

2X660 MW MAITREE BANGLADESH (BIFPCL)

**TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

Specification No. : PE-TS-421-172-N001 (REV. 00)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA-201301**



**TITLE : TECHNICAL SPECIFICATION
FOR
TRAVELLING BAND SCREENING SYSTEM**

SPEC. NO. PE-TS-421-172-N001

SECTION

REV. NO. 00

DATE : 12.12.2017

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**SECTION IA
SPECIFIC TECHNICAL REQUIREMENT
MECHANICAL SYSTEMS**



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1.00.0 GENERAL

The Travelling Band Screens complete with all accessories including special tools and tackles (if any) shall conform to the Data Sheet-A (Section ID) and other requirements of section II. In addition, the requirements of this Section I including Customer Specification attached at Appendix 1 (as applicable) shall also be complied with. In the event of Contradictions between Section IA /Customer Specification (Appendix 1)/ Datasheet A (Section IB), the same shall prevail in the order as:

Customer Specification (Appendix 1), Section IA, Datasheet-A (Section ID).

2.00.0 SCOPE OF SUPPLY AND SERVICES INCLUDED IN THE BIDDER'S SCOPE

A) The scope of supply under this specification shall be as follows:

- 2.1 Five (5) sets of Travelling Band Screens (TBS) viz. independent set of TBS for each inlet channel comprising of Electric drive with reduction gear box and fluid/hydraulic coupling, appropriate sealing arrangement to avoid escape of debris in clean side. All the Equipment supplied with this package should be suitable for Outdoor Location.
- 2.2 Spray wash/Flushing arrangement(if required) with necessary spray wash pumps, header isolation valves and spray wash nozzle headers with matching counter flanges complete with bolts, nuts and gaskets for all flanges at terminal points.
- 2.3 2x100% automatic self-cleaning strainers with debris discharge valves and other accessories as required.
- 2.4 Each travelling band screen stream shall be provided with required instrumentation as shown in Sketch-A and mentioned in Datasheet-A and Sub-Section IC of this Specification.
- 2.5 Starter Panel (cum Switch Gear Panel) shall be as follows:
 - (i) 5 Sets of TWS shall have one Common Starter Panel (cum Switch Gear Panel) for DCS based control system.
Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder). For details of C&I scope please refer Section IC.
- 2.6 Supporting arrangement complete with foundation plates, anchor bolts, nuts, sleeves, embedment's, inserts etc. and installation materials like fixing bolts, clamps and other accessories etc for complete TBS as required to make TBS a complete package.
- 2.7 Five (5) nos. Debris segregation and collection baskets and other details as per Datasheet-A.
- 2.8 Complete Pipe work, including interconnection/distribution piping, valves, flanges/counter flanges (including Counter Flange at Terminal Point) for pipes/valves, bends, fittings, distributors, nozzles and support installation materials for equipments/piping/valves etc. shall be in Bidder's scope.
- 2.9 Any other items not listed above but required to make Travelling Band Screening system as complete package, shall be deemed to be included in bidder's scope of supply.

B) SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE: The bidder's



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scope also includes following services at site, for scope under this specification viz. Travelling Band Screen and its accessories.

- a) Supervision during critical stages of Erection
- b) Final installation checks before commissioning
- c) Commissioning of Travelling Band Screen and its accessories
- d) Trial run and Site Testing

Bidder to include suitable number of visits/mandays for above activities however minimum Five site visits for four days each for above activities shall be included by bidder in their offer price.

C) NOTE: (1) For design & standards of Travelling water screen (Materials specification, pumps, piping, flanges, valves, testing procedures etc) please refer clause no B.0.6.2 of Appendix-1(C)/SECTION-1A (SPECIFIC TECHNICAL REQUIREMENT-MECHANICAL)

(2) Indian Standards and Chinese Standards are NOT acceptable. Wherever international standards have been mentioned same shall not include Indian and Chinese standards.

(3) wherever 'IS' code is indicated in this specification, equivalent international code is to be used as per Note (1) above.

(4) It is likely that fishes may also come along with intake water, therefore a suitable fish handling and return system shall be considered by bidder in their scope.

3.00.00 EXCLUSIONS :

The following are excluded from the bidder's scope:

1. Coarse Bar Screens
2. Stop log Gates at the inlet of each section
3. Gantry Crane
4. Civil works required for installation
5. Erection of Travelling Band Screen and its accessories

4.00.00 DESCRIPTION OF EQUIPMENTS:

Travelling Band Screening System

4.01.00 The Travelling Band Screening system shall be installed upstream of pumps installed in Raw water Pump House and are intended to remove floating matter coming from the source through the open sea water intake canal. The water analysis is enclosed with Data Sheet-A.

Coarse Bar screens (excluded from bidder's scope) shall be provided upstream of each Travelling Band Screen to collect the coarse floating/suspended matter up to the size as specified in Data Sheet-A.

The intake system comprises of 5 stream (4 Working+ 1 Standby) as specified in Data Sheet-A.

Each stream shall be provided with an Independent Travelling Band Screen. However, common Spray wash/Flushing pumps (if required) and Self-cleaning



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Strainers shall be provided for Five nos.Travelling Band Screens.

- 4.02.00 The travelling band screens shall be dual speed and central flow or dual flow designs. Each travelling band screen unit shall consist of a series of screening elements fastened to two parallel vertical strands of chains.

The screen basket shall carry debris and refuse above the operating floor where the screen shall be cleaned by a water jet spray. The wash water, debris and refuse shall be collected in a concrete trough provided on the deck level by the purchaser upto the discharge point.

- 4.03.00 Flushing water shall be taken by the Bidder from the discharge of Raw water Pumps at pressure specified in Data Sheet-A at Terminal point.

If required bidder may provide 2x100% Horizontal type booster pumps to raise the pressure of water so as to meet the requirements of the flushing operation. These pumps shall be provided with suitable control interlocks for satisfactory flushing/cleaning of screens.

Spray wash system for each Travelling Band screen shall be provided with a motorised inlet isolation valve, which shall be opened whenever a particular Travelling Band screen has to be spray washed/flushed.

Terminal point for Spray Wash/Flushing system shall be as per details shown in Sketch-A.

However the bidder shall hydraulically design the equipments for purchaser's pump shut off head specified in Data Sheet-A, and taking into consideration the shut off head of the bidder's spray wash/flushing pump(if provided).

- 4.04.00 The details of the Travelling Band Screens with the quantity, design parameters etc. to be supplied shall be as per Data Sheet-A in Sub-Section ID.

5.00.00 CONTROL PHILOSOPHY:

- 5.01.00 The operation philosophy as detailed below is suggestive only and successful Bidder shall furnish the complete control & interlock scheme for Travelling Band Screen and Auxiliaries after award of contract and it shall be subject to purchaser/End Customer approval.

- 5.02.00 Travelling Band Screens, Spray wash/flushing pumps, spray wash valves, automatic self-cleaning strainers and other auxiliaries shall be controlled and operated from standalone DDCMIS of Raw water pumps system located in Raw water pump house control room, supplied by the Purchaser.

- 5.03.00 The following shall be provided in DDCMIS.

- a) All interlocks and protections for Travelling Band Screens, spray wash pumps, automatic self cleaning strainers shall be realized in the DDCMIS.
- b) Auto/Manual Selector Switch for
 - ❖ Travelling Band Screens



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- ❖ Spray wash pumps(if applicable)
- ❖ Self cleaning strainer.
- c) Indication(Running/ Stopped)/alarms/annunciations/ for
 - ❖ Travelling Band Screens
 - ❖ Spray wash pumps
 - ❖ Self cleaning strainer.
 - ❖ Spray wash valves
- d) Start/Stop facility for each TBS, spray wash pumps(if applicable), spray wash valves, Self cleaning strainers, etc.
- e) Key lockable type emergency stop push button shall be provided in the Local to TBS and spray wash pumps for Stopping in case of Emergency.
- f) Differential Level indication for each Travelling Water Screens.
- g) Complete automatic shut-down of the system .
- h) Selection of various modes of operation as described in succeeding paras.

5.04.00 Differential Level Transmitter:

5.04.01 Two Nos. Differential Level Transmitter shall be provided across each Travelling Band Screen and following signals shall be derived:

- o Differential Level Display on DDCMIS
- o Differential Level High
 - ❖ Annunciation on DDCMIS
 - ❖ Starting of Spray Wash pump(if provided)
 - ❖ Starting of Travelling Band Screen on slow speed
- o Differential Level Very High
 - ❖ Annunciation on DDCMIS
 - ❖ Starting of Spray Wash pump(if provided)
 - ❖ Starting of Travelling Band Screen on high speed
- o Differential Level Normal
 - ❖ Stopping of Travelling Band Screen and Spray Wash pump

5.05.00 If Spray wash booster pumps are offered by bidder instrumentation as per Datasheet A shall be provided for spray wash pumps.

5.06.00 Travelling Band Screen Controls:

Each Travelling Band Screens (TBS) shall be provided with following modes of operation from DDCMIS.

