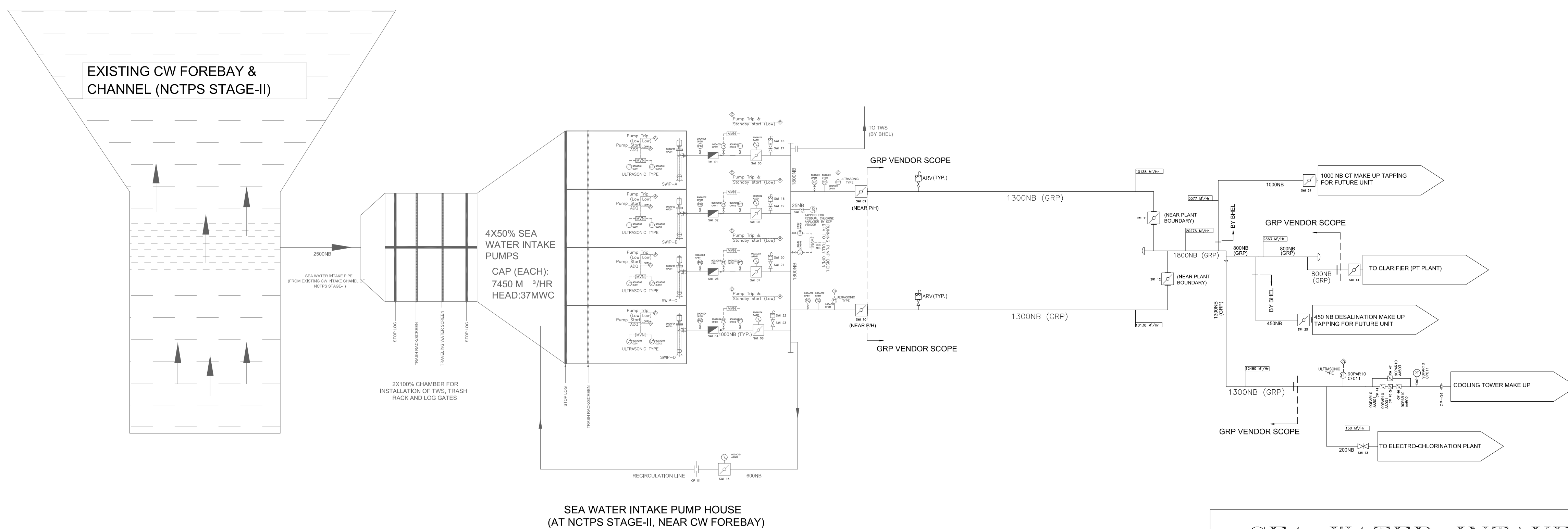
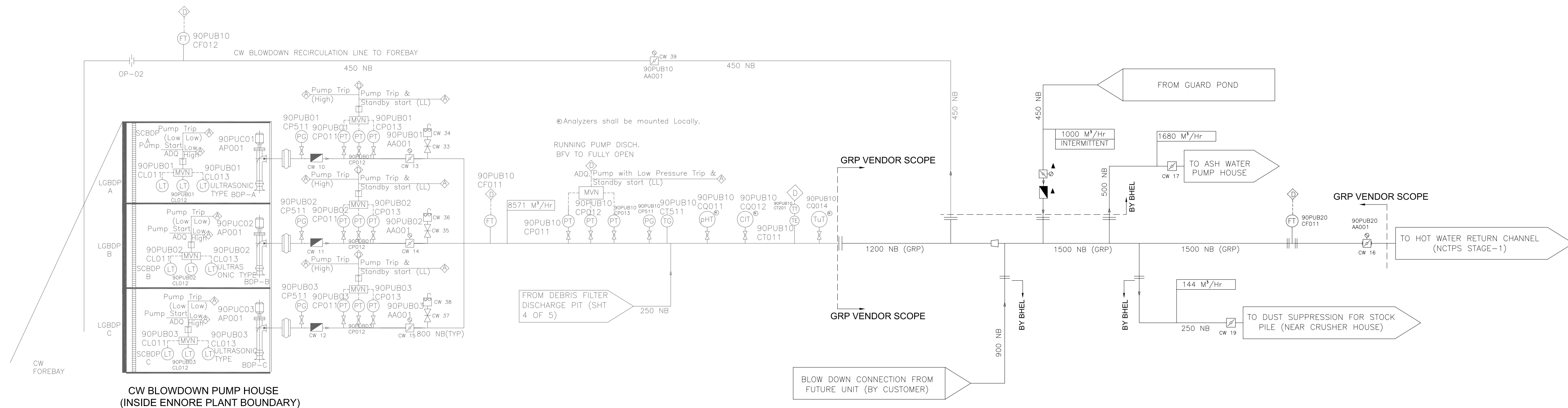
Designation: -

