2X660 MW MAITREE BANGLADESH (BIFPCL)

TECHNICAL SPECIFICATION
FOR
PLATE HEAT EXCHANGERS

Specification No. : PE-TS-421-179-N001 (REV 0)

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

CONTENTS

This Technical Specification consists of three Sections:

SECTION I

IA SPECIFIC TECHNICAL REQUIREMENTS

IB DATASHEET – A

INTENT OF SPECIFCATION

1.0 GENERAL :

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/ or his sub-contractors works, painting, proper packing & delivery of the item namely **PLATE HEAT EXCHANGERS** complete with all mandatory spares, accessories, commissioning spares (if any), counter flanges with nuts, bolts, gaskets and coatings (wherever necessary), including special tools & tackles (if any) including PG test at site as mentioned in this specification for:

2 x 800 MW MAITREE BANGLADESH THERMAL POWER PROJECT

The Plate heat Exchangers complete with all accessories including special tools and tackles (if any) shall conform to the Data Sheet-A (Section IB) and other requirements of section IIA. In addition, the requirements of this Section IA including Customer Specification attached at Appendix 1 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 IB).

2.0 SYSTEM DESCRIPTION :

2.1 The Plate Heat Exchanger are intended to be used in closed circuit DM cooling water circuit for Cooling Hot passivated DM Water by Auxiliary Cooling Water (Sea Water).

2.2 Passivated DM Water is circulated through various auxiliary coolers of TG/SG/Station Aux., in closed loop by means of pumps. This DM water picks up heat from different cooling equipment's. Heat from DM water is transferred to auxiliary cooling water (Secondary side) thru' the Plate Heat Exchangers covered under this specification.

2.3 The analysis of DM Water, Clarified Water (Auxiliary cooling water) to be handled by the Plate Heat Exchangers are attached as Annexure to Data Sheet-A.

2.4 A strainer of 2 mm size at ACW inlet lines of PHE is provided and backwashing of PHE's is not envisaged.

NOTE:
(1) For design & standards of PLATE HEAT EXCHANGERS (Materials specification, pumps, piping, flanges, valves, testing procedures etc) please refer clause no B.0.6.2 of Appendix-1(B)/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.

3.0 SCOPE OF SUPPLY :

3.1 The details of the Plate Heat Exchangers with the quantity, design parameters etc. to be

supplied shall be as per Data Sheet-A enclosed at Section IB.

3.2 Each Plate Heat Exchanger (quantity and other details specified in Data Sheet-A) shall be complete with the following accessories and auxiliaries.

(i) Suitable drain and vent connections for both primary (DMCW) and Secondary Water (ACW) streams complete with isolation valves.
(ii) Supporting arrangement complete with foundation plate channels, anchor bolts, nuts, sleeves, inserts etc.
(iii) Lifting arrangement i.e., lifting lugs, eye bolts etc.
(iv) Matching counter flanges with necessary bolts, nuts, and gaskets for all flanged terminal points, including for DMCW and ACW inlet/outlet nozzles & reducers/expanders.
(v) Inspection ports at the End plates of the PHE.
(vi) Other accessories as required to make PHE's complete in all respects.
(vii) Commissioning spares, if any.
(viii) One Ratchet spanner for each type of PHE is included in bidder's scope of supply.
(ix) Matching piece (Reducer/Expander), with coatings (as required), to match the PHE nozzle connection with connecting pipe size at DMCW Side (Primary) and ACW side (secondary side), as indicated in Data Sheet A. In case of sea water Matching piece on ACW side (secondary) shall be flanged with coatings (as required for sea water application) and counter flange for same on connecting pipe side shall be provided by BHEL, however bolts, nuts, gaskets shall be in bidder scope.
(x) Mandatory spares as applicable as per Data sheet A.

3.3 Finish paints for touch up painting of equipment after erection at Site in sealed containers.

4.0 INSPECTION REQUIREMENTS

4.1 Inspection for "Pressing of plates to form whole corrugation of the heat transfer plate" shall be from third party like TUV/Lloyd and certificate shall be submitted for review of BHEL.

4.2 Minimum requirement for quality Plan shall be as per quality plan attached in the Section IIA of the specification. Manufacturing Quality Plan for PHE shall be subject to approval during detail engineering. No price implication shall be admissible to QP approval by BHEL/Customer.

4.3 Heat transfer area for the PHE as offered by bidder with technical offer shall be measured by White light scanning method during contract stage to ascertain the correctness of heat transfer area as offered by bidder.

Bidder to note that Heat Transfer Area measured by White Light Scanning during contract stage should not have negative tolerance more than 3% w.r.t to the heat transfer area indicated by bidder against the offered model of PHE. However in the case of negative tolerance (limited to maximum 3 percent) , bidder has to provide additional plates proportionately, as free issue, assembled into all the applicable PHE's before the Final inspection and "As built Certificate" shall be issued by the bidder accordingly. Bidder to note that negative tolerance beyond three percent shall not be accepted, however no credit shall be given to the bidder for positive tolerance

of the plate area measurement.

5.0 PERFORMANCE GUARANTEE AND TESTING:

5.1 The PHE shall be guaranteed to meet the performance requirements specified in Section-II and also for trouble free operation after commissioning.

5.2 PG test requirements are specified in Datasheet-A. In case of any deficiency, the vendor shall rectify the same at site with no additional cost to BHEL. All duly calibrated instruments required for PG testing including for flow measurements shall be arranged by the bidder and taken back after the test. The computation of flow by characteristics curve of Pumps for PG testing of PHE's shall not be permitted.

5.3 It is clarified that pressure gauges and temperature gauges are provided at each PHE inlet / outlet on both primary / secondary sides and bidder can install their calibrated instruments on these locations. It is further clarified that due to layout constraints flow measuring instruments installation on pipe is not feasible. Bidder shall arrange the Ultra-sonic flow meter / similar type of instrument for PG testing.

5.4 At the time of performance testing, cleaning of the plates (if required) and instruments like pressure gauges, temp. Gauges, flow measuring instruments etc. shall be arranged by the bidder and no instruments shall be provided by BHEL for performance testing.

6.0 Documents to be submitted along with the offer, duly signed and stamped:

a) Compliance certificate.
b) Guarantee Schedule.
c) Thermal sizing calculations (only for reference and shall be reviewed during detailed engineering).
d) GA Drg. of PHE indicating all-important details for Layout purpose, withdrawal space required for plates, weight of assembly, nozzle & matching piece details etc. (only for reference and shall be reviewed during detailed engineering).
e) Deviation Schedule (as per NIT format; in case of nil Deviation, mention "No Deviation" in the schedule and submit).

7.0 Document submission schedule after the award of contract shall be as below:

PACKAGE	BHEL DRG NO	DRG TITLE	Drg Submission schedule
PLATE HEAT EXCHANGERS (PHE)	Primary Documents		
	Maitree-00-PA-MDA-117101-PEM	Technical Data sheet of PHE	R-0 within 20 days from LOI/PO & subsequent revisions within 07 days of comments received from BHEL.
	Maitree-00-PA-MLU-117102-PEM	GA drawing of PHE	
	Maitree-00-PA-MED-117103-PEM	Thermal sizing calculation of PHE	
	Maitree-00-PA-MQA-117105-PEM-A.pdf	QAP of PHE	

	Secondary Documents		
	Maitree-00-PA-MED-117104-PEM	Performance curves of PHE	R-0 within 20 days of Cat-I(or)II approval on TDS
	Maitree-00-PA-MFE-117106-PEM	O&M MANUAL for PHE	Within 30 days from MDCC
	Maitree-00-PA-MFE-117107-PEM	PG Test Procedure for PHE	R-0 within 20 days of Cat-I(or)II approval on PHE Document.

For final documentation refer clause no B.0.3.9.4 of Appendix-1(B)/SECTION- IA

8.0 EXCLUSIONS :

The following are excluded from the bidder's scope:

8.1 Civil foundation works required for installation of the heat exchangers.

8.2 Piping, valves etc., on the external circuit of both primary and secondary water streams.

8.3 Erection & Commissioning of equipment at site.

OTHER GENERAL REQUIREMENTS

9.0 Items though not specifically mentioned in the specification but needed to complete the equipment to meet the intent of specification, shall also be deemed to be included unless otherwise specifically mentioned in exclusions.

The construction of the auxiliary cooling water heat exchangers shall be of plate type heat exchangers.

The design of the heat exchangers shall comply with all applicable international standards. Only proven products shall be supplied.

The plate type material shall be preferably of titanium. The design shall allow for erection of additional plates when required to increase the heat exchanging surface.

The heat exchangers shall be equipped with safety valves, supports, suitable valves and pipework for venting, draining as well as with pressure measuring devices, etc.

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APPENDIX-1(B)

B0

General Technical Specification

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भारत हेवी इलेक्ट्रिकल्स लि. / BHEL
अंतर्राष्ट्रीय परिचालन प्रभाग
INTERNATIONAL OPERATIONS DIVISION
नई दिल्ली / New Delhi-3 (India)

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 expressively 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° 370'0'' 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:

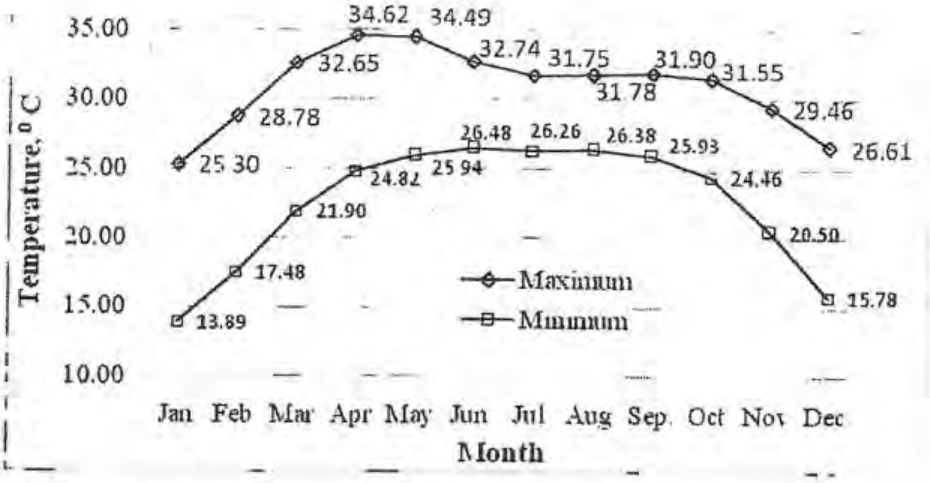
The project site is located in the country's South Central Zone consisting of three dominant seasons:

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

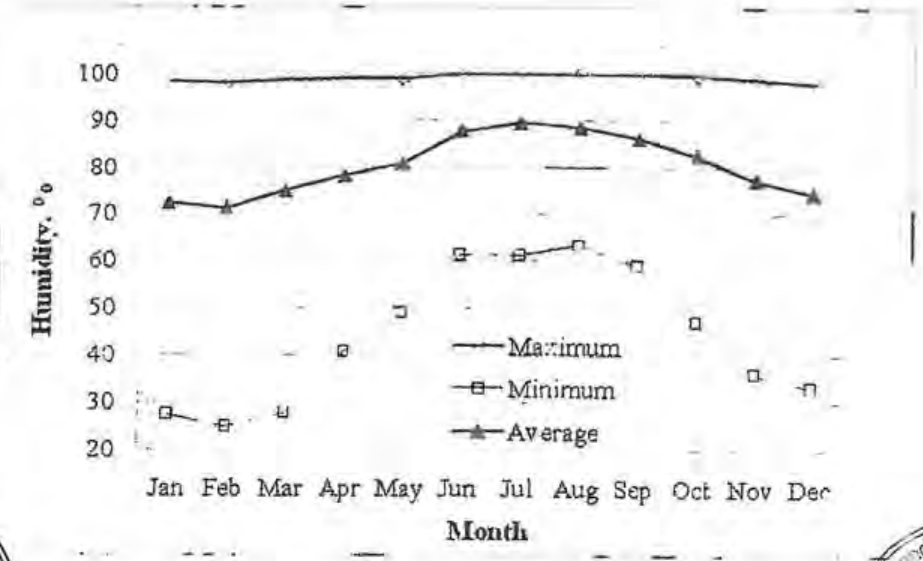
During the Monsoon Season occasional cyclonic storms can occur.

