




Project	Subject	Doc. No.	Rev	Date
2X660 MW Udangudi STPP Stage-I UDANGUDI,TAMIL NADU	Technical Specification for Glass Reinforced Plastic (GRP) piping	PE-TS-435-100-M042	3	24/12/2020

**TAMIL NADU GENERATION AND DISTRIBUTION
CORPORATION LTD.**

**2x660 MW UDANGUDI S.T.P.P. STAGE-I
UDANGUDI, TAMIL NADU.**

	OWNER	TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.-CHENNAI, TAMIL NADU. TANGEDCO HEADQUARTERS,1ST FLOOR,NEW EB QUARTERS,144,ANNASALAI,CHENNAI-600002.
	OWNER'S CONSULTANT	TATA CONSULTING ENGINEERS LIMITED BENGALURU
	CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR-PROJECT ENGINEERING MANAGEMENT, NOIDA.
SYSTEM:	TECHNICAL SPECIFICATION FOR GLASS REINFORCED PLASTIC (GRP) PIPING	
SPECIFICATION No.	PE-TS-435-100-M042	

	GLASS REINFORCED PLASTIC (GRP) PIPING – UNDERGROUND	SPECIFICATION No. PE-TS-435-100-M042	
		REV. No.: 03	DATE: 24.12.2020
		Sheet 1 of 1	

CONTENTS

	<u>TITLE</u>	<u>No of Sheets</u>
1	Scope of Enquiry	3
2	Project Information	3
3	Technical Requirement	9
4	Quality Plan	7
5	Compliance Sheet	1
6	Annexure – 1 to 5	10

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 02		DATE: 08.07.2020
	Sheet 1 of 3		

SCOPE OF ENQUIRY

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 02	DATE: 08.07.2020	
	Sheet 2 of 3		

1. PROJECT SCOPE

- i. **Bidder's scope** covers **Detailed Design, Engineering, Manufacturing, Transportation, Site-Storage, Erection & Hydro-testing** of Glass Reinforced Plastic (GRP) piping for 2x660 MW Udangudi Supercritical Thermal Power Project Stage-I.
- ii. **Bidder's scope** covers to provide **civil design inputs** eg: Thrust blocks, RCC Encasing etc. requirement along with loading details to BHEL. Civil works shall be done by a separate agency (BHEL scope) based on above inputs and are excluded from Bidder's scope.
- iii. **Bidder's scope** also covers **Supervision** of BHEL's complete civil works including excavation, trenching, bed preparation, pipe encasing, thrust blocks, backfilling etc. for complete GRP piping system.
- iv. Piping carrying **sea water** as shown in the layout (for systems: feed water piping to desalination plant, make up piping to CW forebay, CW Blow down piping, SWRO reject piping to sea water outfall tank and Auxiliary Cooling Water (ACW) piping) shall be of GRP material.
- v. Complete piping system with fittings (Tees, elbows, expander, end caps etc.) along with flanged tapping (for main/branch pipe connections, drains, vents, manholes etc.) shall be in bidder's scope. Isolation valves drain and vents, measuring instruments shall be supplied by BHEL with flanged ends, as free supply items.
- vi. Transient/ Surge analysis of the systems (as applicable) shall be carried out by BHEL. Based on the same, suitable Air Release Valves shall be provided by BHEL as free supply items. Branch connections in the main header piping for ARVs shall be provided by Bidder.
- vii. GRP pipelines shall be mainly underground with RCC encasement of 250mm for all sizes. Top of the buried pipe shall be at least 1.5 meters below the ground level (Refer Figure-1 of Technical Requirements – sheet 6 of 9). Based on the Bidder's civil design inputs, civil works i.e. excavation/ trenching, bed preparation, RCC encasement, backfilling, installation of thrust blocks etc. shall be done by BHEL during project execution. Erection & Hydro-testing of piping (segments as well as full system) shall be done by Bidder. It shall be Bidder's responsibility to supervise and ensure correct execution of BHEL's complete civil works and thus, installation of GRP piping by coordinating with BHEL's civil execution agency to avoid any interface issues as well as to arrest any leakage issues during site execution.
- viii. Bidder to note that the following Annexures are attached as a part of this specification:

Annexure-1 comprises of estimated BOM based on BHEL layout drawing attached with the specification as Annexure-3. Bidder to note that his scope includes **supply of all items** required for complete erection, Hydro-testing & Commissioning of piping

	GLASS REINFORCED PLASTIC (GRP) PIPING	SPECIFICATION No. PE-TS-435-100-M042	
		REV. NO.: 02	DATE: 08.07.2020
		Sheet 3 of 3	

(other than those mentioned as free supply by BHEL) including tools /tackles and supervision of BHEL's complete civil works. Detailed layout drawing shall be prepared by the successful bidder after award of contract for BHEL approval and site reference.

Annexure-2 comprises of Piping & Instrumentation Diagram for the systems comprising of GRP piping - "Plant Water scheme" and "CW- ACW scheme".

Annexure-3 comprises of BHEL Piping Layout drawing showing the routing details of GRP piping for this project.

Annexure-4 comprises of Technical Datasheet for Below Ground GRP piping which shall be duly filled by Bidder and submitted to BHEL for approval.

Annexure-5 comprises of suggestive sketch for RCC Encasement of GRP piping showing stage-wise concrete encasement.

2. 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.
3. 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.
4. General Arrangement drawings/ Material Specification/ Design Calculations/ Data sheets/ Layout drawings/ Installation procedures/ Pipe support details/ Materials test certificates etc. for complete GRP piping shall be approved by BHEL/ Customer.
5. 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. Pipes and fittings shall be tested as per approved Quality Plan.
6. 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.
7. 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.
8. The bids shall be in Bilingual (English & Hindi)/ English language and in SI Units.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 02		DATE: 08.07.2020
	Sheet 1 of 3		

PROJECT INFORMATION

	GLASS REINFORCED PLASTIC (GRP) PIPING	SPECIFICATION No. PE-TS-435-100-M042	
		REV. NO.: 02	DATE: 08.07.2020
		Sheet 2 of 3	

SITE CONDITION

Location and existing Infrastructure

The plant location details are as follows:

Country	: India
State	: Tamil Nadu
Administrative district	: Thoothukudi
Next big cities to site	: Thoothukudi (approx.45 kms from site)
Road access	: East Coast Road – State high way (176)
Nearest Railway Station	: Thiruchendur (approx.12 kms from site)
Nearest Airport	: Vagaikulam (approx.60 kms from site)
Nearest Harbour	: Tuticorin (approx.45 kms from site)

The proposed power project will be located at Udangudi in Tamil Nadu. The proposed power project site is located at about 45km South of Thoothukudi. The proposed marine facilities for the power project will be built on the coast adjoining the power project. The site is accessible by well developed roads.

The town of Tuticorin has all infrastructural facilities and has number of Industries. Tuticorin is well connected by both state highways, National highways and has direct rail link with State Capital Chennai.

Soil Profile

A Preliminary soil investigation report and topographical survey has been carried out by Owner. The results are furnished in a separate annexure.

The Detailed geotechnical Investigation and Setting out survey will be performed by the EPC contractor, and will be the basis for the detailed engineering for the project. The geotechnical report shall contain recommendations for foundation design during detailed engineering.

Seismic intensity

Seismic Intensity	:	As per IS : 1893 Latest
Zone	:	II
Intensity	:	As per IS:1893-Latest

Tide Levels

The recorded tide levels with respect to the Chart Datum (CD) near the identified intake point are as follows:

Mean high water-Spring	CD + 0.99 m
Mean high Water-Neap	CD + 0.71 m
Mean low Water-Neap	CD + 0.55 m
Mean low water-Spring	CD + 0.29m
Mean sea level	CD + 0.64 m
Highest High Tide Level	CD+ 1.026 m
Lowest Low Tide Level	CD + 0.110 m

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 02	DATE: 08.07.2020	
	Sheet 3 of 3		

Meteorological conditions

Ambient Air Temperature

Maximum dry bulb temperature : 41 °C

Minimum dry bulb temperature : 17 °C

Relative humidity

Mean Maximum humidity (Summer) : 84%

Mean Minimum humidity (Summer) : 62%

Maximum humidity (Monsoon) : 97%

Minimum humidity (Monsoon) : 45%

Rainfall

Annual rainfall (Maximum) : 718.2 mm

Annual Rain fall (Minimum) : 384.1 mm

Twenty four (24) Hour max : 138.2 mm

High Flood Level

High Flood Level for site : RL 2.450 m

Wind

Mean Wind Speed (max) : 20.6 km/h

Wind direction : North, North East, North West, East

The details given are arbitrary and may vary. The contractor should collect the actual data from the Meteorological Department pertaining to the site location and design the plant accordingly.