- Manual Mode
- Timer Mode
- Auto Mode thru' differential level between upstream and downstream of TBS's.
- **Manual Mode**



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When Manual mode is selected and start push button is pressed/selected, TWS will start on low or high speed as selected, irrespective of the differential levels and shall continue to run until operator switches it off.

- **Timer Mode**

The TWS will start on low/high speed (depending upon selection) thru' timer – at the selected time interval, irrespective of its differential level and shall stop after the preset run time.

Even though the run timer times out, but the differential level of the TWS has not fallen below “differential level normal” the TWS shall continue to rotate till the differential level falls below the preset limit.

- **Auto Mode**

On receipt of high differential level signal, the TWS selected in 'Auto' mode will start on low speed and rotate until differential level falls below the preset limit.

TWS Operation (Slow speed): TWS shall start on slow speed when it senses “TWS \$ Differential Level High” and shall continue to operate until “TWS \$ Differential Level Normal” is sensed.

TWS Operation (High Speed): TWS shall operate on high speed when “TWS \$ Differential Level Very High” is sensed through Level Transmitter or “TWS \$ Differential Level Very Very High” is sensed through Differential Level Switch.

5.07.00 In all modes of operation TBS once started shall complete minimum One (1) rotation before stopping.

5.08.00 TBS and its auxiliaries shall be designed for continuous operation.

5.09.00 Spray Wash Pumps Controls/ Instruments (if applicable):

5.09.01 Spray Wash Pump when selected in auto shall start with the starting of the Travelling Band Screen (in any mode of operation) and shall continue to run until all screens stop, in which case pump shall also stop.

5.09.02 The isolating valves at pump suction shall be provided with 'Open' limit switches and Motorized Valve at Pump Discharge for pump start permissive. On receipt of pump start command if any valve is closed/Not Open, it shall annunciate alarm in DDCMIS, trip the pump and start standby pumps.

5.09.03 Pump start permissive shall be provided as follows:

- i. Suction/ discharge Valves Open
- ii. “Suction Pressure Adequate”

5.10.00 Self-Cleaning Strainers Controls/ Instruments:

5.10.01 One number Differential pressure gage shall be provided across each SCS for local measurement of differential pressure across Self Cleaning Strainers.

5.10.02 Two (2) numbers Differential pressure transmitter shall be provided across each SCS and following signals shall be derived:

- “SCS Differential Pressure high” for starting of automatic back wash/self-cleaning/flushing



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- "SCS Differential Pressure Normal" for stopping of automatic back wash/self-cleaning/flushing
- Remote differential pressure indication across Self-cleaning strainer to be displayed on DDCMIS

6.00.00 GENERAL REQUIREMENTS:

- 6.01.00 In addition to the requirements of Section-II the following shall also be complied with for packages/ projects under scope of this specification.
- 6.02.00 The typical flow diagram applicable, is enclosed herein in this Section (Sketch A) with scope demarcation for bidder's compliance.
- 6.03.00 General arrangement for Travelling Band Screens, Spray Wash piping, type of installations and location of the spray wash pump Skid etc shall be furnished along with the offer. Bidders to note that TBS with accessories shall be installed outdoors and therefore shall be suitable for outdoor duty.
- 6.04.00 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 6.05.00 TBS and its support structure shall be designed and manufactured as per the applicable codes and to take care of following conditions
- Design Differential level
 - During various mode of operations, at design flow and under all climatic conditions.
- 6.06.00 The TBS drive motor shall be sized to start the Travelling Band screen against differential head of 0.75 MWC and operate continuously thereafter.
- 6.07.00 Cathodic Protection for TWS and its accessories along with Sacrificial Anode shall be provided by the bidder in the equipment. Calculation for the same shall be provided during contract stage, subject to approval.
- 6.08.00 The TBS design shall be such as to ensure that Sea water at TBS outlet shall be free from any vortex and turbulence.
- 6.09.00 Each assembly and sub assembly shall be provided with suitable arrangement for lifting using gantry/crane/mono rail /chain pulley block. Lifting hooks shall be located so as to facilitate lifting in balanced position.
- 6.10.00 The make of various bought out items shall be subjected to purchaser's/owner's approval in the event of order.

7.00.00 QUALITY PLAN

Quality Plans for some items along with additional quality assurance & inspection requirement are enclosed in the Specification are for bidder's guidance only and are not exhaustive. The quality requirements/QP furnished in specification are not complete. The bidder shall comply with these minimum requirements and submit the QPs comprehensively including all components of complete Travelling Band



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Screens with accessories at raw material/ in process /final stages shall furnish the same as per format in the event of order based on the guidelines given as above, same shall be subject to BHEL/ Customer /Consultant's approval.

8.00.00 SITE DEMONSTRATION TESTING AND TRIAL RUN:

The Travelling Band Screens shall be guaranteed to meet the performance requirements specified in Data Sheet-A and also for trouble free operation after commissioning at site.

8.01.00 Site Demonstration Testing:

Following site demonstration tests shall be performed at site at Full load.

- i) Pressure drop (Differential Level) in clean condition viz. after Spray wash/ Flushing.
- ii) Satisfactory cleaning operation of spray wash system.
- iii) Smooth operation without any undue noise and vibration.

8.02.00 Above mentioned parameters shall be demonstrated by the supplier during demonstration testing. If the results of these tests show the non-performance of the TBS or its accessories, the supplier shall modify the TBS or accessories as required it to meet the test requirements.

8.03.00 If the vendor fails to demonstrate satisfactory operation as above after modification, the owner/purchaser may at his discretion reject the equipment.

9.00.00 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

9.01.00 Documents to be submitted after award of LOI: Document submission schedule after the award of contract shall be as below:

BHEL DRG NO	DRG TITLE	Drg Sch for Vendors
Maitree-00-PBB-MFB-116401-PEM	P&ID OF TWS SYSTEM	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
Maitree-00-PBB-MLU-116402-PEM	GA OF TWS	
Maitree-00-PBB-MFE-116403-PEM	CONTROL PHILOSOPHY & GA OF CONTROL PANEL- TWS	
Maitree-00-PBB-MFE-116404-PEM	DETAILS OF DEBRIS SEGREGATION BASKET-TWS	
Maitree-00-PBB-MDA-116407-PEM	DATASHEET FOR TWS	
Maitree-00-PBB-MFE-116411-PEM	CIVIL DETAILS OF TWS	
Maitree-00-PBB-MQA-116420-PEM	QP OF TWS	R-0 within 20 days from Cat-I(or)II approval of 'PID, Datasheet & GA of TWS' and subsequent revisions within 10 days of comments received from BHEL.
Maitree-00-PBB-MFB-116405-PEM	PIPING INSTALLATION DIAGRAM	
Maitree-00-PBB-MLU-116406-PEM	GA OF STRAINER	



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Maitree-00-PBB-MDA-116408-PEM	DATASHEET OF STRAINER	R-0 within 30 days from Cat-I(or)II approval of 'Datasheet of TWS' & subsequent revisions within 10 days of comments received from BHEL.
Maitree-00-PBB-MDA-116409-PEM	DATASHEET OF VALVES	
Maitree-00-PBB-MDA-116410-PEM	DATASHEET FOR PIPE, FITTING & FLANGES	
Maitree-00-PBB-MDA-116419-PEM	DATASHEET FOR GEARED MOTOR OF TWS	
Maitree-00-PBB-MDA-116412-PEM	DATASHEET FOR PRESSURE/DIFF. PRESSURE GAUGE	R-0 within 30 days from Cat-I(or)II approval of 'PID & Datasheet of TWS' and subsequent revisions within 10 days of comments received from BHEL.
Maitree-00-PBB-MDA-116413-PEM	DATASHEET FOR DIFF. LEVEL TRANSMITTER	
Maitree-00-PBB-MDA-116414-PEM	DATASHEET FOR ELECTRICAL ACTUATOR	
Maitree-00-PBB-MDA-116415-PEM	DATASHEET OF DIFF. PRE. INDICATOR SWITCH	
Maitree-00-PBB-MFB-116416-PEM	WIRING DIAGRAM	R-0 within 30 days from Cat-I(or)II approval of 'Control Philosophy' and subsequent revisions within 10 days of comments received from BHEL.
Maitree-00-PBB-MFB-116421-PEM	DATASHEET OF STARTER PANEL (CUM SWITCHGEAR PANEL)	
Maitree-00-PBB-MFB-116422-PEM	CABLE SCHEDULE	
Maitree-00-PBB-MFB-116423-PEM	O&M MANUAL	Within 30 days from MDCC

9.02.00 The following documents shall be furnished by the bidder with his offer:

- Compliance certificate duly signed and stamped.
- Deviation Schedule as per NIT.
- Electrical Load Data.
- GA Drawing for reference with following details clearly indicated/marked
 - a) All principal dimensions like dimensions of openings at Deck Level, etc.
 - b) Location and size of D wall, etc.
 - c) Recommended capacity and lift of the Gantry crane.