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.

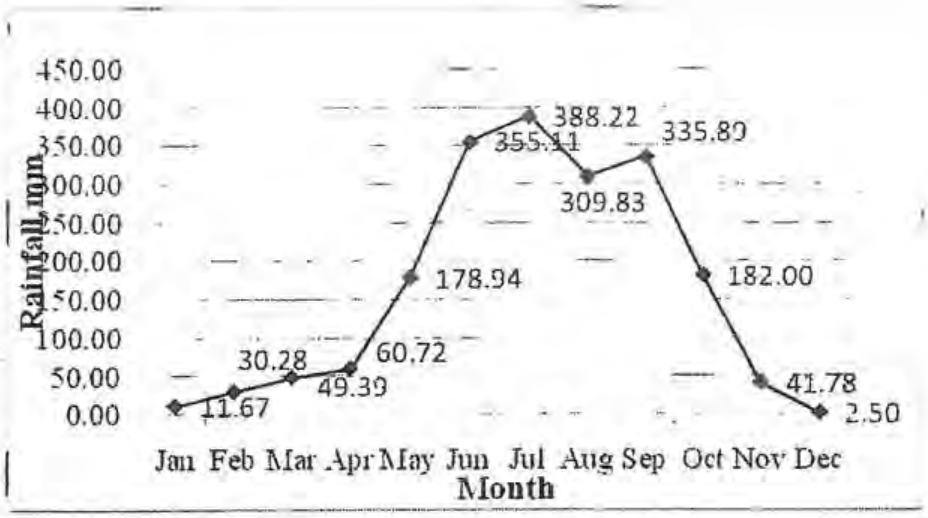


The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



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).

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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 Possur 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:

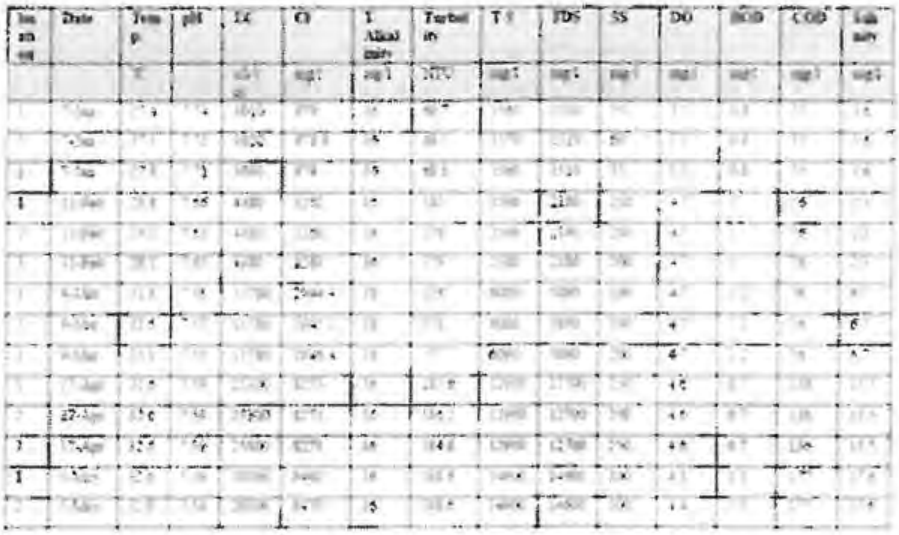


Figure 1 Water quality of the Passur River at Mongla point (Source: EIA-Report)

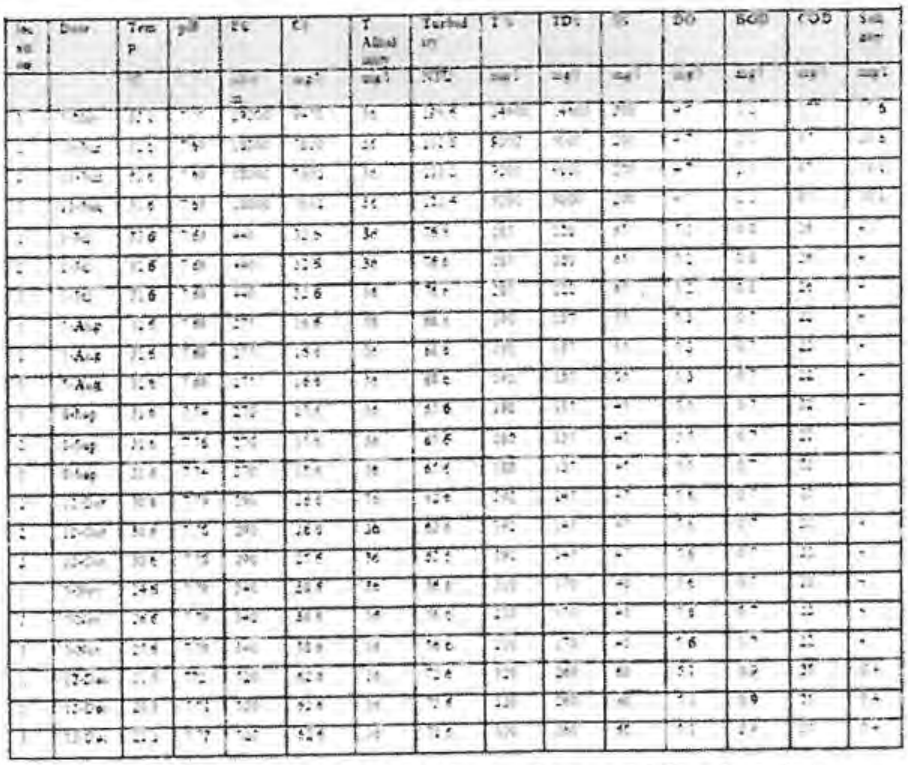
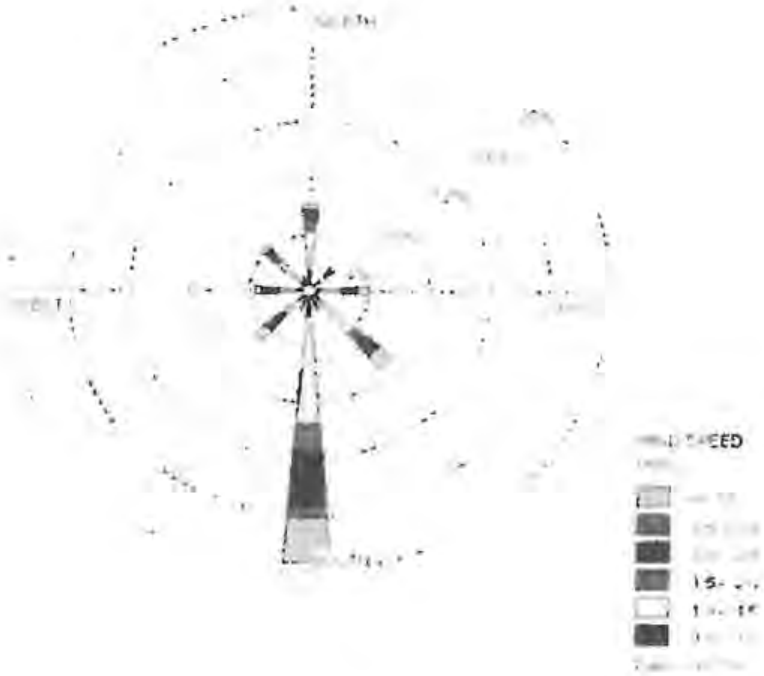


Figure 2 Water quality of the Passur River at Mongla point (Source: EIA-Report)

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:

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

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

- $F_{MCR\text{-}PF\text{-}RSC}$ 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.:

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

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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 star-up transformer losses.

B0.2.9.5 Plant availability

The Contractor shall:

a. design and configure all components of the Plant
b. propose spare parts stock and
c. 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:

a. It shall be capable of following the daily and seasonal demand profile of the electrical network.
b. Full compliance with the conditions of the admissible air pollution is required within the power range.
c. 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 ± 10% /min;
- ramp rate: Minimum ± 3%/min (MNCR to 50% BMCR); Minimum ± 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 Tenderershall 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.

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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;

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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.

b. Manual synchronising facilities, with such check facilities shall be provided as a minimum for all circuits except for station/service transformer circuits.

c. The Facility shall be provided with a central on-site control room (CCR) so that operators can control the generators and perform switching and load dispatch duties. A Distributed Control System (DCS) shall be provided to coordinate the control and supervision of the Facility including half hourly Dependable Capacity correction for Reference Site Condition

d. The Facility shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from Load Dispatch Center.

3.5 Electrical Protection, Communication Instrument Systems

The Facility shall incorporate a protection system for generators, generator transformers, service transformers, and station electrical distribution systems as per Prudent Utility Practice.

Communication, control, monitoring, and voice channels will be provided between the Facility and BPDB's National/Regional Control Center by BPDB. The Company shall provide interconnection within the Facility for all such communication circuits/channels.

3.6 Power Tariff Metering

a. The Metering System to be installed at the Facility shall include tariff metering and indicative metering.

b. For each unit, the measurements, which are used for calculation of the main tariff metered energy, are taken at the outgoing side of the interconnecting lines (main and check) and Back-Up Metering System on the high voltage side of each generator transformer and station transformers, as applicable. The tariff meters installed will measure the net energy sent out from the facility. As provided in Section 12.1, the Back-Up Metering System shall also be of the same type and identical to the Metering System.

c. The tariff meters shall have separate facilities for recording the net inflow to the Facility and net outflow of energy from the Facility, and the aggregate of these parameters. This information shall be available for transmission to remote locations via the communication circuit to be provided by BPDB.

d. Sufficient indicative metering facilities will be installed to allow efficient normal operating and maintenance procedures and automatic control functions to be conducted at the Facility. The metering shall be logged by the Facility's DCS.