Meteorological data corresponding to Tuticorin observatory station shall be adopted. These data can be collected from Regional Meteorological Centre, India Meteorological Dept, 50, College Road, Chennai – 600 006.

Design Requirements related to site conditions

Design Ambient Data

Rainfall data:

The maximum rainfall in a year to be considered for design is 718.2 mm. 24 hours maximum to be considered is 138.2 mm. Area drainage study as required is in Contractor's scope of work.

Wind data

Wind loads to be considered for design of structures shall be based on the design wind speeds arrived at based on IS : 875 (Part -3) – Latest Edition. The parameters for calculation of design wind speed as per IS : 875 (Part -3) – Latest Edition are elaborated under Volume II, Section 5 of Detailed Technical Specification - Civil.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 1 of 9		

TECHNICAL REQUIREMENTS

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 2 of 9		

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 & Hydro-testing.

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 11320	Glass Fiber rovings for the reinforcement of Polyester and of epoxide resin systems
6	AWWA C950	AWWA Standard for fiberglass pressure pipe
7	AWWA M45	Fiberglass pipe design
8	ASTM D 3517	Standard Specification for “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pressure Pipe
9	ASTM D 2996	Standard specification for Filament-Wound “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pipe
10	ASTM D 3839	Standard guide for underground installation of “Fiberglass” pipe

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 C950 / ASTM D3517.

b) Length

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

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 3 of 9		

c) Wall Thickness

The minimum Wall thickness of pipe at any point shall not be less than the wall thickness specified in the approved drawings. Minimum wall thickness in the published wall thicknesses of manufacturer shall conform to the tolerance limit as given in relevant IS / AWWA / ASTM standards to which GRP pipes are being supplied.

Contractor shall submit design calculations as per AWWA M45 & AWWA C950 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 Annexure-1. 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 248Kpa or SN-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 M45/ relevant code shall be submitted to BHEL for approval and stiffness class to be selected suitably.

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-1.

3.0 MATERIAL REQUIREMENTS

a) Resin

A Vinyl ester resin type shall be used for inner liner and iso-phthalic resin type shall be used for outer liner. 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 relevant IS/ ASTM standards.

c) Wall Composition

GRP pipes must be provided with UV (ultraviolet) stabilizers in the resin system so that there should not be any degeneration during storage in the pipe surface due to ultraviolet light. Structure of pipe shall have chemical resistant liner, reinforced structural layer and outer surface layer.

The thickness of inside and outside resin rich liners shall be **minimum 1.6mm**.

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.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 4 of 9		

GRP pipes and fittings minimum design requirement (sea water application):

S. No.	Design Parameters	Requirement
1	Stiffness Class	5000
2	Vacuum	760mmHg
3	Inner liner thickness	1.6 mm
4	Resin type for inner Liner	Vinyl ester
5	Glass type	E-CR
6	Resin type for Exterior Liner	Iso-phthalic
7	Aggregate type	Silica Sand
8	Exterior Layer thickness	1.6 mm
9	Minimum initial specific stiffeners STIS	5000 N/m ²
10	Ring bending strain	1.3

4.0 MANUFACTURING REQUIREMENTS

GRP pipe shall be machine-made either with a Continuous Filament Winding process using advancing mandrel method or with a Helical Filament Winding process with full automation.

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. Dimensions of the fittings shall be as per relevant standards (internal diameter of the fittings shall be same as pipe), and drawings shall be submitted by Bidder to BHEL for approval.

Complete pipes/ fittings to be installed by Bidder must be new & unused.

(a) Fittings made from straight pipe

Fittings shall be fabricated from complete pipes or portions of straight pipes complying with IS/ ASTM/ AWWA 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, ensuring equal or superior properties than pipe.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 5 of 9		

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 the relevant IS/ AWWA/ ASTM code.

As per scope, Bidder has to provide Civil design/ Technical inputs to BHEL for GRP piping. Bidder shall submit detailed installation procedure for GRP piping for BHEL approval. It is Bidder's responsibility to supervise BHEL's complete civil works & ensure correct installation & proper quality of complete GRP piping system. Bidder shall be deemed responsible for any possible defect (like leakage through joints, excessive ovality or deflection or dislocation of joints & pipe spools) found in GRP piping during hydro-testing of the system during/ after complete installation.

(a) Below ground Piping

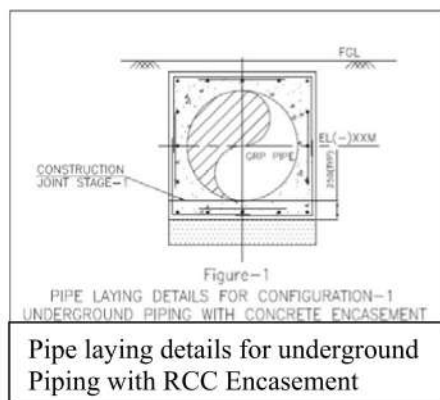
Based on the final layout drawing (BHEL approved) and based on Bidder's civil inputs as well as site supervision, civil works i.e. trench excavation, bed preparation, concrete encasing, thrust blocks, backfilling etc. for the below ground GRP pipes shall be done by BHEL during project execution. RCC encasement shall be suitable enough to protect pipe against live load, at rail / road / pipe crossings.

GRP pipes and fittings shall be joined with unrestrained sleeve couplings (Double REKA joint) or un-restrained double 'O' ring Bell-Spigot joints. Manhole tees and flanges of 600Nb branch size with MOC as GRP shall be provided by the Bidder as per location shown in BHEL piping layout drawing. Cover for the same along with fasteners etc. shall be of steel and in BHEL scope.

For GRP piping layout, Bidder is requested to refer attached Annexure-3.

Proper installation is very important for performance of GRP pipes in long-term. Further, please note that piping shall be laid as per details given in **Figure-1**. Also refer attached **Annexure-5**, suggestive Sketch for RCC encasement of GRP pipe for stage-wise concrete encasement of GRP piping. Bidder shall be provided with trench for pipe laying with concrete Stage-1 casted for pipe jointing/ installation. Bidder shall supervise & ensure proper quality of trench as well as RCC bed. Trench Excavation, encasement, thrust block installation and backfilling processes shall be performed by BHEL; furthermore, these activities shall also be supervised and monitored by Bidder in order to ensure that the desired pre- and post-installation conditions are achieved. Pipe transportation from storage yard to site, lowering, placing & jointing and installation of piping/ fittings/ manholes etc. are in Bidder's scope.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03 DATE: 22.12.2020		Sheet 6 of 9

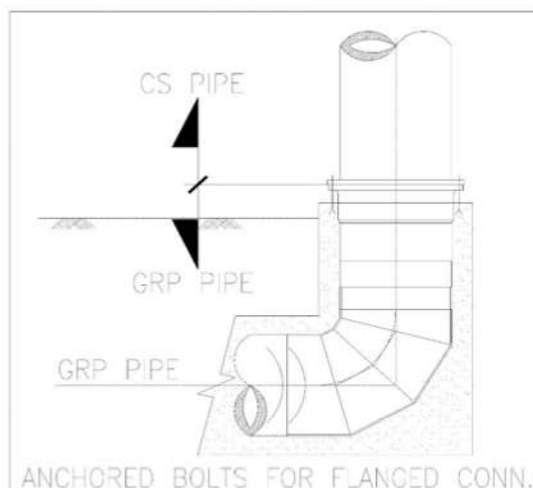


(b) Flanged Joint

Flanged joints shall be used for connecting GRP pipes with valves, steel pipes and other Terminal Points (Flange details shall be as per AWWA). Flanged joints shall be used with EPDM gasket and SS fasteners which are to be supplied by Bidder (suitable for sea water application). The flanged joint shall be made from the same material as the pipe. All components of the joint shall be suitable for sea water application.