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ANNEXURE-1 PACKING PROCEDURE

1.0 Packing procedure before dispatch:

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

1.1 Preparation for Packing:

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained from all TWS's parts, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The TWS shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

1.2 Protection of parts:

- The TWS main components (Sprockets, Screen baskets, Frame etc.) shall be packed in properly in high grad bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- TWS miscellaneous items shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, & Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases
- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust preventive primer.
- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in plate heat exchanger shall be closed properly by suitably covering to prevent foreign material entering in plate heat exchanger.
- All fabricated wooden cases & crates conform to the requirement as per



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table given below:

Gross Weight [Kgs.]	Board Thickness	Batton / Rafter Thickness
2000 to 9000	Min. 30 mm	Min. 35 mm
9000 to 18000	Min. 50 mm	Min. 35 mm

- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

1.3 Preservation

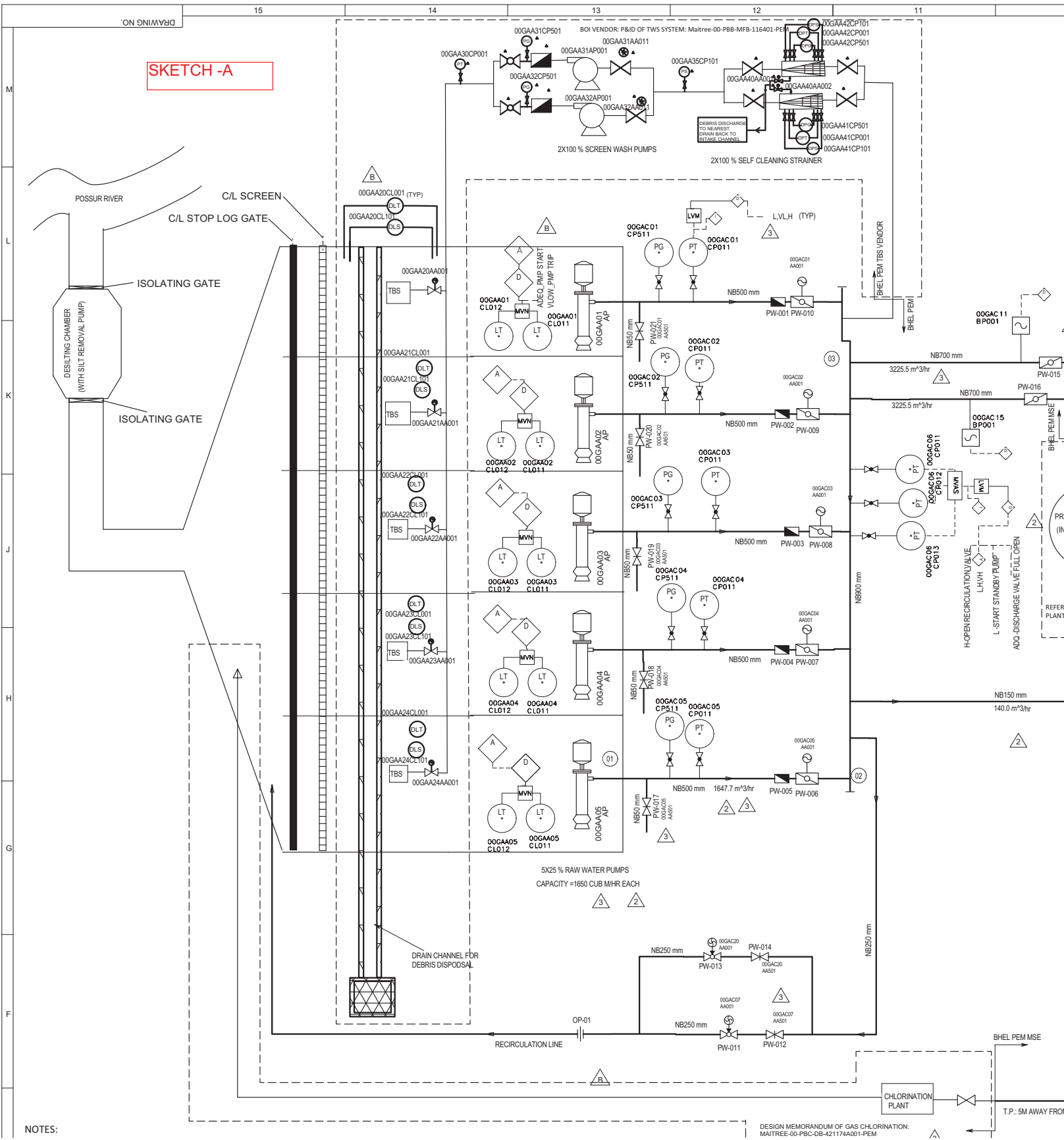
The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose plates and gaskets are to be protected from extreme climatic conditions.

1.4 Photographs

Bidder to take photographs of all parts like Sprockets, Frame, Screen baskets, SCS, Spray wash pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

1.5 NOTE: Packing shall be sea worthy.

SKETCH -A



NOTES:

DESIGN MEMORANDUM OF GAS CHLORINATION:
MAITREE-00-PBB-DB-421174A001-PEM

B5.2.3.3 Travelling band screens

- Travelling band screens complete with all accessories and protective hoods one for each pump
- level-differential control units to indicate the level difference and to operate the travelling band screens, using ultrasonic level measurements before and after the bar screens.

B5.3.3.4 Travelling band screens

The mesh fabric and the mesh panel frames shall be made of high grade stainless steel (e.g. AISI type 316 Ti or an approved equivalent material). Furthermore, the guide frames, the chain with bolts, spacers, etc., the drive gear, the shaft and all other equipment which will be immersed in river water or which cannot be reliably protected by painting shall be made of high grade stainless steel (e.g. AISI type 316 Ti). The rollers for the chain may be made of plastic.

The machine shall be driven by three (3) speed pole reversible electric motors so that the operating speed can be varied depending on the degree of fouling of the water.

At least two (2) spray water lines shall be provided for each machine. The spray water lines and nozzles shall be so designed that the sieves are thoroughly cleaned by the sprays at all three operating speeds.

Access for mechanical cleaning arrangements (brushes) to be operated from outside shall be provided for cleaning of the spray nozzles. The spray water lines inside the protective hood and the spray nozzles shall be made of high grade stainless steel (e.g. AISI 316 Ti) or an approved equivalent material.

The internal wastewater troughs of the machines shall also be connected to the spray water system. The troughs shall be made of plastic.

The protective hoods of the band screen machines shall also be made of plastic. Removable inspection flaps shall be provided in the hoods. The hoods and the flaps are to be fixed in such a way that there will be no water leakage.

The screen shall remove particles larger than 3 mm from the water as well as other floating matter having passed through the bar screens. The direction of flow in the band screen machines shall be preferably from the inside to the outside. The shape of the screen elements and the provision of shovel plates shall ensure that the waste matter, which is collected, will be completely removed and does not fall back into the machine.

The band screen machines shall be equipped with chain tension monitoring devices. The chain tension shall be indicated directly at the machines and should also be available at the local central control cabinet. An alarm shall be triggered when the chain is slacking.

An overload protection device shall be provided for each band screen machine.

A weighed safety flap with an electrical transmitter contacts shall be provided at the rear wall of the inflow chamber of each travelling band screen machine in order to prevent damage to the screen elements in the event of excessive differential pressure. The flaps shall be provided with a mechanism, which allows opening the flap instantaneously when the set point level difference is reached. Partial opening of the flap before the set response point is attained is not permissible. The safety flaps and the guide frames, etc. shall be made of high grade stainless steel (e.g. AISI type 316 Ti).

APPENDIX-1(C)

B0

General Technical Specification



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B0. General Specification

B0.1 Subject of Specification

The Joint Venture of Bangladesh-India Friendship Power Corporation (pvt) Ltd (BIFPCL) intends to construct a 2x 660 MW_{e, gross} coal fired power plant (the Plant, the Maitree-STPP Project or the Project) in the district of Khulna for which BIFPCL firms as Employer, utilizing high availability, high efficiency steam cycle technology.

The Contractor shall cover all works for the engineering, procurement, construction and commissioning of the whole plant on a turnkey basis.

Two power units with steam generator, steam turbine generator and ancillary systems shall be proposed in a technology that enables the Contractor to guarantee a high net efficiency while achieving a high reliability (certain restrictions regarding the technology and the design parameters apply, as detailed herein). A second phase of the same capacity is foreseen as a future possibility, however, this Specification deals only with 2 x 660 MW_{e, gross} unless otherwise and expressly stated.

The Plant shall be built on a "green field" basis. It shall be conceptualized in accordance with the above criteria, the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe shocks when connected to the Grid as specified in this **Section B0**. The steam cycle shall operate with once-through technology at supercritical i.e. with steam temperature of 568°C to 600°C, with established and proven parameters and materials.

The engineering design of the Plant shall be conceptualized in accordance with the above criteria, and therefore it is vital that the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe load adjustments when connected to the Grid. The proposed Plant shall be based on a reference plant of equal size firing similar fuel, which shall have a proven track record. The Tenderer shall submit with the tender detailed information on this reference plant(s) and shall allow the Employer and / or his representatives to contact and visit and examine the reference plant(s) in detail.