PPA Schedule 1: Technical Limits and Contracted Characteristics

1.3 Frequency, Power Factor and Voltage Limits

a. At rated voltage and frequency, the Facility will operate at 100% load with a power factor in the range 0.85 lagging to 0.95 leading at the generator terminals, which range shall not be exceeded. The curves from the manufacture(s) showing the Reactive Power capability of the generators form part of Schedule 2.

b. The Facility will operate within the line voltage range used in practice by BPDB and in no case shall the Facility be required to operate more than +5% or less than -10% on the 400 kV high voltage system.

c. The Facility shall operate within the frequency range 48.5 Hertz to 51.5 Hertz which range shall not be exceeded. The Facility shall be capable of continuous operation for the periods defined in Table 3,

Table 3: As per PPA

Frequency Range (Hz)	Minimum Sustainable Operation
48.5 to 51.5	Continuous
47.5 to 48.5	10 minutes
Less than 47.5	Trip Condition
Greater than 51.5	Trip Condition

B0.2.11.2 Essential Requirements of Electricity Grid Code of the Bangladesh Energy Regulatory Commission

In this chapter essential requirements for the grid connection and Plant operation are extracted from the BGC. For ease of reference, the relevant chapters/articles of the BGC are mentioned in brackets.

The full compliance with the BGC shall be proven by electrical system studies and investigations.

It is to be emphasized that there are some discrepancies between the requirements of the BGC and the requirements of the International Electrotechnical Commission Standard IEC 60034. In case of contradictions the requirements and stipulations of IEC 60034 shall prevail.

The Tenderer shall discuss all deviations from the grid connection conditions, which will result in an economic advantage for the investment and the operation of the Plant.

B0.2.11.2.1 System performance (Section 5.4)

Each generating unit shall be capable of generating at full rated power output within following ranges:

	From	To
Frequency	47 5 Hz	52 Hz
Rated Voltage	-10%	+ 10%
Power factor	0.85 lagging *)	0.95 leading

*) This value deviates from the BGC and is chosen as common for generator of this size.

The Transmission System frequency shall normally be 50.0 Hz and shall normally be controlled in the range 49.0 – 51.0 Hz (50 Hz ± 2%). The User shall however be subject to the grid discipline directed by the Commission.

Voltage variation on the Transmission System shall normally be +/- 10% during emergencies and +/- 5% during normal operation, in accordance with the provisions of Planning and Security Standards for Transmission System. Insulation coordination of the **Users'** equipment and rupturing capacity of switchgear shall conform to applicable Bangladesh Standards/Codes.

Protection schemes and Metering schemes shall be as detailed in the Protection & Metering Sections of the Code.

For new Power Stations the equipment within their site for data transmission and communications shall be owned and maintained by the respective Generator.

B0.2.11.2.2 Connection point (Section 5.6.1)

Unless specifically agreed with the Licensee the Connection point shall be the outgoing gantry of Power Station switchyard. The metering point shall be at the outgoing connection point. All the substation equipment including Protection, Control and Metering equipment owned by the Generator within the perimeter of the Generator's site shall be maintained by the Generator. Other Users' equipment shall be maintained by the respective Users. From the outgoing feeder gantry onwards, the Licensee shall maintain all electrical equipment.

B0.2.11.2.3 Data requirements (Section 5.7)

Users shall provide the Licensee with data for this Section as specified in the Data Registration Section.

B0.2.11.2.4 Frequency management & responsibilities (Section 8.3 and 8.4)

Generators shall follow the dispatch instructions issued by the **NLDC**.

All Generating Units shall have the governor available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limit.

Under certain conditions the system frequency could rise to 52 Hz or fall to 47.5 Hz. All Generating Units should be capable of operating within the range and the **NLDC** informed promptly of any restrictions. **Generators** shall be responsible for protecting their Generating Units against damage should frequency excursions outside 52 Hz and 47.5 Hz ever occur. Should such excursions occur, the **Generator** should decide whether or not to disconnect his apparatus for reasons of safety of apparatus, Plant and/or personnel. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained rising frequency
Under rising frequency conditions, the **NLDC** shall take appropriate action to issue instructions to **Generators** to arrest the rising frequency and restore frequency within normal range. Such instructions may include reducing generated output or de-synchronizing Generating Units from the Transmission System. When the frequency rises above 51.0 Hz actions must be taken immediately by the **Generator**. Under such condition, the Generating Units which were responsible for seeing frequency of the system shall decrease their Generating Output at a rate of – (minus) 2% per 0.1 Hz for departure of frequency above 51.0 Hz until the frequency is restored within the normal range. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained falling frequency
Under falling frequency conditions, the **NLDC** shall take appropriate action to issue instructions to arrest the falling frequency and restore it to be within normal range. Such instructions may include dispatch instructions to **Generators** to increase output, to synchronize standby Generating Units to the Transmission System and/or instructions to Distribution Utilities to reduce load demand by appropriate manual and /or automatic load shedding.

When the frequency falls below 49.0 Hz the Generating Units which were responsible for seeing frequency of the system shall increase their Generating Output at a rate of + (plus) 2% per 0.1 Hz (if available) for departure of frequency below 49.0 Hz until the frequency is restored within the normal range. The **Generators** shall be responsible for protecting own units should frequency excursions occurs outside 47.5 to 52 Hz range. The **Generator** shall inform the **NLDC** immediately after taking such action.

All Generating Units that have been declared available shall be required to be synchronized and loaded in the event of the sustained low frequency below 49.0 Hz provided local and safety conditions permit. This action shall be performed without delay after failed attempts to contact the **NLDC**. The Generator shall inform the **NLDC** immediately after taking such action.

B0.2.11.2.5 Voltage management (Section 8.5)

The **Licensee** and **NLDC** shall carry out load flow studies from time to time to predict where voltage problems may be encountered and to identify appropriate measures to ensure that voltages remain within the defined limits. On the basis of these studies the **NLDC** shall instruct **Generators** to maintain specified voltage levels at interconnecting points.

The **Licensee** shall continuously monitor 400 kV/ 230 kV/ 132 kV transmission grid voltage levels at strategic substations. The **NLDC** and the Licensee shall regulate voltage levels within the prescribed levels.

The **NLDC** and the **Licensee** shall jointly take appropriate measures to control Transmission System voltages that may include but not be limited to transformer tap changing and use of MVAR reserves with Generating units within technical limits agreed to between the **NLDC**, **Licensee** and Generating units.

All Generating Units shall have Automatic Voltage Regulator (AVR) in service.

Generators shall inform the **NLDC** of their reactive reserve capability promptly on request. **Generators** shall make available to the **NLDC** the up-to-date capability curves for all Generating Units, as detailed in **Section 5**, indicating any restrictions, to allow accurate system studies and effective operation of the Transmission System.

B0.2.11.2.6 Monitoring of generation (Section 8.7)

For effective operation of the Transmission System, it is important that a **Generator's** declared availability is realistic and that any departures are continually fed back to the **Generator** to help effect improvement.
The monitoring by the **NLDC** of Generating Unit output, and active and reactive reserve capacity, shall be carried out to evaluate the reliability and performance of plant.

The **NLDC** shall continuously monitor Generating Unit outputs and bus voltages (by SCADA). More stringent monitoring may be performed at any time, as detailed in the Testing Section, when there is reason to believe that a **Generator's** declared availability may not match the actual availability or declared output does not match the actual output.

Generators shall provide to the **NLDC** hourly generation summation outputs where no automatically transmitted metering or SCADA equipment exists.

The Generator shall provide other logged readings that the **NLDC** may reasonably require, for monitoring purposes where SCADA data is not available.
Generators shall submit data to **NLDC** as listed in Data Registration Section, termed as Frequency and Voltage Management.

B0.2.11.2.7 Contingency planning (Section 9)

Total System Blackout (Section 9.3.1)
NLDC shall instruct all relevant Generators having Power Stations with Black Start capability to commence their pre-planned Black Start procedure.

Remark: The Maitree-STPP shall **not** have Black Start capability.

Partial Transmission System Blackout (Section 9.3.2)
NLDC shall ensure with the **Licensee** and **Users** that security of the healthy part of the Transmission System is maintained.

NLDC and the **Licensee** shall gradually extend the healthy system to provide start-up power to appropriate Generating Units.

NLDC and the **Licensee** with close coordination with Distribution Utilities and **Generators** shall gradually restore demand to match generation as it becomes available.

All **Users** shall take care to ensure load generation balance is maintained at all times under **NLDC's** direction.

Special Consideration (Section 9.5)
During the restoration process following Transmission System blackout conditions, normal standards of voltage and frequency shall not apply.

B0.2.11.2.8 Protection (Section 12)

General Principals (Section 12.3)
No item of electrical equipment shall be allowed to remain connected to the Transmission System unless it is covered by appropriate protection aimed at reliability, selectivity, speed and sensitivity. Guidelines mentioned in protection manuals may be kept in view.

All **Users** shall co-operate with the **Licensee** to ensure correct and appropriate settings of protection to achieve effective, discriminatory removal of faulty equipment within the time for target clearance specified in this Section.

Protection settings shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of all affected Users. In the case where protection is bypassed and/or disconnected, by agreement, then the cause must be rectified and the protection restored to normal condition as quickly as possible. If agreement has not been reached the electrical equipment will be removed from service forthwith.

Fault Clearance Times (Section 12.5)

From a stability consideration the maximum fault clearance times for faults on any **User's** system directly connected to the Transmission System, or any faults on the Transmission System itself, are as follows:

Target Clearance Times:

i. 400 kV : 100 ms
ii. 230 kV : 160 ms
iii. 132 kV : 160 ms.

Slower fault clearance times for faults on a Users system may be agreed to but only if, in the **Licensee's** opinion, system conditions allow this.

Generator Requirements (Section 12.6)

All Generating Units and all associated electrical equipment of the **Generator** connected to the Transmission System shall be protected by adequate and coordinated protection so that the Transmission System does not suffer due to any disturbance originating from the Generating Unit.

In the event of failure of the protection systems provided to meet the fault requirements detailed above, backup protection shall be provided by the **Generator** with a fault clearance time not slower than 400ms for faults on the Generating Unit's HV connections. The protection shall also cover EHV lines and transformers to the standards as for the Transmission System and circuit breaker fail, pole slipping, loss of excitation, power system stabilizer and negative phase sequence tripping.

Transmission Line Requirements (Section 12.7/12.7.1/12.7.3)

Every 400 kV Line and 230 kV Line taking off from a Power Station or a substation shall have main protection and backup protection as mentioned below. The **Licensee** shall notify **Users** of any changes in its policy on protection from time to time.