Where a GRP pipe is to be connected to a steel pipe, it shall have a special flange matching the steel flange of the steel pipe (matching steel flange shall be supplied by BHEL). The GRP special flange shall be designed by Bidder to provide the equivalent strength and resistance against the anticipated loading as that of steel pipe.

In case GRP flanges are not designed to provide the equivalent strength, a few bolts of the flanged joint shall be designed with a larger bolt length and anchored in the concrete (refer sketch below) to take care of longitudinal stress due to thrust loads in GRP piping near flanged joint.



	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 7 of 9		

(c) Rubber Gaskets

Rubber gasket used with push-on flexible joints & flanged joints shall conform to the requirements of IS 5382/ ASTM F 477.

(d) 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 approved Quality Plan (approval by BHEL/ Customer). For Hydro-testing of bends, lamination joint strength may be alternatively checked at shop by hydro-testing of straight pipe (one number per size) with lamination joint at pressure twice pressure class. For Hydro-testing of other fittings, minimum one number of fitting of each type & size shall be hydro-tested at shop at pressure twice pressure class.

(A) Type Tests

- a. The Long term type tests (HDB & strain corrosion/ chemical resistance) should have been conducted by the manufacturer or its technology provider on GRP pipes at an independent laboratory or duly approved accredited third party agency. Bidder shall submit these type test reports to BHEL during contract stage. In case the Type Test Certificate is more than Three (03) years old from the date of bid submission mentioned in the enquiry of this package, Type Test shall be performed as per applicable standard (s). The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days' notice shall be given to 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. Type test charges are to be included in base offer and not to be quoted separately.

(B) Hydrostatic Tests

100% of the pipes shall be subjected to an internal hydraulic pressure test at the manufacturer's works prior to delivery as per MQP annexed.

The pipeline shall be field hydro-tested in stretches of suitable lengths at 1.5 times of design pressure. Test pressure shall be maintained for a period of 24 hours in line with IS 13916.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 8 of 9		

8.0 MARKING FOR PIPE & FITTING

The marking on pipes & fittings 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, Batch No. & Date of Manufacture.
- Class of pipe (Pressure & Stiffness).
- Customer name & Project name.

For piping, marking shall be done at both the ends of the pipe spool piece.

9.0 TRANSPORTATION, DELIVERY & SITE STORAGE

- As per scope, complete GRP pipe transportation, delivery, 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 transportation by ship, packing shall be sea worthy so as to ensure safe delivery at site.
- Inside plant boundary, open space shall be provided for 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.
- 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 as per given scope.
- The material being delivered at site shall be jointly inspected by the BHEL/ Customer 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/ Customer.

10.0 QUALITY ASSURANCE

The Quality Plan enclosed with this specification specifies minimum quality control requirements. During contract stage, Bidder shall furnish duly signed & stamped of Quality Plan. The same shall be reviewed and approved by BHEL/ Customer.

Any addition/ deletion in requirements during approval of Quality Plan at contract stage shall be taken care by Bidder without any price implication. All inspection and testing shall be carried out by BHEL/ CUSTOMER. In case inspection is done by both BHEL and CUSTOMER, then the inspection can be carried out jointly or separately.

11.0 DRAWINGS AND DOCUMENTS

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

- Compliance certificate (as enclosed).
- Schedule of deviations, if any (as per compliance certificate).
- Pipe thickness, stiffness and other calculations as per relevant code.

	GLASS REINFORCED PLASTIC (GRP) PIPING		SPECIFICATION No. PE-TS-435-100-M042
	REV. NO.: 03		DATE: 22.12.2020
	Sheet 9 of 9		

- iv. Quality Plan - duly signed & stamped.
- v. Bidder's Field Quality Plan - duly signed & stamped.
- vi. Relevant Catalogs with detailed technical information.
- vii. Un-price schedule of prices.

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

For Approval of both BHEL & Customer:

Below mentioned drgs/ docs shall be considered for delay analysis of supply portion:

- i. GA drawings of Pipes, fittings, end caps (including for Hydro-testing) with marking details and dimensions.
- ii. GA drawings of Coupling with marking details and dimensions.
- iii. GA drawings of Rubber gasket & center register with dimensions.
- iv. Quality Plan of GRP piping - duly signed & stamped.
- v. Type Test Reports as per Quality Plan.
- vi. Technical Datasheets for GRP piping and fittings.
- vii. Pipe thickness, stiffness and other calculations as per relevant code.


Below mentioned drgs/ docs shall be considered for delay analysis of laying and Hydro-testing of piping:

- i. Detailed layout/ installation drawing indicating all details of pipe coupling, fittings, etc. along with all necessary sections.
- ii. Bidder's Field Quality Plan - duly signed & stamped.

For approval of BHEL only:


Below mentioned drgs/ docs shall be submitted to BHEL for reference and approval:

- i. Detailed piping supply, storage, handling, laying & erection and Hydro-test methodology indicating various stages of activities.
- ii. Field hydro-test procedure.
- iii. All necessary civil design/ Technical inputs (including thrust block inputs).
- iv. Type Test Procedure, if required.
- v. Procedure for butt wrap joining of pipes & fittings.
- vi. RCC Encasement methodology.
- vii. GA drawing of Pipe trench for various sections.
- viii. List of required tools and tackles.
- ix. As-built layout drawing after erection completion.

	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020			
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020			
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:			
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 1 OF 7			
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS	
1	2	3	4	5	6		7	8	9	D	**		
					M	C/N			*		M	C	N


1.0 RAW MATERIALS														
1.1a	Unsaturated Polymer Resin (Iso-phthalic)	1 .Relative Density	MA	Physical, Chemical & Visual	One sample from every Lot of 10MT	Two sample from lot of 100MT	IS 6746	1.11 + / - 0.01	Inspection Report / Test certificate	√	P	W	V	In addition to the witness, Test certificates of Raw material supplier & samples tested by manufacture's also to be verified by BHEL / Third Party Inspection Agency (TPIA).
		2. Viscosity	MA					500 cps + / - 20 %		√	P	W	V	
		3. Acid Value	CR					14 + / - 4 mg KOH / gm		√	P	W	V	
		4. Volatile Content	MA					38 + / - 3 % by mass		√	P	W	V	
		5. Gel Time	MA					12 to 16 minutes		√	P	W	V	
		6. Reactivity	MA				ASTM D 7029	<40 @ 25- exothermic peak		√	P	W	V	Acceptance norms indicated here may be modified by supplier after approval of BHEL.
		7. Exotherm peak	MA				ASTM D 2471/7029	160 – 200 °C		√	P	W	V	
		8. Appearance	MA				ASTM D 1209 / ASTM D 1544	Clear & no haze		√	P	W	V	
		1.1b	Vinyl Ester Resin				1 .Relative Density	MA		Physical, Chemical & Visual	One sample from every Lot of 10MT	Two sample from lot of 100MT	IS 6746	1.05 + / - 0.01
2. Viscosity	MA			400 cps + / - 20 %	√	P	W	V						
3. Acid Value	CR			11 + / - 4 mg KOH / gm	√	P	W	V						
4. Volatile Content	MA			40 + / - 3 % by mass	√	P	W	V						
5. Gel Time	MA			12 to 16 minutes	√	P	W	V						
6. Reactivity	MA			ASTM D 7029	<40 @ 25- exothermic peak	√	P	W	V				Acceptance norms indicated here may be modified by supplier after approval of BHEL.	
7. Exotherm peak	MA			ASTM D 2471/7029	160 – 200 °C	√	P	W	V					
8. Appearance	MA			ASTM D 1209 / ASTM D 1544	Clear & no haze	√	P	W	V					

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
Sign & Date		Name	Sign & Date		Name	Seal		Sign & Date		Name	Seal
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav			Reviewed by:			
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:			

	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020					
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020					
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:					
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 2 OF 7					
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS		FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6		7	8	9 *	D	**				
					M	C/N					M	C	N		