The steam boilers shall be designed to burn coal from Australia, Indonesia, South Africa, Mozambique and potentially other countries and to burn high speed diesel for start-up and shut-down purposes. The Plant is designed for the coal range as per design coal list attached in the **Annexes in Part C**. The steam turbo-generators and thermal cycles shall be selected such, that the Plant heat rate would be optimized under consideration of the investment costs. The condenser cooling systems shall be realized with

induced draft wet cooling towers. The turbine generators and all grid relevant parameters shall be designed in accordance with applicable Grid Code and the requirements of NLDC.

The Plant shall be equipped with suitable emission abatement technologies, consisting of primary measures for the CO- and NO_x-reduction, an electrostatic precipitator and a wet flue gas desulphurization plant operating with limestone.

The Project shall include the facilities for the export of the produced power consisting of switchyards, substations and transmission lines.

In addition the Plant shall include all auxiliary and ancillary systems required within the terminal points to render the Plant fit for purpose, this shall also include workshops, admin and staff amenities buildings and the likes unless expressly excluded in this specification.

B0.2 General Plant Description

B0.2.1 General purpose of the plant

The Plant is intended to serve the increasing power demands of the electricity market in Bangladesh. It will be operated in base load operation but frequency support operation must also be possible.

The scope under the EPC turnkey contract shall cover all services and supplies required to meet the purpose of the Power Plant even if not expressly mentioned in the Bidding Documents. This shall include but shall not be limited to: design, engineering, manufacturing, shop testing, procurement, supply, transportation to site (location of use), handling, storage, insurance, taking any permit/approval required, erection, testing at site, commissioning, performance testing, training Employer's personnel and final completion of entire Power Plant inter alia including steam generators and auxiliaries, turbine generators and auxiliaries, all associated BOP packages, all civil, electrical and I&C works for the entire Power Plant as well as for the jetty and associated facilities and the 400kV/230kV substation as described in the Bidding Documents and complete in all respects for successful operation of both units of 660 MW to dispatch power from the Plant to the grid.

The Plant covers the following main systems and components (including all systems not specifically mentioned):

B0.2.2 General scope of supply

The following data are applicable per unit, unless they refer to common systems. For further information see the respective **Sections B1 to B12**.

- **Boiler systems** (refer to **Section B1**)
 - steam generator (supercritical once-through)
 - regenerative air preheater
 - coal pulverizers
 - coal bunker system
 - bottom ash extraction system (dry)
 - boiler fans (PA, SA/FD fans)
 - HP steam / feed water piping
 - HP bypass system
 - air system
 - auxiliary boiler (if required).
- **Turbine systems** (refer to **Section B2**)
 - steam turbine generator
 - LP bypass
 - condenser system incl. evacuation
 - Condenser cleaning system
 - LP/HP heaters
 - deaerator/feed water tank
 - condensate pumps
 - feed water pumps
 - water/steam piping system
 - drip collecting and pump system
 - EOT crane and hoists.
- **Flue gas treatment systems** (refer to **Section B3**)
 - dust filter system (ESP)
 - FGD system (based on wet limestone process)
 - ID fans
 - flue gas ducts.
- **Fuel and Ash handling system** (refer to **Section B4**)
 - coal handling system, including:
 - coal unloaders (grab type)
 - stackers
 - portal scraper reclaimers
 - coal yard (90 days capacity at BMCR with worst coal)
 - coal yard roof cover (take-out option)
 - coal dust suppression systems
 - coal crushers
 - Coal screens
 - emergency coal supply by front end loader



- belt conveyors, junctions towers and other systems as required
- coal blending silos
- limestone handling system, including:
 - Stacker
 - limestone yard for 90 days
 - limestone transportation system from jetty to stockyard, as required
 - transportation from stockyard to limestone intermediate silo by front end loader
- HSD handling, including:
 - HSD truck unloading station
 - HSD tanks
 - HSD transfer pumps and pipe distribution system
- fly ash handling , including:
 - pneumatic fly ash transportation to intermediate fly ash silos
 - intermediate fly ash silos
 - pneumatic fly ash transportation fly ash storage silos at jetty
 - fly ash storage silos at jetty with truck and ship loading
- bottom ash handling, including:
 - bottom ash transportation to intermediate bottom ash silos
 - intermediate bottom ash silos
 - bottom ash storage silos at jetty with truck loading
- gypsum handling, including:
 - Gypsum storage silo at jetty with truck and ship loading
- common residue handling systems
 - transportation of limestone, bottom ash and gypsum from intermediate silos to storage silos at the jetty by pipe conveyor
 - discharge of fly ash and bottom ash via high concentrated slurry/solids disposal (HCSD) to the ash point.

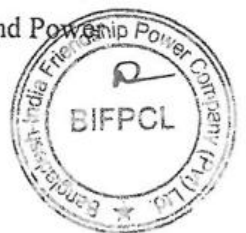


• **Plant Water and Cooling Systems (refer to Section B5)**

- Plant water intake channel
- Plant water intake structures
- Plant water screening plant
- Plant water supply pumps
- Plant water pre-treatment and storage
- Main cooling water system
- Cooling Water pump station
- Induced Draft Cell Cooling Towers
- Main cooling water collection basin
- Desalination feed water supply system
- Auxiliary cooling water system
- Plant water discharge system
- Cathodic corrosion protection systems.



- **Water Treatment Systems** (refer to **Section B6**)
 - Plant water pre-treatment storage and supply
 - Electrochlorination plants
 - Desalination plant
 - Potable water treatment plant
 - Demineralization plant
 - Condensate polishing plant
 - FGD Waste Water Treatment Plant (FGDWWTP)
 - Process waste water treatment facilities including oil separators
 - Sewage treatment plant for sanitary wastes
 - Chemical handling and storage facilities
 - Chemical dosing of cooling water and feed water conditioning
 - Monitoring system for the water/steam cycle.
- **Electrical systems** (refer to **Section B7**)
 - All electrical components related to turbine / boiler / flue gas treatment system and BOP systems
 - Power transformers incl. GT, SUT, UAT, all MV- and LV-T
 - Switchboards and power distributions (busducts, cabling etc.)
 - Emergency diesel, DC and safe AC Systems
 - 400/230kV GIS including auxiliary and ICT.
- **I&C systems** (refer to **Section B8**)
 - All I&C components related to turbine / boiler / flue gas treatment system and BOP systems
 - Central DCS and decentralized PLC Logics
 - Power Plant training simulator.
- **Civil works** (refer to **Section B9**)
 - site surveys and investigations to ensure safe civil design and undisturbed construction
 - site preparation (incl. site filling works) and temporary site installation.
 - all civil related works for the Power Plant including turbine/boiler/flue gas treatment system/cooling water system/electrical system/balance of plant etc.
 - Marine Works including coal jetty, plant water intake and discharge.
 - Power Plant related buildings and structures
 - ancillary buildings such as admin building, canteen, storage and workshop building
 - ash pond
 - HVAC
 - Biomass generation plant (use organic waste of Township and Power Plant),
 - Cranes.



• **Infrastructure (refer to Section B9)**

The following works are included in the infrastructure lot

- all internal roads incl. tie-in with existing roads at bridge and access roads to nearest township
- fencing, gate house inside the boundary
- landscaping in all areas where Contractor work will be performed
- Infrastructure related works outside the boundary wall
- underground services (non-pressurized - rain water discharge, domestic waste water
- rain water retention basin
- oil water separators.

• **Electrical Works 400/230 kV Substation (refer to Section B10)**

- 400 kV gas insulated switchgear
- 400 kV AIS equipments and accessories
- 230 kV gas insulated switchgear
- 230 kV AIS equipments and accessories
- 230 kV XLPE Cables
- 400/230 kV 520 MVA interconnection transformers
- Substation Control and Monitoring System (SCMS)
- 11/0.415 kV auxiliary power transformers
- Telecommunication Equipment
- AC/DC installations
- Power and control cables, bus ducts
- Tariff metering
- Substation outdoor lighting
- Earthing system & lightning protection system
- Power & auxiliary systems for 400 kV and 230 kV area, incl. coordination with overall system
- Fire detection, alarm and fire fighting system
- Substation other supply and services.

• **Jetty structure (refer to Section B11)**

- Retaining wall
- Revetment and Shore protection.

• **Auxiliary plant systems (refer to Section B12)**

- Compressed air system
- Hydrogen system
- Workshop and store
- Chemical laboratory
- Fire fighting system
- Dc-dusting system
- HVAC system



B0.2.3 Interface points

For interface points see below.

B0.2.4 Site conditions

The following information on local conditions is investigated or compiled by the Employer. The Contractor is hereby in no way relieved from his duties of carrying out all investigations required for satisfactory performance of his works. The Contractor shall perform his own Site visits and investigations, prior to Contract award in order to familiarize him with the existing conditions of the Site and the surrounding area.