- Two distance protections plus directional earth-fault protection (in directional comparison scheme) shall be provided as the Main-1 and Main-2 protection respectively.
- One stand alone directional 3-phase or 2-phase over-current relay and one directional earth-fault relay shall provide the backup protection.
- Three pole and/or single pole single shot auto-reclosing equipment shall be fitted, as appropriate, as considered by the licensee. All auto-reclosing equipment will be made inoperative for three phase trip-out and/or back-up protection operation.

- Both distance and directional earth-fault functions shall have compatible communication aided transfer trip scheme.

For short transmission lines Line Differential Protection along with backup Directional normal, Directional time-lag and/or Non-Directional Over-current and Earth-fault protection shall be provided as an appropriate protection scheme.

Relay Panels for the protection of lines of the **Licensee** taking off from a Power Station shall be owned and maintained by the **Licensee**. **Generators** shall provide space, connection facility and access to the **Licensee** for such purpose.

The **Generator** shall ensure that all common facilities needed for installing required protective relaying are made available to the Licensee.

Transformer Requirements - Generating Station/Transmission System (Section 12.9.1)

All windings of auto-transformers and power transformers of EHV class shall be protected by differential relays and REF relays as main protection. In addition there shall be one backup time lag 3-phase Over-current and Earth-fault protection relay. For parallel operation such backup protection shall have directional feature. For protection against heavy short circuits, the Over-current and Earth-fault relays should incorporate a high set instantaneous element. In addition to electrical protection, gas operated relays, winding temperature protection and oil temperature protection shall be provided. Over-voltage, thermal overload and over-fluxing protection should also be provided.

Substation Busbar and Fire Protection (Section 12.10.1/12.10.2)

All **Users** shall provide adequate main and backup bus zone protection incorporated with Local Breaker Backup (LBB) or Breaker Fail Protection (BFP) for busbars in all 400 kV, 230 kV and 132 kV class substations.

Adequate precautions shall be taken and protection shall be provided against fire hazards to all Apparatus of the Users conforming to relevant Bangladesh Standard Specification and/or provisions in the Electricity Rules, 1937 and amendments thereof and other standard engineering practices.

Data Requirements (Section 12.11)

Users shall provide the **Licensee** with data for this Section as specified in the Data Registration Section.

B0.2.11.2.9 Testing (Section 14)

Introduction (Section 14.1)
This Section specifies the responsibilities and procedures for arranging and carrying out Tests which have (or may have) an effect on the Transmission System or the **Generator's** or **Distributor's** systems.

Objective (Section 14.2)
The objective of the Section are to establish whether Generating Units can operate within their Generation Schedule and Dispatch parameters as registered under the Data Registration Section and that the Generator and Distributor comply with the Connection Section. It shall also establish whether each Generating Unit's declared availability capacity is as declared and that the requirements of the provisions of frequency, voltage management and reserve capability are met in accordance with the provisions of the Grid Code.

B0.2.11.2.10 Performance standards for transmission (Section 17)

Purpose and Scope (Section 17.1.1/17.1.2)
Purpose:

a) To ensure the quality of electric power in the Grid.
b) To ensure that the Grid will be operated in a safe and efficient manner and with a high degree of reliability; and
c) To specify safety standards for the protection of personnel in the work environment.

Scope of Application:
This Chapter applies to all Grid Users including:

a) the Licensee
b) the System Operator/ NLDC
c) generators
d) distribution utilities, and
e) any other entity (e.g. owners of HVDC converter, large furnaces, etc.) with a User System connected to the Grid.

Power Quality Standards (Section 17.2)
Power Quality Problems (Section 17.2.1)
For the purpose of this Article, Power Quality shall be defined as the quality of the voltage, including its frequency and the resulting current that are measured in the Grid during normal conditions.

A Power Quality problem exists when at least one of the following conditions is present and significantly affects the normal operation of the System:

a) The System Frequency has deviated from the nominal value of 50 Hz.
b) Voltage magnitudes are outside their allowable range of variation.
c) Harmonic Frequencies are present in the System
d) There is imbalance in the magnitude of the phase voltages.
e) The phase displacement between the voltages is not equal to 120 degrees.
f) Voltage Fluctuations cause Flicker that is outside the allowable Flicker Severity limits, or
g) High-frequency Over-voltages are present in the Grid.

Frequency Variations (Section 17.2.2)
The nominal fundamental frequency shall be 50 Hz. The control of System frequency shall be the responsibility of the System Operator. The System Operator shall maintain the fundamental frequency within the limits of 49.0 Hz and 51.0 Hz during normal conditions.

Voltage Variations Section 17.2.3)
For the purpose of this Section, Voltage Variation shall be defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal value, expressed in percent. Voltage Variation will either be of short duration or long duration.

A Short Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one-half cycle of the power frequency but not exceeding one minute. A Short Duration Voltage Variation is a Voltage Swell if the RMS value of the voltage increases to between 110 percent and 180 percent of the nominal value. A Short Duration Voltage Variation is a Voltage Sag (or Voltage Dip) if the RMS value of the voltage decreases to between 10 percent and 90 percent of the nominal value.

A Long Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one minute. A Long Duration Voltage Variation is an Under-voltage if the RMS value of the voltage is less than or equal to 90 percent of the nominal voltage. A Long Duration Voltage Variation is an Overvoltage if the RMS value of the voltage is greater than or equal to 110 percent of the nominal value.

The Grid Owner and the System Operator shall ensure that the Long Duration Voltage Variations result in RMS values of the voltages that are greater than 95 percent but less than 105 percent of the nominal voltage at any Connection Point during normal conditions.

Harmonics (Section 17.2.4)
For the purpose of this Section, Harmonics shall be defined as sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency. The Total Harmonic Distortion (THD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the fundamental quantity, expressed in percent.

The Total Demand Distortion (TDD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the rated or maximum fundamental quantity, expressed in percent. The Total Harmonic Distortion of the voltage and the Total Demand Distortion of the current at any Connection Point shall not exceed the limits given in Tables 17-1 and 17-2, respectively.

Harmonic Voltage Distortion

Voltage Level	THD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	1.5%	1.0%
66 kV	3.0%	2.0%	2.0%

* Total Harmonic Distortion

Table 17-1: Maximum Harmonic Distortion Factor

Harmonic Current Distortion

Voltage Level	TDD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	2.0%	0.5%
66 kV	5.0%	4.0%	1.0%

* Total Demand Distortion

Table 17-2: Maximum Harmonic Distortion

Voltage Unbalance (Section 17.2.5)
For the purpose of this Section, the Negative Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the negative sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. For the purpose of this section, the Zero Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the zero sequence components of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. The maximum Negative Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

The maximum Zero Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

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Voltage Fluctuation and Flicker Severity (Section 17.2.6)
For the purpose of this Section, Voltage Fluctuations shall be defined as systematic variations of the voltage envelope or random amplitude changes where the RMS value of the voltage is between 90 percent and 110 percent of the nominal voltage. For the purpose of this Section, Flicker shall be defined as the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

In the assessment of the disturbance caused by a Flicker source with a short duty cycle, the Short Term Flicker Severity shall be computed over a 10-minute period. In the assessment of the disturbance caused by a Flicker source with a long and variable duty cycle, the Long Term Flicker Severity shall be derived from the Short Term Flicker Severity levels.

The Voltage Fluctuation at any Connection Point with a fluctuating demand shall not exceed one percent (1%) of the nominal voltage for every step change, which may occur repetitively. Any large Voltage Fluctuation other than a step change may be allowed up to a level of three percent (3%) provided that this does not constitute a risk to the Grid or to the System of any User. The Flicker Severity at any Connection Point in the Grid shall not exceed the values given in Table 17-3.

	Short Term	**Long Term**
132 kV and above	0.8 unit	0.6 unit
below 132 kV	1.0 unit	0.8 unit

Table 17-3: Maximum Flicker Severity

Transient Voltage Variations (Section 17.2.7)
For the purpose of this Section, Transient Voltages shall be defined as the high-frequency Over-voltages that are generally shorter in duration compared to the Short Duration Voltage Variations. Infrequent short-duration peaks may be permitted to exceed the levels specified in Section **17.2.4** for harmonic distortions provided that such increases do not compromise service to other End-users or cause damage to any Grid equipment. Infrequent short-duration peaks with a maximum value of two (2) percent may be permitted for Voltage Unbalance, subject to the terms of the Connection Agreement or Amended Connection Agreement.

B0.2.11.2.11 House load operation (not requested by the Grid Code of Bangladesh)

Each Unit shall successfully go to house load operation in the event of disconnection or complete isolation of such Unit from the Grid.
Each Unit shall be capable of performing house load operation up to a maximum of 2 hours. A Unit that has achieved house load operation shall not be shut down without the prior consent of the NLDC.

1. Within such time, each Unit on house load operation shall be ready to be resynchronized to the Grid System and able to increase output in the usual manner.
2. In the event the Grid System is not energized, each Unit on house load operation shall have the capability to energize a dead bus and to start the other Unit, when instructed by the NLDC. Subsequently, upon instruction by the NLDC, such Unit shall be able to increase output in the usual manner.

B0.2.12 Facility technical limits

The following sections describe the minimum requirements regarding the facility.

B0.2.12.1 Unit start

The facility shall be able to achieve the following operating levels within the same period (in minutes) specified in the following table.

Conditions	Boiler firing to turbine start	Steam turbine start to synchronous	Notice to start to steam turbine synchronous	Synchronous to full load	Total
Cold start after more than 48 hrs outage	TBD	TBD	12 hours	TBD	TBD
Warm start after 8 to 48 hrs shutdown	TBD	TBD	4 hours	TBD	TBD
Hot start after 8 hrs shutdown	TBD	TBD	3 hours	TBD	TBD

Table B0-3: Required start-up times (minutes)[1]

[1] To be determined by the Tenderer

B0.2.12.2 Despatch ramp rates

Ramp rates of 3%/min to 5%/min are expected for the Power Plant when operating between 30% and 100% BMCR. Ramp rates of less than 5%/min are subject to Employer's approval.

The facility shall be able to achieve the following despatch ramp rates as specified in the following table:

Despatch ramp rates		**(Excluding Pulverizer changing over time)**	
		Loading (MW)	**Ramp rates (MW/min)**
Cold start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 600	TBD
Warm start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 600	TBD
Hot start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 600	TBD

Despatch ramp rates (per Unit) [2]

B0.2.13 Environmental impact requirements

Air pollution

The permissible exhaust gas emissions shall comply with the stipulations of the generating license granted. Compliance for the following pollutants shall be guaranteed and proved:

Emission	**Unit**	**Maximum Threshold**
Total PM	mg/m^3	50
Sulphur dioxide (SO_2)	mg/m^3	200
Nitrogen oxide (NOx)	mg/m^3	510

Table B0-5: Emission limits

Note:

NO_x refers to oxides of nitrogen, referenced to NO_2.