1.2	Fiber Glass (E-CR)	1. Roving Weight (Tex)	MA	Physical & Chemical	One sample from every Lot of 10MT	Two sample from lot of 20MT	IS 11320	Chop glass: 2400 gm/km +/- 8%. Hoop glass: 600 gm/km +/- 10%. 1200 gm /km +/- 8% 2400 gm/km +/- 8%. 4800 gm/km +/- 8%	Inspection Report / Test certificate	√	P	W	V	In addition to the witness, Test certificates of Raw material supplier & samples tested by manufacture's also to be verified by BHEL / Third Party Inspection Agency (TPIA). Acceptance norms indicated here may be modified by supplier after approval of BHEL.
		2. Moisture Content	MA					Max 0.3%		√	P	W	V	
		3. Loss on Ignition	MA					+ / -20% or 0.2% From the nominal value stated by supplier (Whichever is greater tolerance)		√	P	W	V	
		4. Conductivity	MA					Max 1.25 MS/m		√	P	W	V	
1.3	Silica Sand	1. Sieve Analysis	MA	Physical, Chemical & Visual	One Sample from every lot of 20MT	Two Sample from every lot of 40MT	Manufacturer's standard	0.05 - 0.8 mm	Inspection Report / Test certificate	√	P	W	V	In addition to the witness, Test certificates of Raw material supplier & samples tested by manufacture's also to be verified by BHEL / TPIA. Acceptance norms indicated here may be modified by supplier after approval of BHEL.
		2. Moisture Content	MA					Max 0.1%		√	P	W	V	
		3. Loss on Ignition	MA					Max 0.5%		√	P	W	V	
		4. Wettability	MA					Max 200 Seconds		√	P	W	V	
		5. Carbonate content	MA					Max 2.5%		√	P	W	V	
		6. Microscopic observation	MA					Round / Oval particles free from sharp edges		√	P	W	V	
1.4	Rubber Gasket Used for double bell (Reka) coupling	1. Shore "A" Hardness	MA	Measurement	100%	Two sample / lot / size	IS 5382	60 +5 /-4	Inspection Report / Test certificate	√	P	W	V	
		2. Dimension Check	MA	Measurement				Approved drgs.		√	P	W	V	
		3. Physical Appearance	MA	Physical & Visual				Reasonably free from visible surface imperfections		√	P	W	V	

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	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav			Reviewed by:			
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:			

	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020			
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020			
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:			
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 3 OF 7			
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6		7	8	9 *	D	**		
					M	C/N					M	C	

		4. Material of Construction	MA	Supplier's test certificate verification				IS 5382	Test certificate	√	P	V	V	
2.0	GRP PIPES													
2.1	Acceptance Tests	Dimensions :			100%	Two sample / lot / size	IS 14402		Inspection Report / Test certificate					In addition to the witness, Test certificates of 100 % pipes tested by manufacture's to be verified by BHEL / Third Party Inspection Agency (TPIA).
		a. Outside/inside dia.	MA	Measurement				Approved drawing		√	P	W	V	
		b. Thickness	MA	Measurement				Approved drawing		√	P	W	V	
		c. Length	MA	Measurement				Approved drawing		√	P	W	V	
2.2		Workmanship	MA	Visual				IS 14402, Cl.9		√	P	W	-	
2.3		Squareness of pipe ends	MA	Measurement				IS 14402, Cl 7.3		√	P	W	-	
2.4		Marking details (at both ends of pipes)	MA	Visual				Approved drawing		√	P	W	-	
2.5		Pressure test (Soundness of pipe)	CR	Visual				IS 14402, Cl. 12.2		√	P	W	V	
2.6		Barcol Hardness	MA	Measurement			ASTM-D-2583	Min. 40 (90% of value recommended by Resin manufacturer)		√	P	W	V	
2.7		Acetone Test	MA	Visual			BS EN 13121	No tackiness after 3 minutes		√	P	W	V	
2.8	Destructive Tests	Longitudinal Tensile Strength	CR	Mechanical Test	One Sample / lot / size / grade (Min. two samples of total PO quantity for each size & grade)	Annex D, IS 14402	IS 14402, Cl. 13.0, Table 6	Inspection Report / Test certificate	√	P	W	V		
2.9		Hoop Tensile Strength	CR			Annex E, IS 14402	IS 14402, Cl. 14, Table 7		√	P	W	V		

BHEL					BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY		Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name			Sign & Date	Name	Seal
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav			Reviewed by:		
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:		


	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020			
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020			
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:			
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 4 OF 7			
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6		7	8	9 *	D	**		
					M	C/N					M	C	

2.10		Pipe Stiffness & Deflection	CR		For each size & grade, one pipe out of 30 pipes	Annex B, IS 14402	IS 14402; Cl.10		√	P	W	V	
2.11		Composition (Ignition loss)	MA	Measurement		ASTM D 2584	% Resin, Glass & Sand (to be filled by bidder)		√	P	W	-	
2.12	Type Test / Long term tests	Hydrostatic Design Basis (HDB)	MA	Mechanical Test	# Refer Remarks	ASTM D 3517 / ASTM D2992	ASTM D 3517 Cl.6.4	Test Certificate	√	P	V	V	# Sampling for Long Term Type tests as per relevant ASTM standard. Review/ Verification of Type Test Report, in case these tests have been carried out earlier (not more than 3 years old from bid submission date as defined in NIT) on the identical model/type/rating at an independent laboratory or witnessed by reputed customer or third party inspection agency like Lloyds, TUV, DNV & BHEL TPis etc. If the above test reports/certificates are not available or not found satisfactory by BHEL/Customer, then the required Type Tests to be carried out by the supplier & witnessed by BHEL/Customer.
		Chemical Resistance of Pipe (Strain Corrosion test)	MA	Chemical		ASTM D3681	ASTM D3681	Test Certificate	√	P	V	V	
		Ring Bending Strain Test	MA	Mechanical Test		ASTM D5365	ASTM D5365	Test Certificate	√	P	V	V	
		Specific ring creep stiffness & wet creep factor	MA	Mechanical Test		ISO 10468	ISO 10468	Test Certificate	√	P	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			


	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020			
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020			
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:			
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 5 OF 7			
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS
1	2	3	4	5	6		7	8	9 *	D	**		
					M	C/N					M	C	

														Vetted TYPE TEST certificate to be verified at the time of inspection.	
3.0	GRP PUSHFIT GASKET COUPLING														
3.1	Acceptance tests	Pressure test	CR	Visual	100%	2 Nos / lot / size	Annex C, IS 14402	IS 14402, Cl.12.2	Inspection Report / Test certificate	√	P	W	V	In addition to the witness, Test certificates of 100 % couplings tested by manufacture's to be verified by BHEL / Third Party Inspection Agency (TPIA).	
		Marking	MA	Visual			IS 14402	Approved drawing		√	P	W	-		
		Pipe Joint Tightness	MA	Visual & Physical	2 Nos / lot / size		ASTM D 3517	ASTM D 4161 – Lab Performance Requirements		√	P	W	V		
4.0	GRP FITTINGS														
4.1	Acceptance tests	Workmanship	MA	Visual	100%	One no. / size / lot	IS 14402	IS 14402	Inspection Report / Test certificate	√	P	W	-	In addition to the witness, Test certificates of 100 % fittings tested by manufacture's to be verified by BHEL / Third Party Inspection Agency (TPIA).	
4.2		Dimensions	MA	Measurement				Approved drawing		√	P	W	V		
4.3		Marking	MA	Visual			IS 14402	Approved drawing		√	P	W	V		
4.4		Barcol Hardness	MA	Measurement			ASTM D 2583	Min. 40 (90% of value recommended by Resin manufacturer)		√	P	W	V		
4.5		Acetone test	MA	Visual			BS EN 13121	No tackiness after 3 minutes		√	P	W	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			


	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020			
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020			
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:			
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 6 OF 7			
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6		7	8	9 *	D	**		
					M	C/N					M	C	