Signature: -

Company Seal: -

Date: -

2x660MW ENNORE STPP								
PRICE SCHEDULE FOR GRP PIPING								
SL. NO.	TYPE OF PIPE	Measurement Unit Length(M)/Nos/ Tonnes	UNIT RATE (Rs.)	TOTAL COST (Rs.)	EXCISE DUTY (Rs.)	CST @2% (Rs.)	FREIGHT CHARGES INCLUDING SERVICE TAX(Rs.)	TOTAL FOR SITE PRICE(Rs.)
	[A] MECHANICAL SCOPE							
1	Piping material cost							
	Pipe							
	DN800 PN9 SN5000							
	DN1200 PN6 SN5000							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	DN1800 PN9 SN5000							
	Bend 90 Deg							
	DN800 PN9 SN5000							
	DN1200 PN6 SN5000							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	DN1800 PN9 SN5000							
	Bend 60 Deg/45 Deg							
	DN1200 PN6 SN5000							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	Bend 30 Deg & below							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	Tee							
	DN1800/DN1300 PN9 SN5000							
	DN1800/DN1000 PN9 SN5000							
	DN1800/DN800 PN9 SN5000							
	DN800/DN450 PN9 SN5000							
	DN800/DN800 PN9 SN5000							
	DN1200/DN450 PN6 SN5000							
	DN1500/DN900 PN6 SN5000							
	DN1500/DN500 PN6 SN5000							
	DN1500/DN450 PN6 SN5000							
	DN1500/DN250 PN6 SN5000							
	Reducer							
	DN1800/DN1300 PN9 SN5000							
	DN1500/DN1200 PN6 SN5000							
	Flanges							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	DN1000 PN9 SN5000							
	DN800 PN9 SN5000							
	DN450 PN9 SN5000							
	DN1200 PN6 SN5000							
	DN450 PN6 SN5000							
	DN900 PN6 SN5000							
	DN500 PN6 SN5000							
	DN250 PN6 SN5000							
	Manhole arrangement							
	for DN1300 PN9 SN5000							
	for DN1500 PN6 SN5000							
	End Cap							
	DN1800 PN9 SN5000							
	DN800 PN9 SN5000							
	Lamination for GRP							
	DN800 PN9 SN5000							
	DN1200 PN6 SN5000							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	DN1800 PN9 SN5000							
	Coupling for GRP							
	DN800 PN9 SN5000							
	DN1200 PN6 SN5000							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
	DN1800 PN9 SN5000							
	Flanged stub for ARV DN200 PN9 SN5000							
	Flanged stub for instrument DN25 PN9 SN5000							
	Flange with Nut & Bolts							
	DN1300 PN9 SN5000							
	DN1500 PN6 SN5000							
2	Vent valves							
	Drain valves							
3	Commissioning spares							
	Total cost of Material supply: [1+2+3]							
4	Pipe laying charge for buried piping							
5	Pipe laying charge for piping on pedestal							
6	pipe laying charge for piping on elevated structure							
7	Hydrotesting charges including all necessary tools & tackles							
	Total cost of Erection & commissioning: [4+5+6+7]							
	[B] CIVIL SCOPE							
8	Secondary concrete work							
9	Enabling works							
10	Misc structural work for supports							
	Total cost of Civil work: [8+9+10]							
	[C]							
	Engineering charge for Transient analysis							
	[D] Annual maintenance contract for 4Years (Initial AMC order shall be placed for 2years, which can be extended to further 2 years as per project requirements.)							
	Total cost for Turnkey execution: [A+B+C+D]							