Reference conditions for NO_x, SO_2, and particulates are 6 % O_2, dry (i.e. zero moisture), 0 °C and 1013 mbar atmospheric pressure

[2] To be determined by the Tenderer

The stack height shall follow the requirements of the Environment Conservation Rules, 1997 of Bangladesh.

Water pollution
Permissible emission limits for aqueous discharges into the river via the Plant Water Discharge System shall comply with the Waste Water Effluent Standards, see Technical Schedule of **Section B0** and IFC EHSG - TPP - Table 5 - Effluent Guidelines. If there are differences in effluent limits in the two guidelines the more stringent limit should be applied..

The findings of the Environmental Impact Assessment (EIA) shall be used for Plant design.

Other waste water which is not allowed to be discharged to the requirements waste water treatment plant will have to be disposed externally.

Soil contamination
The Plant should be designed, operated and maintained in such a way to prevent any soil contamination by oil and chemical spillage during subsequent operation and maintenance of the Plant.

Permissible noise levels
The Plant shall be designed and constructed inter alia in accordance with IFC Environmental, Health and Safety Guideline Thermal Power Plants (EHSG-TPP) to reduce the operating noise level as much as possible. No individual within the boundary of the Site shall be exposed to a noise level exceeding the limits stated in the EHSG-TPP and "The Sound Pollution (Control) Rules, 2006".
Far field noise under normal operation of the Plant measured along the Site boundary of the Plant towards the Township shall not exceed 50 dB(A) during daytime and 40 dB(A) during night-time.
For any other point of the Site boundary of the Plant the noise pressure level shall not exceed 60 dB(A) during daytime and 50 dB(A) during night-time. Day time is defined from 6:00 am to 9:00 pm. Night time is defined from 9:00 pm to 6:00 am.

During the engineering phase the Contractor shall award an independent Third Party to conduct noise propagation calculation to prove that the permissible noise levels at the Plant boundary are met.

In addition the statutory requirements of Bangladesh shall be followed as far as stricter as the other standards, such as EHSG-TPP.

Furthermore the following maximum noise pressure levels shall be not exceeded:

	dB(A)
• At 1 m distance from equipment/enclosures	85
• Within turbine building	90 (Note 1 & 2)
• Steam generator	90 (Note 1)

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- Within central control rooms in power plants 55.

Notes:

1. At normal operation
2. Generally at maximum 88 dB(A), exceptions are the turbine stop valve and control valves 95 dB(A) and turbine drive boiler feed pumps 97 dB(A).

High noise areas (areas with noise levels >85 dB(A)), which require that personal noise protecting gear shall be used when working in such high noise areas, shall be marked.

Electromagnetic Field (EMF)
In accordance with the EHSG-TPP the occupational EMF exposure shall be prevented or minimized.

All technical measures and the required equipment necessary to fulfil the EHSG-TPP shall be provided by the Contractor. Inter alia areas with expected elevated EMF levels shall be indentified and marked.
Fire and explosion, electrical and chemical hazards
In accordance with the EHSG-TPP all technical measures to prevent, minimize and control physical, electrical and chemical hazards shall be include in the Contractror's scope of services and supplies.

B0.3 Supplies and Services

B0.3.1 General

The scope of this specification covers all supplies and services required for meeting the purpose of the Plant, even if these are not expressively mentioned in the following.

The works include the following main components, where the detailed scope of supply is given in the corresponding Sections as listed below:

- **Section B1**: Steam generator plants
- **Section B2**: Steam turbine generator plants
- **Section B3**: Air and flue gas systems
- **Section B4**: Fuel and Ash handling system
- **Section B5**: Plant Water and Cooling Systems
- **Section B6**: Water treatment systems
- **Section B7**: Electrical works
- **Section B8**: Instrumentation and control works
- **Section B9**: Civil Works
- **Section B10**: Electrical Works 400/230 kV Substation
- **Section B11**: Jetty

- **Section B12:** Auxiliary plant systems

The corresponding Annexes and Attachments are contained in **Part C**.

The relevant costs of these supplies and services to be given in the price schedules are to be assigned corresponding to the individual items concerned for each of the sections. The costs of the common equipment and services have to be included in the corresponding Section prices.

B0.3.2 Scope of engineering services

The Engineering services refer to the complete specified Plant and covers following services:

- **Basic and detail engineering**

- **Permit engineering**
  The Contractor shall actively participate in drawing-up of all required licensing applications.

  All services shall be performed by the Contractor to affect the required permits to commence the works and operate the Plant, including but not limited to:

  - preparation of all documents as required according to the pertinent laws
  - clarifications with authorities
  - participation in all clarification meetings
  - construction permits
  - boiler and pressure vessel approvals
  - water/waste water permits
  - operation permits
  - fire fighting approvals
  - and all other services as required.

Furthermore, all other required engineering and other services to meet the purpose of the Project and the agreed project time schedule shall be executed by the Contractor.

B0.3.3 Deputation of Engineers during the Warranty Period

At least three(3) English speaking engineers (mechanical, electrical and I&C),with adequate knowledge and experience of coal power plant of type and technology being provided here from the Contractor, shall be permanently at site during the Warranty Period (that means until Final acceptance of the entire Plant / last unit of the Plant, as the case may be). They shall be competent to advise and lead the Employer's staff on all aspects of engineering, operation and maintenance.

B0.3.4 Common equipment and services

The following supplies and services are to be included in the corresponding Section prices:

B0.3.4.1 General

- Material and personnel costs for tests and inspections which are mandated in legislation
- Material and personnel costs for site inspections
- Declaration of conformity with requirements from Bangladesh and markings for all machines
- Engineering design of complete supplied equipment including interface coordination
- All as-built documents (on data carriers; data formats as requested by the Employer)
- Quality control plan and safety plan
- Complete documentation as set out in the tender specification
- Operating manual (5 hardcopies and 3 electronic copies)
- Detailed operating and maintenance instructions/manual (5 hardcopies and 3 electronic copies)
- A maintenance program for all equipment of the Plant instructions (5 hardcopies and 3 electronic copies)
- For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDs shall be supplied in ACAD or other editable format, and all lists in Excel format.
- All insurances, such as, but not limited to:
  - transport insurance, incl. marine cargo insurance
  - installation all risks,
  - third party liability,
  - automobile liability,
  - M.V. Policy for: motor vehicles, private cars & commercial vehicles,
  - CPM policy for heavy construction equipment,
  - Workmen's Compensation,
  - Employer's liability,
  - Group personal insurance, for contractor's & subcontractor's employees.

B0.3.4.2 Mechanical

- All necessary pipelines, valves, actuators
- All required line warm-up systems
- All connection and adaptation works for tie-in into general supply systems
- All necessary vents, drains and rinsing connections as well as tundishes with covers, as far as possible aggregated to common groups of on operating level
- All connection elements, screws, bolts, nuts, including gaskets and seals as necessary
- All temporary installations required for tie-in measures including post-weld heat treatment complete etc.
- All temporary pipework as required during connection measures
- Check of required existing structures, plant components and systems and their rehabilitation where they lie within the scope of supply, or definition of required measures in good time if they lie outside of the scope of supply
- All necessary support structures, hangers etc.
- All necessary base frames, mounting plates, grouted in parts, rag bolts, covers etc.
- All required steel parts embedded in concrete
- All couplings and coupling guards for electric motors and other drives
- All necessary lifting equipment and hoists (hooks and provisions for chain blocks to be provided for repair work where loads exceed 50 kg, hoists to be provided for repair work where loads exceed 200 kg, and electrical operated hoist for loads exceeding 2,500 kg)
- Required safety equipment, pressure relief valves etc.
- All thermal and noise insulation including cladding as well as any other noise attenuation measures
- Stairways, ladders, platforms, galleries and walkways to all plant components, including escape routes as necessary
- All necessary steel structures, stairs, ladders on platforms weather protection
- All required ventilation or air conditioning equipment for safe operation of mechanical and electrical equipment, to be supplied
- All necessary corrosion protection measures for plant components and equipment stored or mounted on site up to the time of reliability test run
- Complete primer and top coatings conforming to colour code, clarified with the Employer
- Necessary noise abatements measures
- All required freeze protection and electric trace heating for outdoor installations
- Complete labelling of all plant components according to the Employers system and in plain language
- All fire protection measures

- All necessary lubrication systems
- Initial lubricant filling and sufficient lubricants for commissioning and reliability test run, minimization of lubricant types by screening and coordination with the Employer
- Water and demineralised water for pre-commissioning and commissioning activities,
- Provision of all connections and temporary pipework for acid cleaning, steam purging of the live steam line and flushing / cleaning of systems as necessary
- Flushing of all other lines including disposal of the effluents; protection with wood and/or plastic at all instrumentation and appendages to be installed during construction
- All standard accessories and auxiliary equipment which normally form part of the scope of supplies
- All necessary tests, inspections and works acceptances as well as all certificates and reports of these
- Exchange of filter elements following reliability test run
- Removal of temporary strainers
- Valve trims for purging and subsequent exchange
- Removal of any unused material
- Scaffolding for all work above ground level
- Necessary connection points for on line condition-based monitoring equipment.

B0.3.4.3 Substation control and monitoring system

At least but not limited to:

- all field equipment such as bay control units, bay protection equipments (described under chapter "Substation Control and Monitoring System) to be installed at the substation. The field equipment for the substation shall be interconnected by separate IEC 61850 fiber optic station busses in ring configurations
- all equipment to control and monitor the auxiliary equipment of the substation connected to the SCMS by redundant fiber optic links
- common bay unit / station computers
- operator and engineering workstations with TFT monitors and printers to be installed at the substation control room
- all equipment necessary for the implementation of an OPC server/client architecture between the substation and the Power Plant control rooms in order to allow the supervision and monitoring of the substation from the Power Plant DCS facilities. The OPC-server configuration shall be redundant
- Maintenance / service laptop which shall also be used for protection and disturbance analysis by respective log-in.
- data communication gateway to the National Load Dispatch Center (NLDC),

- energy meters for active energy (kWh) with accuracy of 0.2 S and for reactive energy (kVarh) with an accuracy of 0.5 S for tariff metering shall be provided for each outgoing line.

B0.3.4.4 Electrical

- All necessary electrical drives
  - complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
  - All required junction boxes and cubicles
  - All field control boxes
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Complete labelling of electrical equipment (also inside of cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.
- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials
- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.,
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials
- All necessary compression connectors.

B0.3.4.5 Instrumentation and Control

- All necessary control systems and auxiliaries
- All measurements and field control loops (thermometers, pressure gauges, transmitters, sensors, analyzers, local regulating devices, etc.) as well as all instruments for reliability test and checks for the duration of the performance tests
- Other special instruments/ systems like acoustic steam leak detection system (ASLD), acoustic pyrometer, communication systems, ambient air quality monitoring system (AAQMS), effluent quality monitoring system (EQMS)
- Complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
- All required junction boxes and cubicles

- All field control boxes
- All instruments mounted on instrumentation racks
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Signal exchange between local control system and DCS as well with instruments/control systems of other lots
- Complete labelling of I&C-equipment (also inside of control cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Clarification of all logic interconnections: sequence, interlocking, protection, safeguarding for coordinated operation/start-up/shut down of individual items of equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.
- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials
- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials.