Location, accessibility and present condition of the Site

The site for the Maitree-STPP Project is geographically located between 22° 37'0'' N to 22°34'30''N and 89°32'0''E to 89°34'5''E, approximately 14 km northeast of the Mongla Port and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively. The project requires an area of approximately 500 acres.

The topographical survey indicates a natural ground level of +1.15 to + 1.35 meters above sea level. A severe cyclone in 2009 raised the level to 4.47 meters and it was decided to raise the Plant level to +5.00 meters.

Politically, the site is located in Rampal Upazila of the Bagherat District in the Rajnagar Union

Currently, the Site is accessible by boat only.

The nearest inland port is Mongla port at around 14km direct distance.

The proposed Khan Jahan Ali Airport is located at a distance of approximately 12 km from the project site.

Soil conditions

First soil investigations of the Plant site and adjacent areas have been carried out. For information only the findings of these initial soil investigations are attached in Part C Annexes.

In general the subsoil conditions can be described as follows:

top layer filled sand (with unknown silt content) in Plant area
underlying layers of clay
underlaying fine sand.



The Contractor shall conduct soil improvement measures at site. Beside other aspects, consolidation of filling shall be incorporated in soil improvement concept.

Seismic zone

Attention shall be paid to seismic parameters. Related to soil type as identified to Soil Investigation Report, the effect of local soils on earthquake ground motion shall be determined.

For site class "S1" and "S", as expected for the Project, site specific studies shall be carried out to determine the design acceleration response spectrum. During field study minimum the following tests shall be executed:

- Seismic cross hole test; and
- Seismic refraction test.

Based on these results a site specific Response Spectra shall be established. Peak spectral acceleration shall be determined, but shall be not less than 0.12g, as mentioned in BNBC 2012, Table 2.5.2.

Site climatic conditions

The Plant site is from the climatic point of view under maritime tropical conditions. The assumed meteorological conditions for the Site are as follows:

The project site is located in the country's South Central Zone consisting of three dominant seasons:

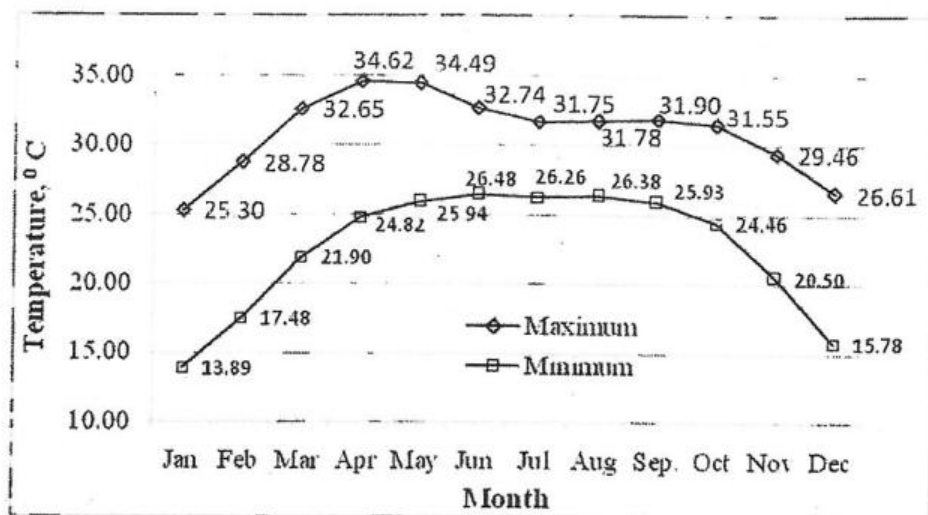
- summer season-March to May
- monsoon season-June to October
- winter season-November to February.

During the Monsoon Season occasional cyclonic storms can occur.

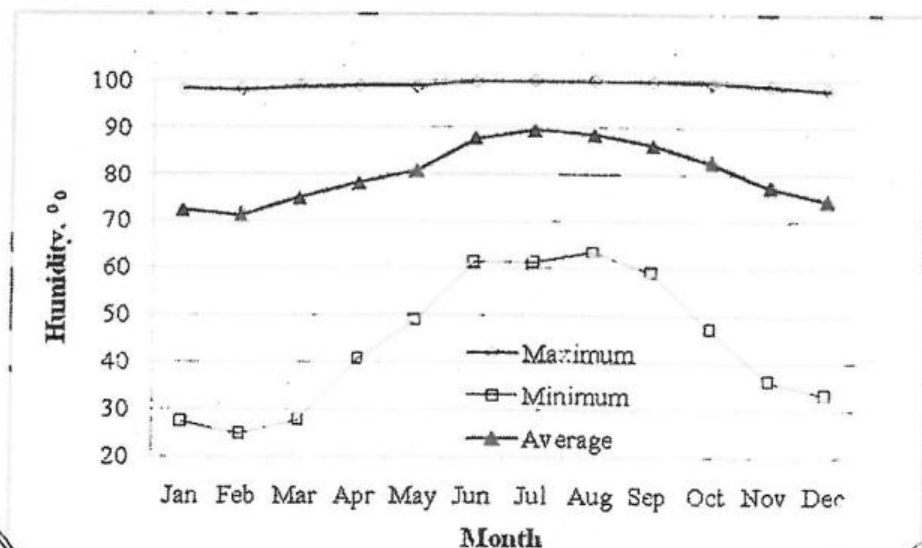
The climatic conditions in the area are continuously monitored by the Bangladesh Meteorological Department (BMD) at the Mongla Meteorological Station.

The temperature varies only slightly throughout the year with the highest temperature of 36.9°C and the lowest temperature of 12.2°C recorded in the period from 1989 to 2008. This distribution is depicted in figure below.





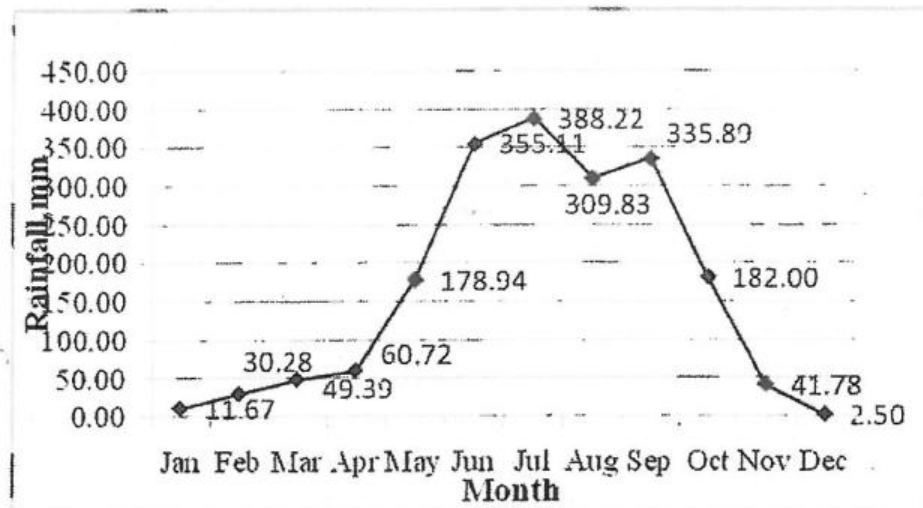
The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



The maximum rainfall occurs during the Monsoon Season by varying between 300 mm and 350 mm with almost no rainfall during the Winter Season.



The average evaporation in the project area varies between 3 - 5 mm/day with its peak of 16 mm/day during July. The average rainfall for the period between 1991 and 2008 is depicted in below figure.



Below definitions are to be used as typical data for the different climatically seasons at the site.

Average Site Condition ASC

Ambient Temperature:	27.3 °C
Ambient Humidity	87 %
Ambient Pressure	1007.6 mbar
River Water Temperature:	29.8 °C

Summer Site Condition SSC

Ambient Temperature	36.9 °C
Ambient Humidity	60 %
Ambient Pressure	1007.9 mbar
River Water Temperature:	33 °C

Winter Site Conditions WSC

Ambient Temperature	12.2 °C
Ambient Humidity	100 %
Ambient Pressure	1017.2 mbar
River Water Temperature:	20°C

Reference Site Conditions RSC

Ambient Temperature	31 °C
Ambient Humidity	88 %
Ambient Pressure	1007 mbar
River Water Temperature:	32°C
Wind speed	1 m/s

Design ambient conditions for Electrical Systems

• Maximum design temperature (outdoor)	45°C
• Maximum daily average ambient shade temperature	38°C
• Maximum monthly average temperature (in the shade)	34.6°C



- Maximum annual average temperature (in the shade) 27.3°C
- Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms 40°C
- Maximum design temperature of the electrical equipment installed indoors non in air conditioned rooms 45°C
- Minimum design temperature 0°C

Marine conditions

Two tides (e.g. flood and ebb) are regularly observed in the Passur River, which enters into the project site through numerous connected creeks.