4.6		Pressure test	MA	Visual	Refer Remarks	IS 14402	IS 14402		√	P	W	V	For Bends, Lamination joint strength may be alternatively checked at shop by hydro-testing of straight pipe (1 No. per size) with lamination joint (as per mfr. std.) at twice pr. Class. For other fittings, one no. of fitting each type & size shall be hydro tested at shop at pressure twice pr. Class.
5.0	PACKING												
5.1	Packing Soundness	Workmanship	MA	Visual	100%	ASTM D3517, CI 9.0	Manufacturer's standard / packing procedure (if applicable)	Inspection Report	√	P	V	-	Refer note 09.
5.2		Dimensions	MA	Measurement					√	P	V	-	

NOTE:

1. BHEL /Customer or Authorised Representative may witness at any stage as deemed necessary during the contract execution.
2. Lot size cannot exceed 100 pipe lengths/ fittings of each type, grade & size.
3. The latest revisions/ year of issue of all the standard indicated in the QP shall be referred, as applicable.
4. Pipes/ fittings shall be provided with UV stabilized resin coat as external layer.
5. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/ verified by supplier's Third-Party Inspection Agency.
6. BHEL reserves the right for conducting repeat test, if required.
7. Instruments used for tests shall have valid calibration certificate with traceability to National level.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav			Reviewed by:			
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:			

	MANUFACTURER / BIDDER / VENDOR NAME & ADDRESS		MANUFACTURING QUALITY PLAN					SPEC. NO.: PE-TS-435-100-M042		DATE: 18.12.2020	
			CUSTOMER : TANGEDCO					QP NO.: PE-QP-435-100-M053		DATE: 18.12.2020	
			PROJECT: 2X660MW UDANGUDI STPP					PO NO.:		DATE:	
			ITEM: GRP PIPING			SYSTEM: GRP PIPING SYSTEM		SECTION: II		SHEET 7 OF 7	
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
1	2	3	4	5	6	7	8	9	D	**	
					M C/N			*		M C N	

8. Samples selected by BHEL for Hydro-test shall be identified with the help of marking.

9. Material shall be packed suitably in order to avoid damage during transit and storage at site in tropical climate conditions. In case of transport by ship, packing shall be as per approved sea worthy packing procedure. Compliance certificates for packing to be submitted to BHEL.

6. LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,


** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER (BHEL)/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,

P: PERFORMED BY, W: WITNESSED BY, V: VERIFIED BY, AS APPROPRIATE, D: DOCUMENTATION, TPIA: THIRD PARTY INSPECTION AGENCY

MA: MAJOR, MI: MINOR, CR: CRITICAL, #: CUSTOMER HOLD POINT (CHP)

WI: WORK INSTRUCTIONS, IS: INDIAN STANDARD, BIS: BUREAU OF INDIAN STANDARDS.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Saurabh Duggal	Checked by:		Krishna Kumar Yadav			Reviewed by:			
Reviewed by:		Sanjay Kumar	Reviewed by:		Ritesh Kumar Jaiswal			Approved by:			

	COMPLIANCE SHEET	SPECIFICATION No. PE-TS-435-100-M042	
		REV. NO.: 03	DATE: 24.12.2020
		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: -

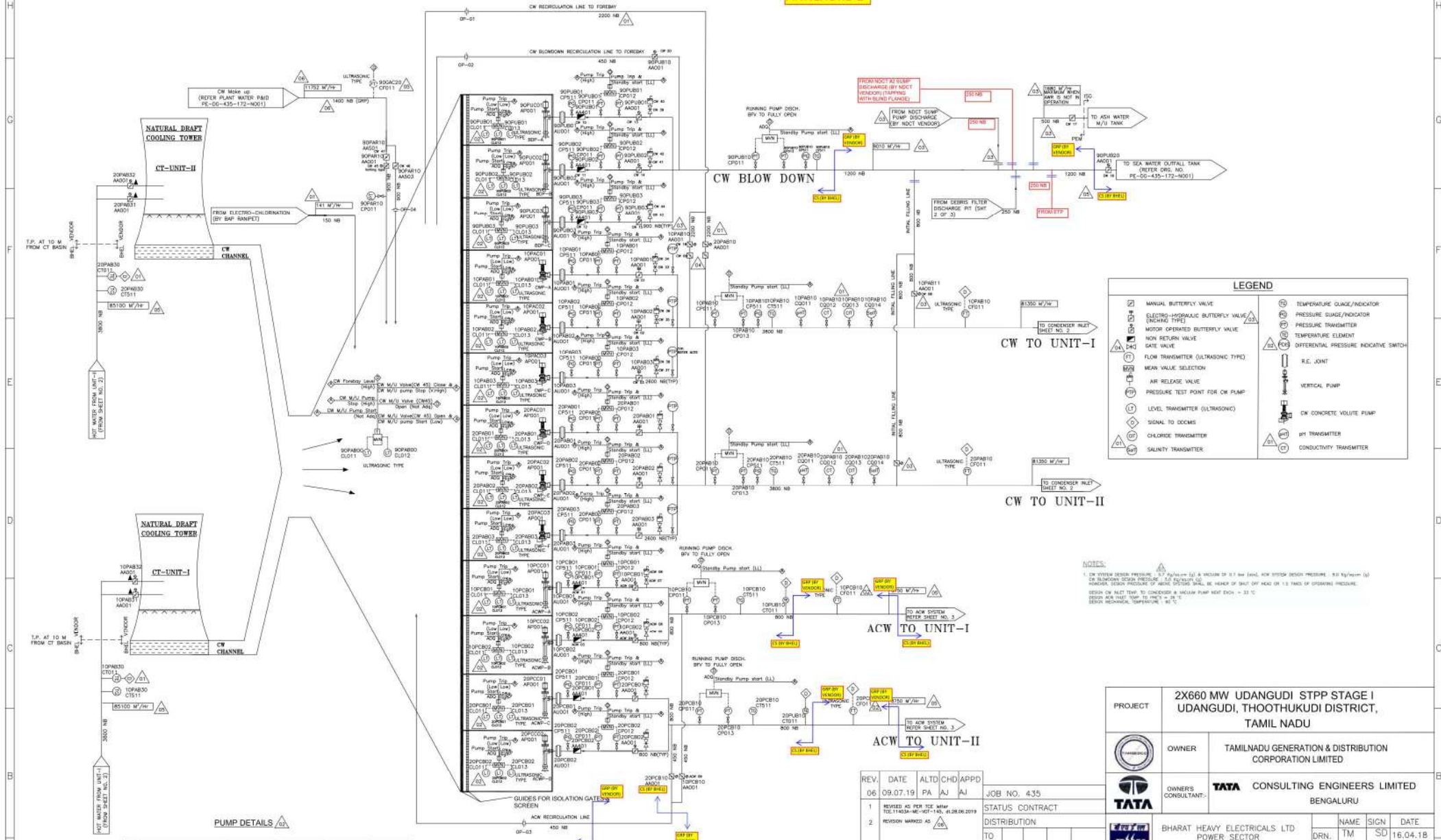
	ANNEXURE-1: ESTIMATED BILL OF MATERIAL (GRP-UNDERGROUND)														DOCUMENT No:		REV NO: 03					
															PE-TS-435-100-M042		22.12.2020					
	PROJECT TITLE: 2x660 MW UDANGUDI STPP STAGE-I										PREPARED BY		CHECKED BY:		APPROVED BY:							
	CUSTOMER: TANGEDCO										SD		SD		SK							
SI. No.	LINE DESCRIPTION	OPERATING		DESIGN		PIPE MATERIAL	PIPE SIZE			BENDS / ELBOWS				TEES		REDUCERS		FLANGES		END CAPS		REMARKS
		PRESS. Kg/cm2 (g)	TEMP (°C)	PRESS. Kg/cm2 (g)	TEMP (°C)		Nb (mm)	THK (mm)	LEN (M)	SIZE (NB)	R	θ dg	No	SIZE (NB)	No	SIZE (NB)	No	SIZE	No	SIZE (NB)	No	
Plant water System																						
1	Make up piping to CW forebay	1.6	33	3	50	GRP	1400	To be selected by Bidder	1670	1400		90 45	2 8	1400x600 1400x500 1400x200 1400x1400 1400x1000	11 1 1 1 1 3	--	--	1400 600 200	4 11 1	1400	1	Buried & Encased
2	From CW Make up piping for Piping operation	1.6	33	3	50	GRP	1000		6	1000		90	1	1400x1000	1	--	--	1000	1	--	--	Buried & Encased
3	CW Make up pumps recirculation line	1.6	33	3	50	GRP	500		60	500		90 30	2 1	--	--	--	--	500	1	--	--	Buried & Encased
4	Feed water piping to Desalination plant	3	33	6	50	GRP	800		1105	800		90 45	5 6	800x300 800x200 800x600	1 2 3	--	--	800 200	4 2	--	--	Buried & Encased
5	Brine Reject water Discharge pumps to outfall sump	1.5	33	3	50	GRP	700		940	700		90 45	3 4	700x200 700x350	1 3			700 200 350	1 1 3	700	1	Buried & Encased
6	Desalination pump recirculation Line	3	33	6	50	GRP	300		60	300		90 45	3 2	300x200	1	--	--	300 200	1 1	--	--	Buried & Encased
7	Tapping Pipes for manholes etc	3	33	6	50	GRP	600 200 350		22 20 10					--	--	--	--			--	--	Buried & Encased