B0.3.4.6 Civil

- All necessary surveying works including all soil investigations required for safe and reliable design and construction
- Preparation of site, demolition works, removal of underground obstacles
- Earthworks, drainage, excavation and refilling works
- Piling of structures to prevent subsidence
- Concrete and reinforced concrete works, masonry and earthing
- Concreting of maintenance platforms and lay-down areas
- Water proofing works for pressing and non-pressing water
- Fire protection during construction
- Roofing; non asbestos
- Plumbing
- Facade works/glazing works; non asbestos
- Non-load bearing walls/installation partitions/dry construction works
- Metalwork and blacksmith work/raised flooring/doors and gates/sheet metal work
- Flooring work
- Fire protection with plumbing; fire protector

- Painting/varnishing
- Craneway works
- Room air conditioning systems, where required, e.g. control cubicle rooms, etc.
- Potable water, service water and waste water
- Housekeeping during construction
- Staff facilities during construction
- Transport of all dumping material to dump locations
- Performance and interpretation of soil bearing tests
- Temporary fencing of construction site
- Site offices for Employer and Employer's representatives
- The Contractor's site office
- Landscaping of areas required under this contract.

B0.3.5 Packaging and transportation

- Suitable packaging and transportation of the entire scope of supplies,
- free construction site, on-site transportation and temporary storage including inspections and, if necessary, ensuring the prerequisites for transportation
- Disposal of packing and transportation material
- Customs clearance
- Crane or hoisting facilities at seaport and site
- Transportation to site
- Unloading at site.

B0.3.6 Erection, commissioning and testing

- Complete erection of the scope of supply up to operational readiness: This includes mobilization and provision of the required supervisory staff, skilled and unskilled personnel, as well as of installation scaffolding, cranes, hoists, equipment and materials, personnel accommodation, prescribed tests and inspections.
- Commissioning and optimization of all plant components as well as conducting all necessary measurements.
- Supervision of erection, commissioning and Reliability Test Run of complete supplied equipment.
- All testing as specified.

B0.3.7 Training

The Contractor shall provide comprehensive training for Employer's engineering, operating and maintenance staff (Employer's staff) covering all aspects of the Power Plant equipment and systems and operation and maintenance.
The Contractor shall train, instruct and supervise the Employer's staff to an adequate standard of knowledge and capability for good trouble shooting,

repair and of the plant equipment as well as to an adequate standard for safe and efficient commercial operation of the Plant.

The training shall at least include:

- training at manufacturer's works during the assembly of the major plant items
- classroom and hands on training
- on the job training during erection, commissioning and reliability test run; and
- simulator training.

The Contractor shall submit the training plan for the classroom, on the job and simulator training including schedule, place, content of lectures etc. for the Employer's approval no less than six (6) months in advance to the cold commissioning.

Post training assessment shall be carried out and documented. In case the results are below expectations (to be agreed upon by both Contractor and Employer before training) the respective training modules shall be repeated in an improved way.

B0.3.8 Spare parts, tools, appliances, and consumables

B0.3.8.1 Spare parts

The Tenderer/Contractor shall elaborate a maintenance and spare part concept which ensures that outage times are minimized and that the required availability is met, in particular considering all those components which are not redundant.

An "Initial Spare Part List" shall be provided with the Bid. The "Initial Spare Part List" shall contain all those parts which are required to operate maintain and repair the Plant efficiently and which are necessary to achieve the guaranteed availability during the warranty period (that means, 24 months from the date of PAC/COD). The "Initial Spare Part List" shall comprise therefore:

- the "Mandatory Spare Parts", which are required for the normal operation and scheduled maintenance / repairs of the Plant - that means, mainly the "wear and tear parts";
- the "Recommended / Strategic Spare Parts", which are in Tenderer's opinion and from Tenderer's experience required to minimize the outage of the Plant - that means, parts which are supposed by a Tenderer to breakdown during the Warranty Period, which may be required for unscheduled repairs, which will lead to outage of the a Unit or the Plant and which will have a longer delivery period.

The Tenderer shall provide details and prices for the "the Initial Spare Parts" by using the provided price breakdown. "The Initial Spare Parts List" shall be contained twice in the Bid: (i) un-priced in the techno-commercial bid, but comprising all technical details, and (ii) priced in the financial bid.

The cost of the "Initial Spare Parts" shall be excluded from the EPC Turnkey Lump Sum Price, but will consider for the financial Bid Evaluation.

In case a Tenderer fails to submit the "Initial Spare Part List" or if the "Initial Spare Part List" is consider by the Employer as non-compliant or insufficient, the Employer shall decide at its sole discretion either to reject the entire Bid as non-compliant or to apply the highest price for spares from the competitive Bids for the financial Bid Evaluation.

A "Final Spare Part List" (segregated as the "Initial Spare Part List") including all details, such as vendor's / original equipment manufacturer's (OEM's) name and location, drawings, normal delivery period, quantity, life time / service life, vendor's/OEM's serial numbers and price etc., shall be submitted by the Contractor to the Employer for approval not later than eighteen (18) months prior to the scheduled Commercial Operation Date (COD) / Issuance of the Provisional Acceptance Certificate (PAC) of the 1st unit.

The Contractor shall name three (3) vendors / OEMs with complete address for each of all required spare parts.

The Spare Parts Lists shall:

- specify fixed unit prices for the Spare Parts ("Initial Unit Prices"), and such fixed pricing shall remain valid until twelve (12) months prior to the COD of 1st Unit (the "Initial Spares Period"); and
- include an agreed indexation mechanism that shall be applied to the "Initial Unit Prices" following the expiry of the "Initial Spares Period", for the Employer's consideration and approval.

The Employer may order spare parts at the Initial Unit Prices at least twelve (12) months prior to the COD of the 1st Unit, and such Spare Parts shall be delivered in due time before the COD of the applicable unit.

Spare Parts shall remain available for order anytime during the first three (3) years commencing from the COD of each unit, at the Initial Unit Prices as adjusted pursuant to the indexation mechanism approved by the Employer.

However, the Employer shall have the freedom to decide at its sole discretion to purchase spare parts either from the EPC Contractor (according to the agreed unit prices as stated above) or directly from vendors/OEMs.

All spare parts before COD belong to the Contractor. That means, all spare parts required for commissioning, testing etc. of the Plant up to COD form part of the principal scope of supply and shall be not included in the spare parts lists.

Each item shall be labelled in English and be separately packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years storage in a dry weatherproof building.

The spare parts shall be placed in bins, racks, drawers, shelves, cabinets, etc. to be provided by the Contractor..

If during warranty period the Contractor is allowed to use spare parts from the spare part stock, the Contractor has the obligation to order new spare part at short notice and to replenish the spare part stock.

The Contractor shall not use any of the spare parts without written permission from the Employer.

B0.3.8.2 Tools and appliances

The following tools and appliances shall be supplied under this Contract for use by the Employer:

a. two (2) sets of all special tools and gauges required for the operation and maintenance of the Plant
b. one (1) set of special lifting and handling appliances required for the operation and maintenance of the Plant
c. suitable storage bins/racks/shelves for the above.
d. Standard tools according to the relevant Technical Schedules.

Each tool or appliance is to be clearly marked with its size and/or purpose.

The tools and appliances supplied may have been used for erection and commissioning purposes by the Contractor, but shall be handed over in good working order.

Each set of tools and appliances under category (a) and (d) shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the Plant and equipment in question. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle in this contract.
Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Employer/Engineer.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to high level equipment such as deaerators. Electrically operated hoists and runway trolleys shall be provided for all lifts in excess of 2.5 tons.

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Employer at the time of taking over of the unit.

Where the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

B0.3.8.3 Consumables

The Contractor shall supply all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to COD. All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.

All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and a number of different types shall be kept to a minimum. For each type and grade of lubricant recommended the Contractor shall list at least three equivalent lubricants manufactured by alternative companies.

The Contractor shall submit to the Employer the list and schedule of lubricants, greases, chemicals and consumables items including items qualities and quantities required per month of the Plant operation for the Employer's approval eighteen (18) months prior scheduled COD of the 1st Unit.

B0.3.9 Documentation

B0.3.9.1 Documentation with tender

General

- If a consortial bid is submitted, documents on the consortial agreement
- Description of options and alternatives offered
- Completely filled in price-, guarantee-, time-, and data schedules of the specification
- List of proposed makes and vendors
- Reference lists for delivery and installation of plants of similar type and size with separate references for the steam generator and steam turbine operating at same or similar parameters
- Requirements of grid code which cannot be met (if any)
- Description of means to accomplish primary frequency control according to grid code
- Description of means to accomplish secondary frequency control according to grid code
- Time schedule engineering for deliveries, erection/installation, commissioning and reliability test run
- Complete description of the Plant offered including description of the process and the equipment
- Layout drawings of the Plant
- Dimensioned drawings and sectional views of the principal plant components including materials
- Schematics of the principal plant systems
- General descriptions of individual systems and descriptions of operation including description of start-up, shutdown and emergency shutdown procedures
- All other documents necessary for comprehension of the offered plants and equipment
- Documents on the quality assurance system, including Quality Assurance Plan (The Quality Assurance Plan shall meet the requirements of ISO 9001:2000 and cover all activities under this FTS.)

- Training program and schedule for Employer's personnel
- Space requirement for lay down area, construction site and equipment
- List of personnel including qualification to operate the Plant and to perform day-to-day maintenance
- Initial Spare Part List as described under B03.7
- Equipment maintenance schedules for reliable centered maintenance.

Mechanical

- Process flow diagram of all systems
- Performance diagrams of main pumps and fans
- Plant and major equipment start-up curves for cold (all material on ambient temperature), warm and hot start up to MCR
- Water and waste water mass balances.

Steam Generator

Description for the equipment offered, giving information about:

- general outline of installation
- main control loops
- description of boiler protection system
- graphs showing the performance characteristic versus the load (flue gas temperatures, steam temperatures etc., including h-p-diagram)
- correction curves for ambient conditions and fuel variations
- material diagram showing material, dimensions, highest flue gas temperature and highest steam temperature, design material temperature and maximum admissible material temperature and design pressure for components of the steam/water system
- pulverizer performance diagram showing turn-down range of pulverizers and pulverizer outlet temperatures for different coal qualities.

Steam turbine generator

Description for the equipment offered giving information about:

- general outline of installation,
- main control loops,
- description of boiler protection system,
- conclusive correction curves for steam turbine and cooling system with variations in:
  - power output with ambient temperature, humidity and river water temperature
  - specific heat rate with ambient temperature, humidity and river water temperature
  - generator efficiency vs. power output for varying power factor
  - degradation curves for the power unit and the Plant
  - diagram showing the output of the turbine, of the generator and of the generator transformer versus the ambient air temperature (from +10 °C to +40 °C), humidity (between 20% and 100%) and river water temperature (from +20 °C to +35 °C).