The tidal range varies between 1.2 and 3.1 meters. The mean water level (CD) is about 0.87 meters (PWD=CD -1.17 meters). The mean high water level varies due to spring-neap tide conditions between +1.60 m and +2.6m PWD. The Highest High Water Level (HHW) is about +3.1m PWD and the Lowest Low Water Level (LLW) is about -1.4m PWD.

The marine conditions are detailed in **Section B11**, with details about:

- water levels
- waves
- currents
- river bathymetry, topography.

The salinity of the Passur River system varies with the amount of fresh water entering the system which is highly seasonal dependent. The surface water temperature ranges between 22.9°C and 33.0°C and the different water quality parameters are tabulated in **Part C Annexes**.

The marine conditions as recorded at Mongla Port Gauge Station (approx. 14 km south-east to the site) are as follows:

- Highest High Water Level (HHW) + 2.642 MSL
- Lowest Low Water Level (LWL) - 1.858 MSL

The Power Plant shall be designed for 100 years flood condition based on data provided by relevant Organization in Bangladesh and taking into account the Highest Astronomical Tide (HAT), the maximum wave conditions (including storm surges) and the potential event of Cyclone. The Contractor is responsible to verify the worst conditions.

These reference data are with respect to LAT, which corresponds to the Chart Datum (CD). The site land data is however with respect to the Bangladesh Land Survey Datum (BLSD), which corresponds to approx. +1.55 m CD (hence the MLSD corresponds to MSL).



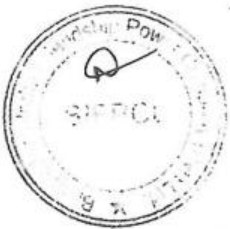
Design Wave Height 2.0 m
 Design Wave Period 6.0 sec
 Sedimentation and Siltation: Soft to stiff clay and alternations of very sandy and stiff clay.

The results of bathymetric investigations of the Passur River can be found in Part C Annexes.

A water analysis from the area adjacent to the site giving salinity and water quality is shown below:

Stn no	Date	Temp	pH	EC	Cl	T. Alkal	Total	TS	TDS	SS	DO	BOD	COD	Salinity
		°C		µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	10-Jan	27.4	7.7	3010	870	30	86.7	1180	1110	35	5.1	0.2	57	1.6
2	10-Jan	27.1	7.7	3010	870	30	86.7	1170	1110	30	5.1	0.2	55	1.6
3	10-Jan	27.5	7.7	3000	870	30	86.5	1160	1110	35	5.1	0.2	54	1.6
1	11-Feb	26.8	7.6	4180	1250	35	182	2390	2180	210	4.7	0.7	5	2.3
2	11-Feb	26.2	7.5	4180	1250	35	178	2390	2180	200	4.7	0.7	5	2.3
3	11-Feb	26.1	7.5	4180	1250	35	179	2380	2180	200	4.7	0.7	5	2.3
1	8-Mar	31.5	7.5	11780	2940	38	175	6080	5890	190	4.7	1.2	75	6.7
2	8-Mar	31.5	7.7	11780	2940	38	175	6080	5890	190	4.7	1.2	75	6.7
3	8-Mar	32.1	7.5	11780	2940	38	177	6090	5890	200	4.7	1.2	75	6.7
1	17-Apr	32.5	7.58	25100	8270	38	281.8	12950	12700	250	4.5	0.7	135	15.7
2	17-Apr	32.6	7.58	25100	8270	38	281.2	12950	12700	250	4.5	0.7	135	15.5
3	17-Apr	32.5	7.58	25100	8270	38	284.6	12950	12700	250	4.5	0.7	135	15.5
1	18-Apr	32.5	7.58	29200	8480	38	285.5	14800	14500	300	4.3	1.2	145	17.6
2	18-Apr	32.3	7.54	29200	8470	38	285.5	14800	14500	300	4.4	1.2	145	17.5

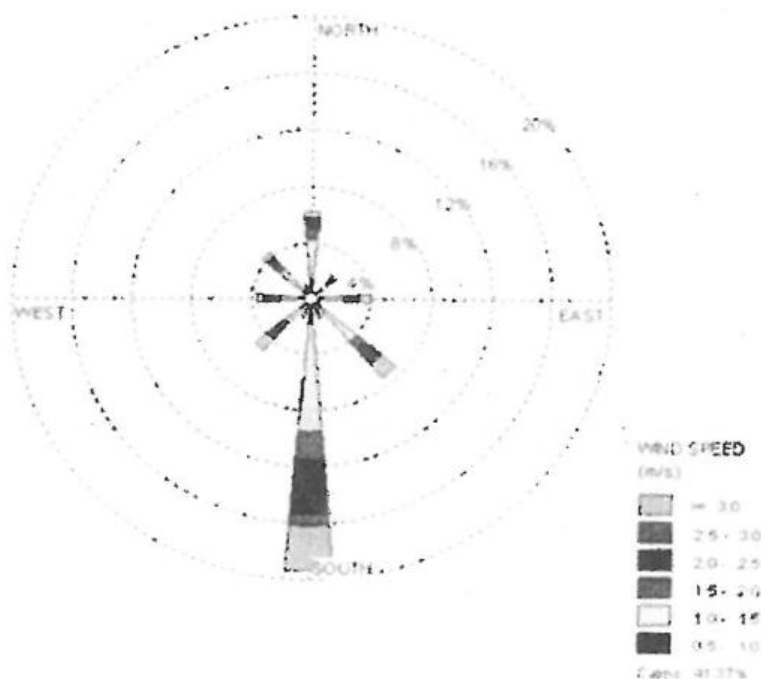
Figure 1 Water quality of the Passur River at Mongla point
 (Source: EIA-Report)



Additional information on water quality parameters is shown in **Part C Annexes**.

Wind data

The project region is characterized by southerly winds from the Bay of Bengal during the Monsoon Season and north-westerly winds from the Himalayas during the Winter Season. During the Summer Season, the wind blows from south-southwest to north-northeast. The annual average wind speed amounts to 1.7 meter/second and the wind rose for the entire year is shown in Figure 5.5.



B0.2.5 Configuration

Two (2) Plant units mainly consisting of steam generator, steam turbine generator, flue gas treatment plants and associated equipment represent the core components of the Plant. The configuration of the power units and all of its main components shall be chosen according to proven and reliable vendor configuration. In doing so, adequate safety clearances, fire compartments, favourable layout of the Plant components for monitoring and maintenance and all other requirements such as those during Power Plant construction shall be taken into account.

The cooling requirement of the Plant shall be accomplished by induced draught cooling towers. The coal unloading facilities and the ash and gypsum loading facilities to ships shall be incorporated in a new jetty structure. Other main items are the power island, the coal yard, ash pond and other balance of plant facilities.



B0.2.6 Layout

The existing conditions at the location of the Plant are shown in the site overview as per the indicative layout in **Part C Annexes**. The Tenderer shall perform own Site visits and investigations prior to bidding in order to familiarize himself with the existing conditions. The Contractor shall propose the Plant layout deemed most practical and cost optimized for the Power Plant.

An indicative general layout is shown in **Part C Annexes** where only the major Plant components have been indicated. The indicative layout takes into consideration the location of the river water intake and jetty, however the final layout is subject to hydraulic studies and optimizations by the Contractor. The design shall allow access vessels with a draught of 9.60m at the jetty. The vessels shall be suitable for transport of coal, ash, gypsum and limestone. The dredging works for the construction of the intake and outfall are part of the Contractor's scope.

The intake and outfall locations may change according to the permitting process, results of calculations or model tests or clarifications with the Contractor.

The substations for the export of the produced power are located in the northern portion of the Site. The EHV transmission lines to Dhaka and Khulna are not part of these Tender Documents.

Any costs for relocations or reconfigurations shall exclusively be borne by the Contractor.

B0.2.7 Design requirements

This specification entails a functional technical specification (FTS). Hence, the Contractor is given as much freedom as possible in designing the main Plant components, characteristics and design data according to the Contractor's experiences and good engineering practice. One main acceptance requirement is that the Contractor's proposed design work shall be based on a very good reference basis. Prototype equipment and/or design features will not be accepted. All parts and equipment shall be arranged in such a manner as to facilitate surveillance by the operator and for ease maintenance, operation and control.

In the event of contradictions or discrepancies within B0 or between requirements in B0 and stipulations other parts of the Technical Specifications these shall be clarified by mutual consent before Contract signature. In case contradictions have been not clarified the more stringent requirements shall apply.



The main design features (basic design reports, drawings, PFD, P&IDs, design data etc.) and the main vendors and subcontractors shall be subject to the approval by the Employer.

The main equipment/system subcontractors for: steam generator, steam turbine, main transformers, flue gas desulphurization plant shall be firm with the tender. For others equipment/systems, up to 3 subcontractors/vendors can be proposed with the tender.

The Employer has the right to refuse design features and vendors or subcontractors, if the Contractor cannot verify the reliability of the suggested design, vendor or subcontractor.

The Plant is expected to operate in base-load mode with high plant load factor. The design lifetime of the Plant shall be of not less than 30 years of operation or 200,000 full load operating hours, whichever is longer. The Plant and all its auxiliaries shall be designed to operate for the complete lifetime under the site conditions as described in **Section B0** and dedicated other part of this FTS.