	ANNEXURE-1: ESTIMATED BILL OF MATERIAL (GRP-UNDERGROUND)														DOCUMENT No: PE-TS-435-100-M042		REV NO: 03 22.12.2020					
	PROJECT TITLE: 2x660 MW UDANGUDI STPP STAGE-I										PREPARED BY		CHECKED BY:		APPROVED BY:							
	CUSTOMER: TANGEDCO										SD		SD		SK							
SI. No.	LINE DESCRIPTION	OPERATING		DESIGN		PIPE MATERIAL	PIPE SIZE			BENDS / ELBOWS			TEES		REDUCERS		FLANGES		END CAPS		REMARKS	
		PRESS. Kg/cm2 (g)	TEMP (°C)	PRESS. Kg/cm2 (g)	TEMP (°C)		Nb (mm)	THK (mm)	LEN (M)	SIZE (NB)	R	θ dg	No	SIZE (NB)	No	SIZE (NB)	No	SIZE (NB)	No	SIZE (NB)	No	
CW - ACW System																						
8	CW Blowdown Piping to outfall sump	1	33	5	60	GRP	1200	To be selected by Bidder	1710	1200		90 45	2 8	1200x800 1200x600 1200x500 1200x250 1200x200	1 11 1 4 1	--	--	1200 800 600 500 250 200	2 1 11 1 4 1	--	--	Buried & Encased
9	ACW piping outside TG building	4	43	8	60	GRP	800		1025	800		90 15	14 2	--	--	--	--	800	12	--	--	Buried & Encased
10	ACW recirculation piping	4	33	8	60	GRP	450		85	450		90 55	3 1	--	--	--	--	450	2	--	--	Buried & Encased
11	Tapping Pipes	4	33	8	60	GRP	600 500 250 200		22 3 10 3					--	--	--	--	--	--	--	--	Buried & Encased




#Note: 1. BOM provided is estimated BOM based on the drawing attached with the specification. Bidder to note that his scope includes supply of all items required for complete erection and Hydro-testing of piping (other than those mentioned as free supply by BHEL) as per drawing including tools/ tackles.

2. BOM has been prepared on the basis of Terminal Points shown in the layout drawing. Any changes in pipe routing between these Terminal Points shall be borne by Bidder without any cost implication to BHEL.

ANNEXURE-2



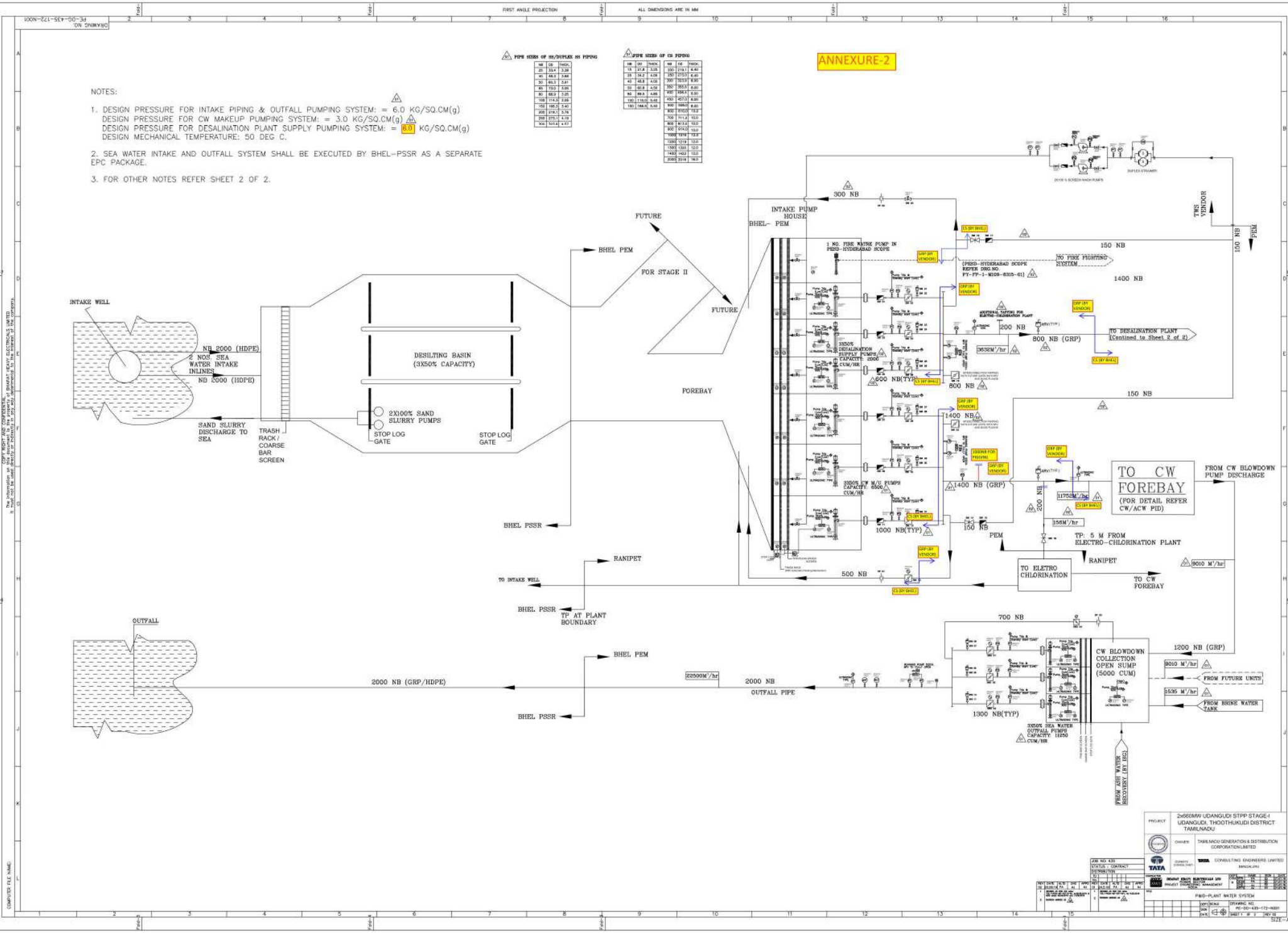
NOTES:
1. CW SYSTEM DESIGN PRESSURE: 5.7 kg/cm² (g) & VACUUM OF 0.7 bar (abs), ACW SYSTEM DESIGN PRESSURE: 5.5 kg/cm² (g)
2. CW BLOWDOWN DESIGN PRESSURE: 4.0 kg/cm² (g)
3. HOWEVER, DESIGN PRESSURE OF ALL SYSTEMS SHALL BE HIGHER OF SHUT OFF HEAD OR 1.5 TIMES OF OPERATING PRESSURE.
DESIGN CW BLOW DOWN TO CONSIDER AS VACUUM PUMP BLOW DOWN = 33.7°
DESIGN ACW BLOW DOWN TO CONSIDER AS 1.5°