ANNEXURE-A1
(PIPING FLOW DIAGRAM)

ANNEXURE-A2

**For Indicative Piping Layout, refer the drawing
already attached in Annexure-1**

	TECHNICAL DATA SHEET	SPECIFICATION NO. PE-TS-412-100-M042	
		REV. NO.: 0A	DATE: 09.06.2017
		Sheet 1 of 3	

ANNEXURE-A3

	TECHNICAL DATA SHEET	SPECIFICATION NO. PE-TS-412-100-M042	
		REV. NO.: 0A	DATE: 09.06.2017
		Sheet 2 of 3	

FOR BELOW GROUND GRP PIPE

	<u>DATA TO BE FILLED BY THE BIDDER FOR EACH TYPE & SIZE</u>		
1.0	Outside Diameter	mm	
1.1	Nominal reinforced Wall thickness	mm	
1.2	Liner Thickness	mm	
1.3	Total Wall Thickness	mm	
1.4	Hoop Tensile Modulus of Elasticity	N/mm ²	
1.5	Hydrostatic Design Basis -for Stress basis	N/mm ²	
1.6	Hydrostatic Design Basis -for Strain basis	%	
1.7	Long Term Ring Bending Strain	%	
1.8	Deflection Lag factor	-	
2.0	Stiffness Class 5000 N/m ² (min)	N/m ²	
2.1	Design Pressure rating	Kg/sq.cm (g)	
2.2	Pressure Class considered	PN	
3.0	Standard permitted deflection	%	
3.1	Max. allowable long term vertical deflection (rel)	%	
	<u>Calculations at min soil cover</u>		
4.0	Predicted deflection		
4.1	Combined loading working strain due to		
4.2	internal pressure	%	
4.3	max permissible deflection	%	
5.0	Buckling pressure		
5.1	Allowable calculated value	N/mm ²	
5.2	Max value due to vacuum, ground water & soil pressure	N/mm ²	
5.3	Max value due to traffic, ground water & soil pressure	N/mm ²	
	<u>Calculations at max soil cover</u>		
6.0	Predicted deflection		
6.1	Combined loading working strain due to		
6.2	internal pressure	%	
6.3	max permissible deflection	%	
7.0	Buckling pressure		
7.1	Allowable calculated value	N/mm ²	
7.2	Max value due to vacuum, ground water & soil pressure	N/mm ²	
7.3	Max value due to traffic, ground water & soil pressure	N/mm ²	

	TECHNICAL DATA SHEET	SPECIFICATION NO. PE-TS-412-100-M042	
		REV. NO.: 0A	DATE: 09.06.2017
		Sheet 3 of 3	

FOR ABOVE GROUND GRP PIPE

	<u>DATA TO BE FILLED BY THE BIDDER FOR EACH TYPE & SIZE</u>		
1.0	Outside Diameter	mm	
1.1	Nominal reinforced Wall thickness	mm	
1.2	Liner Thickness	mm	
1.3	Total Wall Thickness	mm	
1.4	Hoop Tensile Modulus of Elasticity	N/mm ²	
1.5	Axial Tensile Modulus of Elasticity (If Bi-Axial pipes)	N/mm ²	
1.6	Hydrostatic Design Basis -for Stress basis	N/mm ²	
1.7	Hydrostatic Design Basis -for Strain basis	%	
1.8	Long Term Ring Bending Strain	%	
1.9	Deflection Lag factor	-	
2.0	Stiffness Class 5000 N/m ² (min)	N/m ²	
2.1	Design Pressure rating	Kg/sq.cm (g)	
2.2	Pressure Class considered	PN	
3.0	Standard permitted deflection	%	
3.1	Max. allowable long term vertical deflection (rel)	%	
4.0	Predicted deflection		
4.1	Combined loading working strain due to		
4.2	internal pressure	%	
4.3	max permissible deflection	%	
5.0	Buckling pressure		
5.1	Allowable calculated value	N/mm ²	
5.2	Max value due to vacuum	N/mm ²	