All Plant equipment and material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

The thermodynamic process of the Plant is to be optimized by the Contractor according to the proposed equipment. An economic optimal balance between investment, maintenance and operation expenses and Plant availability (planned and unplanned outages) shall be proposed.

The Contractor shall ensure a design of the Plant to achieve an average target availability of 90 % (regarding the definition and calculation of the availability please refer to Chapter B0.2.9.5). The Contractor shall accordingly provide for all systems:

- sufficient redundancies
- sufficient storage capacity
- appropriate adjustment of control parameters, and
- shall provide an appropriate spare part concept/proposal as further described under Chapter B0.3.7.

Redundancy concept

All equipment shall be implemented with (n+1) redundancy - unless otherwise stated -, where n is the number of equipment required to maintain the maximum capacity of a unit. N+1 means that even in case of outage of the biggest component sufficient capacity is available to maintain the maximum capacity of the Power Plant unit.

For all components which are not redundant, the Contractor shall provide a maintenance and spare part concept to ensure that outage times are minimized and to ensure that the required availability is met.



Each equipment whose unavailability due to a failure could result in damages to another equipment shall be backed up by a stand-by equipment, one of them being fed by an emergency source in case of external black out.

Failure of any single item of auxiliary equipment including the Power Plant's DCS and electrical systems shall not result in a reduction in power evacuated from the Power Plant.

Replacement and repair of redundant components shall be possible without interrupting Plant operation.

Future Extension

The Contractor shall ensure sufficient space to enlarge the coal storage capacity from 90 day storage to 180 day storage capacity.

All provisions to enable generally the later extension of the coal storage shall be implemented but no additional costs shall be incurred which are not immediately required for the first phase only, unless expressly mentioned here or in the respective parts of this specification.

B0.2.8 Fuel

The Plant shall be operated with imported sub-bituminous and bituminous coal as the principle fuel. Coal will be supplied via bulk carrier vessels (barges and vessels up to 25,000t, to be unloaded at the Coal Jetty.

The Plant will have to be able to be fully operational and in accordance with all guarantee parameters with all coals on a 100 % basis that comply with the coal characteristics as indicated in **Part C**.

For reference purposes, the list that contains the performance coal and the design range for the coals is included in **Part C Annexes**.

For start-up, low-load operation and shut-down, high speed diesel (HSD) shall be used. HSD will be supplied by truck. A typical analysis is given in **Part C Annexes**.

Special technical requirements for the HSD system are given in **Section B4**.

B0.2.9 Output, heat rate and availability requirements



B0.2.9.1 Guarantee definitions

The following guarantees are defined:

Acceptance Guarantees:

The acceptance guarantees must be met in all operating gases unrestrictedly. They are not subject to any correction. Acceptance Guarantees are specified in the Technical Schedules of **Section B0**. The acceptance guarantees are required to be achieved or executed as a condition precedent to Taking Over.

Special Guarantees:

These guarantees are subject to correction, e.g. for fuel characteristics or ambient conditions and if they are not met, they are subject to payment of performance damages. Special Guarantees are specified in the Technical Schedules of **Section B0**.

Minimum Acceptance level (MAL):

Minimum acceptance level (MAL) means the relevant minimum performance levels for the Plant as specified in the relevant part of the Technical Schedules of **Section B0**. The MAL are required to be achieved or executed as a condition precedent to Taking Over.

Liquidated Damages (LD)

Liquidated Damage means the monetary amount to be paid by the Contractor to the Employer if the Special Guarantees are below the Guaranteed Value but above Minimum Acceptance Levels.

B0.2.9.2 Plant output

Gross Electrical Power Output

The gross electrical power output per unit is determined at the turbine generator terminals to the isolated phase busbars, downstream of the connection for the excitation transformer.

The gross electrical power output per unit shall be: **660.0 MW_{e, gross}** (plus excitation power requirement in case of static excitation) and shall be kept for the whole coal range.

Net Electrical Power Output

The net electrical power output per unit is determined at the off-take point in the switchyard that means at the high voltage (HV) terminals of the dedicated generator transformer (GT).

The net output is determined by subtracting the consumption of the auxiliary transformer including transformer losses from the gross output.



Export Power Output

The export power output of the Plant is determined at the tariff meterings of the Plant.

The export power output of the Plant equals the net power output of both units minus the losses of the interconnection transformers (ICTs) and start-up transformers.

Dependable Capacity

Dependable Capacity means - according to the Power Purchase Agreement (PPA) - at any given time the net amount of capacity at the tariff metering; either for the first generating unit or for the Plant, as the case may be.

MCR - Maximum Continuous Rating

MCR is defined as the maximum continuous rating (gross electrical power output) of one (1) power plant, coal within the coal range, under Reference Site Conditions (RSC), governor valves being throttled to provide frequency variation as required, boiler in normal operating mode including blow down (if applicable), auxiliary steam consumption (if applicable) etc.). All load percentages apply to MCR, unless otherwise noted.

The dedicated net electric power output at MCR with PF and RSC is:

- $P_{MCR-PF-RSC}$ in [MWe]

The dedicated steam generator load at MCR with PF and RSC is.

- $F_{MCR-PF-RSC}$ in [kg/s]

TMCR - Turbine Maximum Continuous Rating / VWO - Valves Wide Open (Peak Load)

TMCR/VWO is defined as the maximum continuous rating, at which the steam turbine is capable of operating under normal operating conditions (see MCR). However, when the governor valves are fully opened TMCR/VWO shall be at least 103% of MCR, i.e.:

- $P_{TMCR} = 1.03 \times P_{MCR}$

BMCR - Boiler Maximum Continuous Rating

BMCR is defined as the maximum continuous steam generating capacity, at which the boiler is capable of operating under normal operating conditions (see MCR). BMCR shall be at least 105% of MCR, i.e.:

- $F_{BMCR} = 1.05 \times F_{MCR}$



MNCR - Minimum Continuous Rating

MNCR is defined as the minimum rating of a power plant unit under normal, continuous operating conditions (see MCR) with coal fire only (without back-up firing with start-up/ignition fuel) with any coal within the coal range. MNCR shall be 30% of MCR.

- $P_{MNCR} = 0.3 \times P_{MCR}$

B0.2.9.3 Net heat rate

The guaranteed Net Heat Rates of the Units and the Plant are to be given in the Technical Schedules of **Section B0**.

The competitiveness of the bid will be evaluated by considering the lowest life-cycle-costs of the bids, which will strongly be influenced by the Bid price on the one hand and the guaranteed Net Heat Rate on the other hand. The optimization criterion which may be utilized by the Contractor in the determination of the proposed power station design is the penalty imposed by not achieving the guaranteed Net Heat Rate as per the Contract.

The guaranteed Net Heat Rates refer to the following load points:

- 100% MCR
- 80% MCR
- 60% MCR
- 50% MCR

The „Net Heat Rate” is the heat rate for the dedicated unit. It is defined according to ASME PTC 46.

B0.2.9.4 Auxiliary power consumption, losses, own consumption,

Auxiliary Power Consumption

The auxiliary power consumption is the power that is required by the auxiliary power transformer of each unit.

ICT Losses and Start-up Transformer Losses

The losses of the ICTs and start-up transformers apply for the complete switchyard of the Plant.

Own Consumption

The own consumption is the sum of the auxiliary power of both units and the ICT losses and start-up transformer losses.



B0.2.9.5 Plant availability

The Contractor shall:

- design and configure all components of the Plant
- propose spare parts stock and
- propose maintenance works

in such a way that the availability of each unit is not lower than 90 %.

The availability for the year means the yearly availability of the Dependable Capacity of each unit for dispatch by the Control Centre, calculated in accordance with the following formula:

$$AF_n = \frac{DC \times \text{hours in the year} - ((MO_{cap} \times MOH) + (FO_{cap} \times FOH) + (SO_{cap} \times SOH))}{DC \times \text{hours in the year}}$$

Where:

AF_n	Availability Factor for the year "n"
DC	Dependable Capacity of the Unit as per the Contract
MO_{cap}	capacity reduction during each maintenance outage in the year "n"
MOH	maintenance outage hours for each maintenance outage (MO_{cap}) in the year "n"
FO_{cap}	capacity reduction during each forced outage in the year "n"
FOH	forced outage hours for each forced outage (FO_{cap}) in the year "n"
SO_{cap}	capacity reduction during each scheduled outages in the year "n"



SOH	scheduled outages hours for each scheduled outage (SO_{cap}) in the year "n"
$\Sigma(MO_{cap} \times MOH)$	maintenance outage energy for the year "n"
$\Sigma(FO_{cap} \times FOH)$	forced outage energy for the year "n"
$\Sigma(SO_{cap} \times SOH)$	scheduled outage energy for the year "n"

B0.2.9.6 Maintenance intervals

The Plant shall be designed to follow at least the following requirements for maintenance intervals:

	Recommended outage duration (days)	Recommended intervals between maintenance outages (years)
Scheduled Maintenance (Minor Overhauls)	to be determined by Contractor, see B0 TS	> two years
Major Overhaul	to be determined by Contractor, see B0 TS	> eight years

B0.2.10 Mode of operation

The Plant shall be designed for base load operation and is expected to participate in the system frequency regulation by free governor operation.