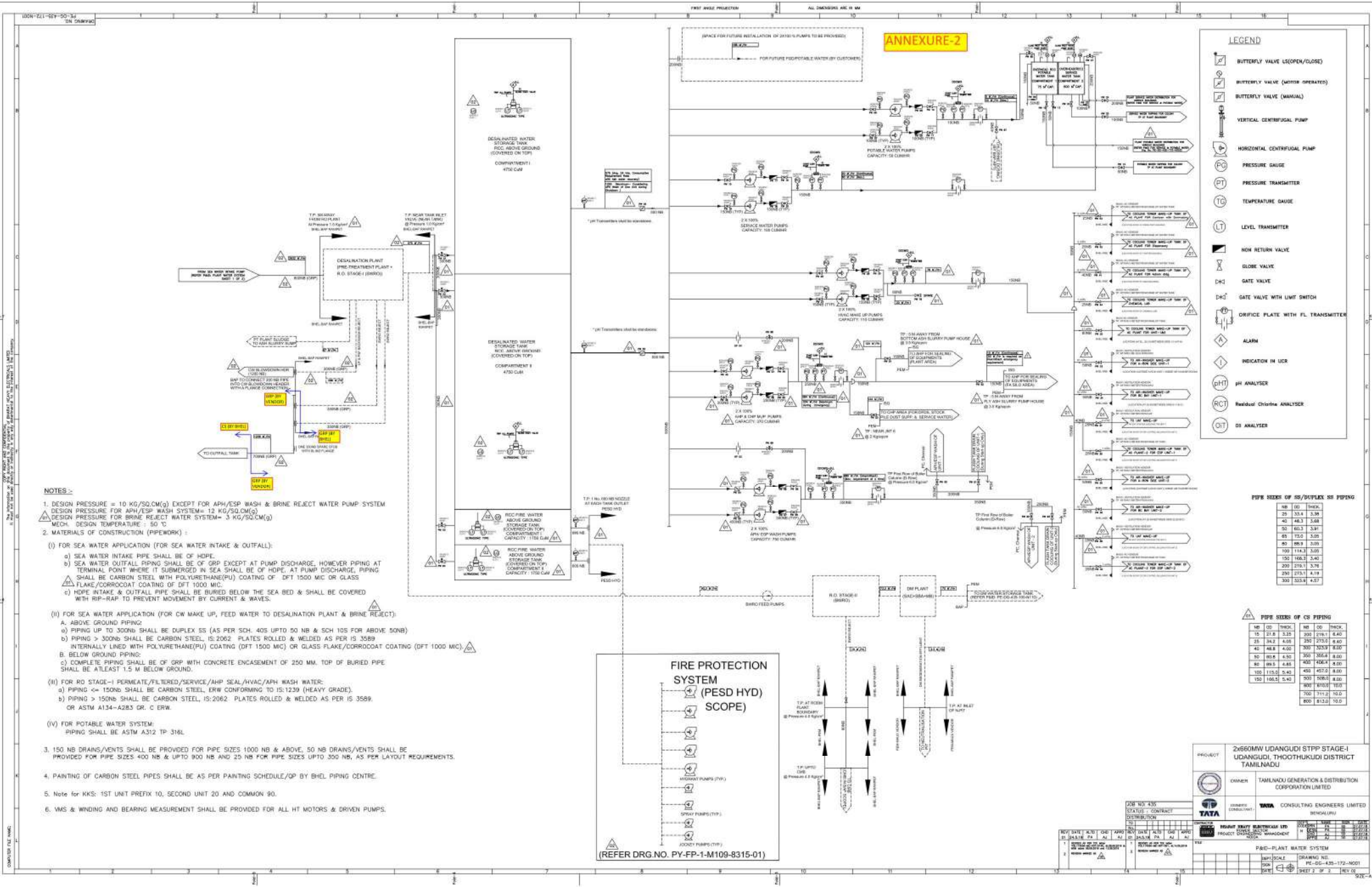
PROJECT		2X660 MW UDANGUDI STPP STAGE I UDANGUDI, THOOTHUKUDI DISTRICT, TAMIL NADU					
		OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED				
		OWNERS CONSULTANT:-	TATA CONSULTING ENGINEERS LIMITED BENGALURU				
PD		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NOIDA			NAME	SIGN	DATE
				DRN.	TM	SD	16.04.18
				CHD.	AJ	SD	17.04.18
				APPD	AJ	SD	17.04.18

TITLE				DRAWING NO.			
CW-ACW SYSTEM P&ID				PE-DG-435-165-N001			
MAUX				SHEET 1 OF 3			
MPL				REV. 06			
C&I							
DEPT.							
SCALE 1:1							
SIGN							
DATE							

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COMPUTER FILE NAME: 24600MW UDANGUDI STTP STAGE 4 UDANGUDI, THOOTHUKUDI DISTRICT TAMILNADU





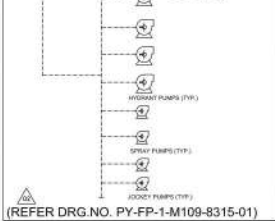
ANNEXURE-2

LEGEND

- BUTTERFLY VALVE (OPEN/CLOSE)
- BUTTERFLY VALVE (MANUAL OPERATED)
- BUTTERFLY VALVE (MANUAL)
- VERTICAL CENTRIFUGAL PUMP
- HORIZONTAL CENTRIFUGAL PUMP
- PRESSURE GAUGE
- PRESSURE TRANSMITTER
- TEMPERATURE GAUGE
- LEVEL TRANSMITTER
- NON RETURN VALVE
- GLOBE VALVE
- GATE VALVE
- GATE VALVE WITH LIMIT SWITCH
- ORIFICE PLATE WITH FL TRANSMITTER
- ALARM
- INDICATION IN I/C
- pH ANALYSER
- Residual Chlorine ANALYSER
- DI ANALYSER

- NOTES:-**
- DESIGN PRESSURE = 10 KG/SQ.CM(G) EXCEPT FOR APH/ESP WASH & BRINE REJECT WATER PUMP SYSTEM DESIGN PRESSURE FOR APH/ESP WASH SYSTEM= 12 KG/SQ.CM(G)
DESIGN PRESSURE FOR BRINE REJECT WATER SYSTEM= 3 KG/SQ.CM(G)
MED. DESIGN TEMPERATURE : 50 °C
 - MATERIALS OF CONSTRUCTION (PIPEWORK) :
 - FOR SEA WATER APPLICATION (FOR SEA WATER INTAKE & OUTFALL):
 - SEA WATER INTAKE PIPE SHALL BE OF HDPE.
 - SEA WATER OUTFALL PIPING SHALL BE OF GRP EXCEPT AT PUMP DISCHARGE, HOWEVER PIPING AT TERMINAL POINT WHERE IT SUBMERGED IN SEA SHALL BE OF HDPE. AT PUMP DISCHARGE, PIPING SHALL BE CARBON STEEL WITH POLYURETHANE(PU) COATING OF DFT 1500 MIC OR GLASS FLAKE/CORRODOAT COATING OF DFT 1000 MIC.
 - HDPE INTAKE & OUTFALL PIPE SHALL BE BURIED BELOW THE SEA BED & SHALL BE COVERED WITH RIP-RAP TO PREVENT MOVEMENT BY CURRENT & WAVES.
 - FOR SEA WATER APPLICATION (FOR CW MAKE UP, FEED WATER TO DESALINATION PLANT & BRINE REJECT):
 - ABOVE GROUND PIPING:
 - PIPING UP TO 300NB SHALL BE DUPLEX SS (AS PER SCH. 40S UP TO 50 NB & SCH 10S FOR ABOVE 50NB)
 - PIPING > 300NB SHALL BE CARBON STEEL, IS 2062 PLATES ROLLED & WELDED AS PER IS 3589 INTERNALLY LINED WITH POLYURETHANE(PU) COATING (DFT 1500 MIC) OR GLASS FLAKE/CORRODOAT COATING (DFT 1000 MIC).
 - BELOW GROUND PIPING:
 - COMPLETE PIPING SHALL BE OF GRP WITH CONCRETE ENCASMENT OF 250 MM. TOP OF BURIED PIPE SHALL BE ATLEAST 1.5 M BELOW GROUND.
 - FOR RO STAGE-I PERMEATE/FILTERED/SERVICE/APH SEAL/HVAC/APH WASH WATER:
 - PIPING < 150NB SHALL BE CARBON STEEL, ERW CONFORMING TO IS:1239 (HEAVY GRADE).
 - PIPING > 150NB SHALL BE CARBON STEEL, IS:2062 PLATES ROLLED & WELDED AS PER IS 3589. OR ASTM A134-A283 GR. C ERW.
 - FOR POTABLE WATER SYSTEM:
PIPING SHALL BE ASTM A312 TP 316L.
 - 150 NB DRAINS/VENTS SHALL BE PROVIDED FOR PIPE SIZES 1000 NB & ABOVE, 50 NB DRAINS/VENTS SHALL BE PROVIDED FOR PIPE SIZES 400 NB & UPTO 900 NB AND 25 NB FOR PIPE SIZES UPTO 300 NB, AS PER LAYOUT REQUIREMENTS.
 - PAINTING OF CARBON STEEL PIPES SHALL BE AS PER PAINTING SCHEDULE/OP BY BHEL PIPING CENTRE.
 - Note for KKS: 1ST UNIT PREFIX 10, SECOND UNIT 20 AND COMMON 90.
 - WMS & WINDING AND BEARING MEASUREMENT SHALL BE PROVIDED FOR ALL HT MOTORS & DRIVEN PUMPS.