Electrical system

- Electrical single-line diagram for the Power Plant including LV, emergency, safes AC and DC power supply
- Electrical single line diagram for the 400/230 kV GIS
- Unit protection and measuring single line diagram
- Performance diagrams (circle diagrams) of generator, saturation curves, unbalanced load diagrams
- Diagram with the output of the turbine, the generator and the generator step-up transformer versus ambient temperature
- Preliminary lists of motors and electrical consumers including power demand
- Auxiliary power requirement of the plant unit
- Arrangement of generator bus duct up to generator transformer, H.V and L.V. Cubicles, unit auxiliary transformer
- General arrangement of main electrical equipment within the relevant buildings, rooms, etc., including cross-sections
- Arrangement of connection from generator transformers to 400 kV GIS
- Arrangement of connection from start-up/stand-by transformers to 230 kV GIS General arrangement of the 400/230 kV GIS substation including the related control building and connection 400/230 kV interconnection transformers to 400 kV and 230 kV GIS
- Architecture drawing of the 400/230 kV substation control and monitoring system
- Description of the individual protection relays with related reference lists
- Description of the main electrical equipment (e.g. generator, excitation, AVR, generator protection, generator step-up and unit auxiliary transformer, start-up/stand-by transformer, 400/230 kV interconnection transformer, 400 kV reactors, 400/230 kV GIS, Substation Control and monitoring System, 400/230 kV protection systems, 11 kV switchgear, etc.)- with related reference lists.

Instrumentation & control system

- Control system architecture showing all components provided for this Plant in their actual structural arrangement
- Layout drawing central control room
- Description of hardware, software and design philosophy of the DCS
- Reference list for the DCS with indication of plant type, system architecture and size of the system
- Data sheets, descriptions and brochures of the offered BMS and BPS
- Data sheets, descriptions and brochures of the offered local control systems, in particular PLCs
- Data sheets, descriptions and brochures of the CEMS including (if applicable) common emission data evaluation devices
- Data sheets, description and brochures of the communication systems as specified in the relevant Sections of **Section B8**
- CCTV system philosophy description and configuration drawing

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- Data sheets, description and brochures of the training simulator as specified in the relevant Section of **Section B8**
- Temporary list of all drives, such as unidirectional motors, MOV's, SOV's and remotely operated control valves
- List of modulating controls
- List of package systems (black boxes)
- Description of field equipment
- Description of structure of the control functions including list of unit co-ordination level, functional group level, sub-group level
- Description of the interface to the boiler protection system and the steam turbine generator protection system
- Procedure for calculation of the availability of the DCS.

Civil

- Architectural outline drawings for all buildings and building structures showing the arrangement of the complete Plant, inclusive of all levels and Sections
- Site plan of the complete Plant showing all buildings, building elements, roads, landscaping etc.
- Schematic design of main buildings
- Typical concrete block pad and chimney foundation
- Typical pole foundation for HV towers
- Details, with calculations, for the main foundation system proposed
- Basic design of Site infrastructure
- Basic design of the chimney
- Basic detail of the coal storage yard
- Basic detail of the ash pond.

B0.3.9.2 Documentation after Award of Contract

The documents required for design, construction, installation, operation and maintenance of the entire Plant shall be submitted by the Contractor in good time so as to permit the Plant as a whole to be erected in compliance with the specified time table.

All documents, including the installation and operation and maintenance manuals as well as the related software shall be in fluent, legible English. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

The Contractor shall list all the drawings and submission schedule for the Employer's approval. Only the most important documents are listed below. These documents shall be submitted sufficiently in advance, so that corrections and amendments desired by the Employer as well as resubmission of the documents will not result in any delays with respect to the guaranteed time schedule. The Employer reserves the right to request from the Contractor additional drawings, documents, etc. as may be required

for proper understanding and definition of the design and engineering of the Plant.

The overall responsibility with regard to completeness, correctness and suitability for the permit application process remains with the Contractor. In no case any comment, correction, amendment and approval (if any) by the Employer shall relief the Contractor from this responsibility.

The drawings and documents to be submitted during this stage are listed in the various Sections and comprise the following. They shall be submitted within the specified time scale calculated in weeks after Award of Contract. Details shall be agreed according to the approval procedure for drawings and documents above.

The Contractor may propose modifications to the list as given below, in order to ensure timely completion of permit application documents and performance of the works according to the project's requirements and in accordance with the specified project time schedule. Any modification to this list shall be submitted for Employer's review and approval.

The Employer reserves the right to require detailed information on the progress of drawing and document preparation from the Contractor at any time during this stage.

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• **General**			
• Current list of drawings	I	4	every 1 month
• Complete list of documents with proposed submission deadlines	I	4	every 1 month
• Progress reports	I	-	every 1 month
• Erection and installation progress reports	I	-	every 1 month after start of site activities
• Quality assurance procedure and program	A	with Bid	24
• structure of Contractors QA&QC manpower at site	A	with Bid	24
• indicative field quality plan for civil works	A	with Bid	24
Plant layout		with Bid	16
• List of subcontractors/ manufacturers	A	with Bid	12
• Proposed inspection and testing programs	A	12	24
• Noise propagation calculations	A	-	24

Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Detailed program for commissioning	A	24	6 months ahead start pre-commissioning
• Studies / surveys regarding water intake and water discharge	A	12	24
• Detailed program of Reliability Test Run	A	24	6 months ahead start Reliability Test Run
• Detailed program of Performance Tests	A	24	6 months ahead start Reliability Test Run
• Testing documents/Report of results of all tests	A	2 weeks after test	6 months ahead start Reliability Test Run
• Training program	A	-	6 months ahead of pre-commissioning
• As-built-documentation including drawings of all equipment	A	-	1 month after COD of the 1st Unit
• Declaration of conformance with all local regulations	I	-	latest with start of pre-commissioning
• Spare part lists	A	with Bid	18 months ahead of COD of 1st Unit
• **Time scheduling**			
• Overall time schedule for design, manufacture, supply, assembly, erection and commissioning broken down for the principal plant components and all construction works, stating dates for completion of any preparatory work from others which may be necessary	A	with Bid	every 1 month
• Detailed erection, installation and commissioning schedule	A	12	2 months ahead of erection / pre-commissioning
• **Mechanical Engineering**			
• Arrangement drawings of principal components with ducts and platform layout	A	with Bid	12

Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Arrangement drawings of auxiliary equipment (cubicles, etc)	A	12	24
• Process flow diagrams	A	with Bid	12
• Piping and Instrumentation schematics and isometric drawings, including list of pipelines and valves, stating materials, nominal diameters and pressure, dimensions, insulation thickness of all pipes	A	8	24
•			
• Plans of main pipelines including location of cable routes	A	8	24
• Characteristics of pumps, fans etc.	I	16	24
• Details of required auxiliary energy sources and consumables (e.g. electricity, steam, chemicals, instrumentation air, working air) with condition data, required qualities and consumption values	I	16	24
• Water and waste water balances	A	with Bid	36
• Thermodynamic diagrams / heat balance diagrams	I	with Bid	24
• Start-up and shutdown diagrams with descriptions (cold, warm, hot)	A	with Bid	2 months before pre-commissioning
• Sectional and detail drawings of all components including materials	I	16	36
• Lifting plan for all lifting operations (repair, maintenance, etc.)	I	24	36
• Limits of coal and high speed diesel properties	I	-	with Bid
Design calculations of pumps, isolations, piping, etc.	I	12	36
Water hammer calculation of plant water and cooling water system	I	8	12
• Hydraulic model test procedure of plant water and cooling water systems; institute to perform the tests	A	4	8

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Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Hydraulic model tests reports of plant water and cooling water systems	A	-	12
• Cooling Tower Recirculation Study	I	-	12
• Sedimentation Study	A	-	12
• Pulverizer performance diagram with pulverizer turn-down range	A	with Bid	12
• Material diagrams for pressure part	A	with Bid	24
• Reference lists with information on successful operating years for: - steam turbines - steam generators - pulverizers - firing systems / burners	A		with Bid
•			
• System description of firing system	A	with Bid	24
• Final correction curves for Plant and equipment performance tests acc. to ASME PTC46 etc.	A	-	with Bid
• **Electrical Engineering**			
• Electrical single line diagrams	A	with Bid	12
• List of motors and consumers	I	8	every 1 month, final after erection completion
• Electrical equipment sizing calculations (generator main connection, transformers, emergency diesel generators, safe AC and DC power supply, power cables, etc.)	A	12	24
• Cable list	I	16	every 1 month, final after erection completion
• Standard circuit diagrams for all different kinds of electrical consumers	A	12	24
• Performance diagram (circle diagrams) of generator	I	with Bid	12
• Circuit diagrams for all individual electrical equipment	I	12	24
• Lists of equipment and devices	I	12	24
• Earthing and lightning plans with calculations	A	12	24

Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Lightning protection plans with details of measuring locations and reports of measurements taken following commissioning	I	12	24
• EMC concept with coordinated overvoltage protection	I	12	16
• Arrangement drawings for switchgear and battery rooms, station service transformers, cable floors etc.	A	12	24
• Diagram showing power output of plant generator and related transformer vs. ambient temperature from +20 °C to +40 °C	A	with Bid	12
• Block diagram generator/unit protection	A	12	24
• Block diagram AVQC for the generator	A	12	24
• Line plans of fire alarm system if applicable	A	12	24
• Arrangement drawings showing exact location of fire alarm devices if applicable	I	12	24
• Power and lighting installation plans including related calculation	I	16	24
• General arrangement drawings of the required cable trays, cable laying plans	I	12	24
• Dimensional drawings and erection drawings for generator, transformers, switchgear etc , including frontal and plan views	I	12	24
• Dimensional drawings of generator auxiliary equipment	I	12	16
• Dimensional drawings of switching cubicles, generator leads and star point cubicles, voltage regulation cubicles, excitation cubicles, generator circuit breakers, including equipment configuration	I	12	24
Calculation of mechanical stresses of switchgear rooms due to arcing faults	I	12	16

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Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Short circuit calculation and determination of protection relay settings for generator protection, 400/230 substation and auxiliary electrical supplies under consideration of protection of the entire system	A	12	24
• Protection and metering diagram for unit protection, start-up/stand by transformer protection, 400/230 kV GIS protection	A	16	24
• Load flow, system transient stability and motor start-up study	A	16	24
• Information for electrical system study by PGCB (see relevant part in **Section B0**)	I	8	16
• Generator charts and exciter characteristics	I	12	16
• **Instrumentation and Control Engineering**			
• Control system architecture showing all components, incl design concept redundancy	A	with Bid	24
• Operation and control philosophy	A	8	16
• Design concept earthing	A	16	24
• Design concept explosion protection	A	16	24
• List of packaged systems (Black Boxes)	A	with Bid	24
• Layout drawings central control room showing spatial distribution of desks and panels (3 D view)	A	with Bid (2D only)	24
• Layout of electronic rooms showing spatial distribution of cubicles and racks	A	16	24
• Description for all functional group controls, functional schematics (both in machine language and according to ISA-standard)	A	16	24
• DCS/PLC interface documentation, I/O point assignment	A	16	24

Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Engineering drawings of control valves, control dampers together with their actuators, orifices, nozzles, venturi nozzles	I	16	24
• External connection diagrams, terminal connection diagrams, combined schematic and circuit diagrams	I	16	24
• Communication systems	A	16	24
• As built software programs for DCS, PLC or other systems	I	-	1 month after COD of the 1st Unit
• Instrument list	A	16	24
• Cable routing plan	I	16	24
• **Civil Engineering**			
• 3D model of the complete Plant incl. all civil structures, all mechanical equipment, piping (> 50mm), electrical equipment e.g. cable trays, HVAC, etc.	I	16	24
• 3D model clash checking and walk through	A	3 weeks after 3D model distribution	3 weeks after 3D model distribution
• General layout plan of the Plant site, including all buildings and outdoor installations, roads etc., prepared on the basis of the topographical survey of the site	A	with Bid	12
• Detailed civil arrangement drawings of all buildings and structures, including plan-views and Sections (scale 1 : 100)	A	with Bid	12
• Architectural views (all sides) for all buildings of the Plant	A	4	12
• Arrangement drawings for external systems, including all supply and disposal facilities, roads with manoeuvring areas, outdoor facilities (sewage, drainage, ducts and trenches, fencing and gates; tank farm, outdoor foundations etc	A	4	24

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INTERNATIONAL OPERATIONS DIVISION
New Delhi-3 (India)

Bina Friendship Power Company (P) Ltd.
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Document	Purpose	Weeks after Contract Award: Preliminary	Final
• **Detailed drawings and documents**			
• Detailed foundation drawings for all buildings and structures (A. E., turbine, boiler and stack foundations etc.)	I	4	12
• Detailed structural drawings for all buildings and structures (concrete and steel structures)	I	8	24
• Detailed architectural drawings	I	8	24
• Room books, including external and internal finishes, windows, doors, sanitaries, wall cladding, roof etc.	A	8	24
• Detailed drawings for all internal services and installation works (HVAC, water, sewage, drainage, lighting	I	8	24
• Detailed drawings with embedded parts, anchors, plates, fixings etc.	I	8	24
• Detailed drawings for outdoor installations and services (sewage, drainage; water, ducts, trenches, culverts, pipes, cable routes, manholes, pits etc.	A	8	24
• Detailed drawings for roads, including accesses, footpaths, fencing/gates, landscaping, bridges, pipe racks	A	8	24
•			
• Checked and approved statical and dynamical analysis prepared/for all buildings and structures of the Plant	I	8	24
• Detailed constructive description of individual buildings with regard to the structural design (structural systems, foundations etc.)	I	8	24
•			
• Sectional elevations and roof plan	I	4	24
• Underground services and ducts with equipment appertaining to the services	I	8	24
• Principal details and Sections for traffic areas, especially for ramps and retaining walls	I	8	24

Document	Purpose	Weeks after Contract Award: Preliminary	Final
• Structural drawings pertaining to river water outfall and intake facilities	A	8	24
• Foundation drawings and other underground concrete works	I	4	24
• **Permit application documents**			
• Documentation for operating permits	A	4	12
• Documentation for other permits	A	4	12
• **Other documentation**			
• Schedules of workshop tests	I	-	1 month ahead of test
• Quality assurance manuals	I	16	24
• Manual of Codes and Standards	I	16	24
• **Operating manual** • operating procedures and instructions of the Plant with description of all systems, processes and functional groups • as built documentation • general and individual control concept description • Plant and equipment protection and signal processing description with all alarm and trip signal settings • all operating conditions including electrical grid supply and connection conditions	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit
• **Service and maintenance manual** • maintenance procedures and instructions with description of all equipment and facilities • Equipment data sheets	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit

Purpose: A : for Approval
I : for Information

B0.3.9.3 Data and simulation models

The Tenderer shall submit the data of the Plant for transmission simulation to PGCB according to the Bangladesh Grid Code however minimum following data:

Components	Data	Value of data
Generator step-up transformer	Rating	MVA
	High voltage	kV
	High voltage connection	
	Low voltage	kV
	Low voltage connection	
	Positive seq. Impedance	%
	Positive seq. Resistance	%
	Positive seq. Reactance	%
	Zero seq. Impedance	%
	Zero seq. Resistance	%
	Zero seq. Reactance	%
	MVA for base impedance	MVA
	Maximum tap	kV
	Maximum tap position	
	Minimum tap	kV
	Minimum tap position	
	Nominal tap position	
	Value of tap step	
	Core loss	kW
	Copper loss at full load	kW
	Auxiliary power	kW
Generator	Type	
	Manufacturer	
	Rated output	MVA
	Rated voltage	kV
	Connection	
	Inertia constant	
	Xd	%
	X'd	%
	X"d	%
	X2 (Negative sequence)	%
	X0 (Zero sequence)	%
	MVA for base impedance	
Turbine	Type	
	Rating	MW
	Inertia constant	
	HP natural frequency and vibration band	Hz
	IP natural frequency and vibration band	Hz
	LP natural frequency and vibration band	Hz

Components	Data	Value of data
Exciter	Type	
	Range ± % of rated voltage	%
Governor	Type	
	Model No	
	Droop	%
	Deadband	Hz
Unit auxiliary power consumption	Real power auxiliary load	MW
	Reactive power auxiliary load	MVAR

The Tenderer shall also submit models for simulation studies which are compatible with the software used by PGCB. PGCB is using PSS®E software).

The simulation studies include, but are not limited to:

a. power flow
b. short circuit
c. transient stability.

All characteristics and models shall operate in stable and accurate manner under all frequency range stipulated in this Part B0, including consideration on the following:

a. large frequency variations upwards (increasing) up to 52Hz,
b. large frequency variations downwards (decreasing) up to 47.0Hz,
c. grid system faults,
d. splitting of the grid system into islands.

All simulation models submitted for stability studies must be in the form of fully validated models for the software used by PGCB simulation. The models shall be provided complete with the following documentations:

a. imodel software source codes (flecs) as well as object (binary) codes,
b. description of the models including the engineering of model derivations,
c. user operation manuals
d. user application guides
e. model block diagrams
f. values of parameters
g. input data format
h. criteria for acceptable operation (threshold parameter values such as minimum steam pressure, maximum hydrogen pressure, etc).

The models shall represent closely the on-site response and setting.

Generator and excitation systems

The fully validated control block diagram representation of the software used by PGCB simulation model (including all limiters and power system stabilisers), shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, Volt/Hz limiter, maximum field current limiter, stator current limiter, minimum field current limiter etc.
3. Input-output relationships, by giving:
   a) Equations
   b) Characteristics/Chart/look-up table
   c) Other input/output relationship (if any).
4. Indication whether the parameters in the block diagram can be measured on the actual system.

Governor

The fully validated control block diagram representation of the software used by PGCB simulation model for the governor systems shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, additional corrective control against frequency deviations (if any) and other controls (if any).
3. The following variables, states, and limits:
   a) mechanical output
   b) generator output
   c) turbine speed
   d) mechanical output of steam turbine (ST)
   e) MW output of ST
   f) shaft speed of ST
   g) turbine steam pressure of ST
   h) turbine steam pressure deviation of ST
   i) turbine steam temperature of ST
   j) main control valve position of ST
   k) intercept valve position of ST
   l) load limiter signal.
4. Tenderer shall inform values of limits and acceptability (or violation) criteria on the following:
   a) reverse power (cause reverse power trip when violated)
   b) Power Load Unbalance (PLU) (or similar) relay trip (if any which cause trip when set criteria is violated)
   c) operational limits and criteria
   d) others (if any which cause trip when violated).

5. Tenderer shall inform input-output relationships, by giving:
   a) Equations
   b) characteristics/chart/look-up tables
   c) other input/output relationship (if any).
6. Tenderer to inform whether the parameters in the block diagram which exist and can be measured on the actual system.

The above models and documentation shall be submitted in CD-ROM media (read only). One hardcopy of the same is also required to be submitted.
Due dates and versions for data submission and simulation models are as follows:

Due dates	Type of data to be submitted
90 days after signing of this Agreement	Committed Project Data Contracted Project Data
90 days prior to the Initial Operation Date of the First Unit	Estimated Registered Data
30 days after the Commercial Operation Date of the First Unit	Registered Data

B0.3.9.4 Requirements for documentation

Unless agreed otherwise, five (5) hard copies and three (3) sets of electronic copies of all documents are to be submitted in the English language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files.

The Contractor shall provide, install, operate and maintain a web based electronic data room / data server. The format and filing system shall be mutually agreed between Employer and Contractor.

All documentation shall comply with uniform documentation instructions according to Employer's requirements. Detailed requirements for documentation will be determined during contract execution by the Employer.

Contractor shall comply with Employer's directive concerning documentation requirements for implementation in an automated plant operation system.

The final documentation including but not limited to operating manuals, maintenance and service manuals, component documentation, assembly documentation, drawings and listing, etc. shall be submitted in the English

language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

Contractor shall also integrate and submit all the above data for each Unit into the PSS®E load flow raw data file ("raw data") and PSS®E dynamic raw data file ("dyr data") which are ready to be used for studies on operation and planning of the Grid System by PGCB using PSS®E (to be confirm by PGCB/BIFPCL)
Data for each Unit shall also include reactive power capability curve of the Facility, written in the format compatible to PSS®E activity GCAP. For this purpose, at least 10 (ten) pairs of data on the generator reactive power capability curve shall be provided for each Unit.

The final requirements for Transmission lines and Interconnecting Facilities documentation will be subjected to PGCB's approval which will be made known during execution stage.

B0.3.9.5 Approval procedure for drawings and documents

The Employer reserves the right to ask the Contractor to submit drawings and other documents for approval to the Employer or to its representative.

Before submittal of any such drawing or other document, the Contractor shall submit a detailed list comprising all drawings or other documents the Contractor will produce. Based on this list the Employer will decide which drawings or other documents will have to be submitted for approval, information or other purpose.

The documents for approval are primarily basic documents and all documents that are required to check that Contractual and operational requirements are met. It is expected that in total approximately 600 to 800 documents will be for approval.

When submitting drawings or other documents for approval, including any prepared by subcontractors, the Contractor shall certify in each case that he has examined such drawings or documents and that they comply with the requirements of the Contract.

The Contractor is requested to provide Third Party Verification of structural documents, e.g. structural analysis, drawings and connecting details prior to submission for approval. These documents must contain all information necessary for the execution of the works.

Approval of a drawing or other document will imply that:

- They have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the specification.