All the equipment and the facilities shall be suitable for continuous and also for short-time operation under the average and the extreme ambient air and river water conditions present on site.

The design of the Plant shall be based on the following operation and dispatching requirements:

- It shall be capable of following the daily and seasonal demand profile of the electrical network.
- Full compliance with the conditions of the admissible air pollution is required within the power range.
- The power generation shall be fully dispatch able within the technical limits of the Plant to be specified by the Contractor but at least between MNCR and 100 % of the Net Output of the Plant at BMCR.

The units shall be operated as base load plant. It must be capable for following operation modes:

- sliding pressure operation of HP pressure from subcritical pressure at part load to supercritical pressure range at full load;
- start-up modes from notice to start to synchronization:
 - hot start: start-up following a continuous shutdown for a period of 8 hours or less in max. 3 hours;
 - warm start: start-up following a continuous shutdown for a period between 8 and 48 hours in max. 4 hours;



- cold start: start-up following a continuous shutdown for a period more than 48 hours in max. 12 hours;
- shut-down mode;
- Each Unit shall be capable of automatic operation and control and full cyclic operation between MNCR and BMCR without restriction;
- operation without HP heater;
- house load operation;
- In case of sudden load throw-off, the steam generator shall be capable of automatically bringing down the steam generating capacity from BMCR to match with HP-LP bypass capacity;
- The Power Plant shall be designed for minimum rate of loading/unloading mentioned below without compromising on design life of pressure parts;
- step load change: Minimum $\pm 10\%$ /min;
- ramp rate: Minimum $\pm 3\%$ /min (MNCR to 50% BMCR);
Minimum $\pm 5\%$ /min (50% MCR to 100% BMCR).

For more detailed requirements refer also to Chapter B0.2.12.

B0.2.11 Electrical network connection conditions

The Plant shall comply with:

- a. the Essential Electrical Requirement of the PPA
- b. the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
- c. the Great Britain Grid Code.

In case of contradictions or discrepancies the order of precedence shall be as follows:

- a. Essential Electrical Requirements of the PPA
- b. Electricity Grid Code of the Bangladesh Energy Regulatory Commission
- c. Great Britain Grid Code.

Any other requirements of the Bangladesh Power Development Board (BPDB) or Power Grid Company of Bangladesh (PGCB) shall also be considered.

The Tenderers shall list all those grid connection requirements which cannot be met by the proposed Plant.

B0.2.11.1 Essential Electrical Requirements of the PPA



In this chapter essential electrical requirements for the grid connection and plant operation are extracted from the PPA. For ease of reference, the relevant chapters/articles of the PPA are indicated.



PPA Section 11: Power Evacuation and Switchyard

11.1 Power Evacuation

The Company shall deliver power at the Delivery Point and BPDB shall evacuate power from the Delivery Point. In this regard, BPDB itself or through PGCB shall construct Power Evacuation Facilities at its own costs and expenses. The Company shall construct switchyard for evacuation of power, with the provision for termination of two 400 kV circuits and two 230 kV circuits of PGCB. This switchyard along with line breaker, CT, PT and other necessary equipment and associated relays, controls, protection, communication and instrument system situated within this switchyard, will be operated and maintained by the Company. The company will also construct connecting lines (U/G or O/H) from power plant to this switchyard. The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable Gateway on company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104). The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The company Switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

BPDB shall provide by no later than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date, the following facilities to the Company for the purpose of Commissioning, synchronization and operation of the Facility:

- i. One number 230 KV D/C transmission line from the BPDB / PGCB 230 KV system, to be terminated at the specified point at the switchyard of the Facility;
- ii. (ii) Start-up power of not less than 50 MVA capacity, to be supplied to the Facility through this 230 KV transmission line, by no later than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date;
- iii. One number 400 KV D/C transmission line from the BPDB / PGCB 400KV system, to be terminated at the specified point at the switchyard of the Facility, with adequate capacity to evacuate entire power generated by the Contracted Capacity of the Facility, by no later than one hundred and eighty (180) Days prior to Scheduled Initial Operation Date;



11.2 Electrical

a. Communication link

The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable gateway on Company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104).

The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The Company switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

b. Control of Switchyard

Provision and installation of all control and signal cables between the company switchyard and the Facility shall be responsibility of the Company. Necessary interface shall be provided within the switchyard control facility for receiving the signals from PGCB grid control. It shall be responsibility of the Company to lay and terminate cables for this purpose.

All circuit breakers and disconnect switches shall be capable of being electrically controlled from the three control positions as follows:

- i. Local Control: Located adjacent to switching devices, to facilitate maintenance, inspection, and emergency operation.
- ii. Remote Control: Located at the switchyard control room, where switching devices are controlled by direct wire.
- iii. Supervisory Control: Located at the Load Dispatch Centre (NLDC) at Dhaka, for remote control and supervision via the tele-control systems to be supplied by the Company.

The Company shall provide all the necessary control-selector switches, position indicating contacts, and interposing relays.



11.3 Electrical Protection, Communication and Instrument Systems

The Company shall provide a complete and comprehensive protection system for the generators/generator transformers/service transformers, transmission lines and the station electrical distribution systems. The Company shall undertake the installation of the protection relay panels within the control room, wiring between panels and switchyard equipment, and commissioning tests of the protection schemes.

The Company (in consultation with BPDB) shall provide suitable interface unit at the Company premises for communication links to the PGCB's SCADA system for Communication, control, monitoring and voice channels required for PGCB's National/Regional Control Center.

Communication, telemetry, fiber optical terminal, and tele-protection equipment (PLCC) shall be supplied and installed by PGCB at company switchyard end, matching with PGCB's remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48V DC/AC auxiliary supply at company switchyard end shall be provided by company. The wiring of all signalling and control circuits required for the system shall be cabled out to interface marshalling cubicles by the Company. The Company shall supply and install necessary cabling and cubicles. Cabling between the Company's cubicles and PGCB' LDC equipment shall be provided and installed by the Company.

PPA Schedule 1: Minimum Functional Specifications

3. ELECTRICAL REQUIREMENTS

3.1 Generators

- a. Each generator shall comply with IEC 34: 1994 and shall be rated to match [each][the] Steam turbine[s] and the steam turbine output over the full range of ambient temperatures. Generator and exciter windings shall possess insulation that is non-hydroscopic and of Class F type in accordance with IEC 85 standard.
- b. Not Used
- c. The quality management of the generator[s] and accessories shall be in accordance with the requirements of ISO 9001, EN 29001 or BS 5750 Part 1 or such other equivalent international quality standards and Prudent Utility Practices.
- d. Temperature detectors shall be provided to monitor the maximum operating temperature of the machine.
- e. The generator[s] shall be capable of operating within 48.5 Hz and 51.5 Hz and +/- 5% of nominal rated voltage within the power factor range 0.85 lagging and 0.95 leading at the generator terminal. However, the combined variation in voltage and frequency shall not exceed 5%.



- f. Generator[s] shall have a minimum short circuit ratio complying with IEC 34.

3.2 Excitation System

- a. A continuous fast acting automatic excitation control system of proven design shall be provided to control each generator's voltage without hunting or instability over the entire operating range of the generators.
- b. The excitation system shall be provided with a fast acting MVAR limiter so as to prevent the generator output falling below safe limits. A power system stabiliser shall be incorporated in the excitation system of each generator. BPDB shall provide the settings for the power system stabiliser. The AVR shall be provided with but not limited to Quadrature Droop Compensation and Cross Current Compounding. Protection features, as part of the system shall include overvoltage, overcurrent, voltage transformer (VT) fuse failure, diode failure, overfluxing, and AVR power supply failure. A field shorting or discharge switch feature shall be included in the system as protection against over stressing the generator insulation in the event of a fault.
- c. Manual excitation control facilities shall be provided as back up to the automatic channel, and shall have an adequate range to allow for control of excitation for testing purposes. A true null balance shall be provided to allow for smooth excitation transfer between manual and automatic control.

3.3 Power and Auxiliary Transformers

The Facility shall include a main transformer for each generator, together with all protection, busbars and disconnectors where required. These main transformers shall be equipped with on load [to be discussed with BPDB] tap changers and shall be of OFAF (forced oil, forced air) or ODAF (oil direct, forced air cooled) or suitable type rated for the full continuous output of the generator.

All service station auxiliary transformers (utilization voltage <650V) shall be OFAF, ODAF or ONAN cooled if located outside, or resin type design if situated inside the buildings.

3.4 Control and Supervision

- a. Supervisory control, monitoring, and data acquisition information shall comply with BPDB's system control concept and proposed/current system. BPDB shall provide all supervisory control, monitoring, and data acquisition circuits from BPDB's National/Regional Control Center, all of which shall conform to the Company's requirements.