FIRE PROTECTION SYSTEM (PESD HYD) SCOPE




PIPE SIZES OF SS/DUPLEX SS PIPING

NB	OD	THICK.
25	33.4	3.38
40	48.3	3.68
50	60.3	3.91
65	73.0	3.05
80	88.9	3.05
100	114.3	3.05
150	168.3	3.40
200	219.1	3.76
250	273.1	4.19
300	323.8	4.57



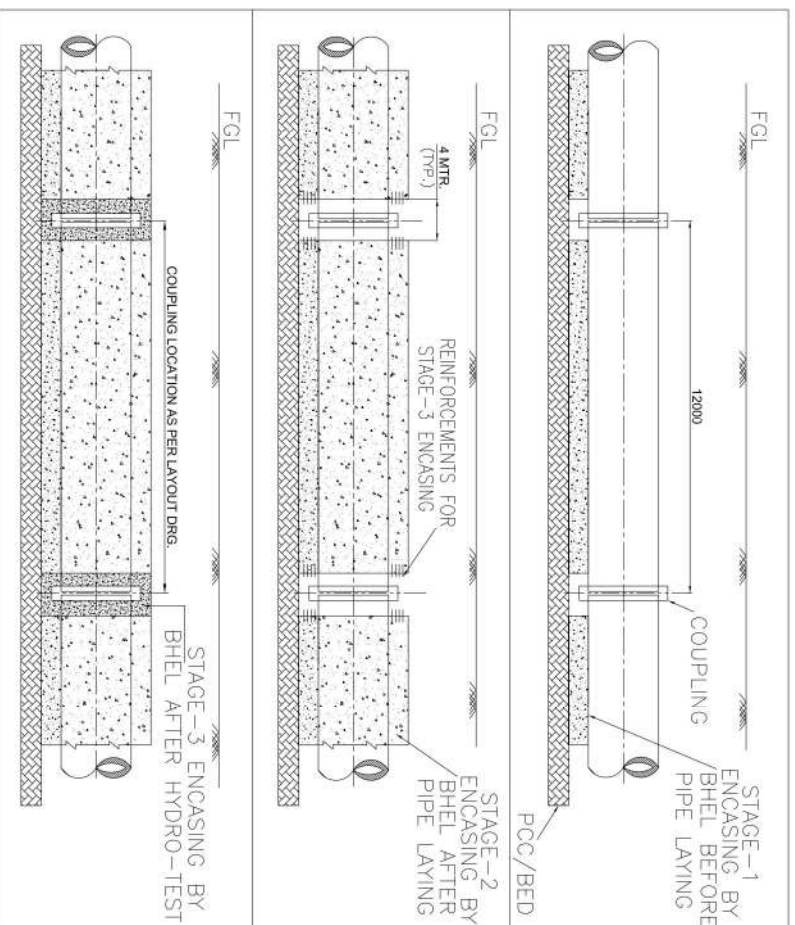
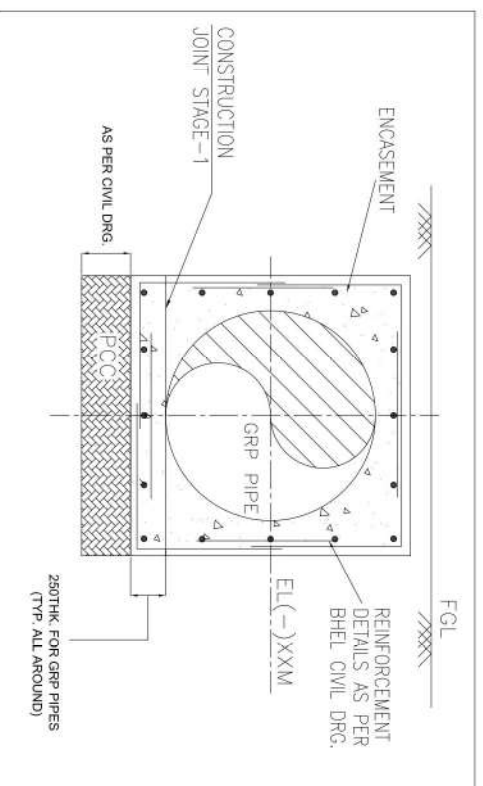
	TECHNICAL DATA SHEET	SPECIFICATION No. PE-TS-435-100-M042	
		REV. NO.: 02	DATE: 08.07.2020
		Sheet 1 of 2	

ANNEXURE-4

	TECHNICAL DATA SHEET	SPECIFICATION No. PE-TS-435-100-M042	
		REV. NO.: 02	DATE: 08.07.2020
		Sheet 2 of 2	

FOR BELOW GROUND GRP PIPE

	<u>DATA TO BE FILLED BY THE BIDDER FOR EACH SIZE & PRESSURE CLASS</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 Minimum Soil cover of 1.5 m or equal to pipe diameter, whichever is maximum (for design purpose)</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 Maximum soil cover of 4.0 m (for design purpose)</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	



1. Concrete encasing of piping shall be carried out in 3 stages as shown in the figure.
 2. Hydro-test of the pipeline/ segment of the pipeline must be done only after the part concrete encasement.
 3. A uniform base of concrete shall be erected in the first stage on which the piping shall be laid.
 4. After laying of piping by Bidder, care should be taken that before concrete encasement, the pipeline should be aligned and stress-free.
 5. In the second stage, concrete encasing of the laid piping shall be done so as to provide support to the piping during Hydro-test.
 6. A space of around 2 meters shall be left on both the ends of pipe couplings before the hydro-test.
 7. Thrust blocks shall be constructed by BHEL for each of the fitting located in the pipe segment to be hydro-tested.
 8. Hydro-test shall be conducted to satisfaction by Bidder in line with the details mentioned in Hydro-test procedure.
 9. Any other requirements for carrying out Hydro-test such as thrust restraining blocks at the end of the pipeline or any such similar arrangement shall be in Bidder's scope (except excavation).
 10. After the successful Hydro-test of the pipeline, the remaining part of the pipe segment (around coupling location) shall be concrete encased (BHEL's scope) in stage-3 of encasement.
- NOTE:
1. The concreting will be done after signing of pre-pour inspection. The concrete will be placed in stages allowing sufficient time between layers for the cement to set and no longer exert buoyant forces on the pipe.
 2. The concrete will be transported from batching plant to site by transit mixer. Concrete will be placed in a continuous horizontal layer of uniform thickness.
 3. Compaction and curing of concrete shall be done by BHEL as per standard procedure.
 4. Bidder to supervise & monitor the complete civil activities of BHEL scope to ensure smooth and error-free installation of the system.

ANNEXURE-5

SUGGESTIVE SKETCH FOR STAGE-WISE RCC ENCASING OF UNDERGROUND GRP PIPING