

BIFPCL
2 X 660 MW MAITREE BANGLADESH

TECHNICAL SPECIFICATION
FOR CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)

Specification No. : PE-TS-421-165-N002 (REV. 00)



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N002**
SECTION:
SUB-SECTION:
REV. NO. **00** DATE **02.01.2018**
SHEET **1** OF **1**

INDEX

THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

CONTENTS

SECTION	TITLE
I	Specific Technical Requirements
IA	Specific Technical Requirements (Mechanical)
IB	Specific Technical Requirements (Elec.)
IC	Specific Technical Requirements (C&I)
ID	Data Sheet – A
II	Standard Technical Specifications
IIA	Standard Technical Specifications (Mechanical)
IIB	Standard Technical Specifications (Elec.)
IIC	Standard Technical Specifications (C&I.)
III	Documents to be submitted by Bidder
IIIA	Guarantee Schedule (To be submitted along with the Bid by all Bidders)
IIIB	Compliance Certificate (To be submitted along with the Bid by all Bidders)
IIIC	Data Sheet – B (To be submitted by successful Bidder after award of Contract)



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N002**
SECTION:
SUB-SECTION:
REV. NO. **00** DATE **02.01.2018**
SHEET **1** OF **1**

SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

- SUB-SECTION IA** - Specific Technical Requirements (Mech.)
- SUB-SECTION IB** - Specific Technical Requirements (Electrical)
- SUB-SECTION IC** - Specific Technical Requirements (C & I)
- SUB-SECTION ID** – Datasheet-A



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS- 421 165-N002**

SECTION: **I**

SUB-SECTION: **IA**

REV. NO. **00** DATE **01.12.2017**

SHEET **1** OF **1**

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **1** OF **8**

1.0 GENERAL

The Condenser On load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-II) and Data Sheet-A enclosed herewith. In addition the requirements of this section I including customer specification attached at Appendix-I of section IA shall also be complied with. However, wherever the details given in Section-II and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-I/ customer specification (Appendix-I) / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification (Appendix-I), Section-I, Datasheet-A, Section-II.

Section I consists of 4 Sub-Sections viz. Sub-Sec. IA, IB and IC for Mechanical, Electrical and C&I respectively and Sub-Sec. ID for Datasheet-A, the requirements of all 4 sub-sections shall be complied with.

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 Condenser on load tube cleaning systems (COLTCS) :

The condenser on load tube cleaning system (COLTCS) is intended to prevent formation of various forms of fouling and scaling in the condenser tubes. The cooling water system is of closed circuit type with cooling towers or open circuit type as specified. The water analysis is indicated with Datasheet-A.

3.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR COLTCS.

3.1 The details of COLTCS with quantities, design parameters, size and MOC's as per Data Sheet-A.

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR COLTCS:

3.2.1 Each set of COLTCS shall comprise following :

- a) One No. Ball Separator at Condenser CW outlet pipe.
- b) One No. Ball recirculation pump with drive motor.
- c) One No. Ball collector.
- d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.
- e) Differential pressure measuring system for ball separator. DP measuring system shall comprise of 2 nos. DPT +1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT and DPG shall be independent.
- f) Ball monitoring system comprising an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **2** OF **8**

monitor then they can offer other alternatives like automatic ball sorter etc.

- g) Length of Ball separator, Scope of Counter Flange, Nuts, bolts and gaskets shall be as per Datasheet-A.

Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-M017 enclosed at enclosures at Annexure-II of Datasheet-A.

- h) Complete Pipe work, including interconnection piping, flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Purchaser's scope. **However, valves along with its Flanges/Counter Flanges/Gaskets/Nuts & Bolts shall be in Bidder's Scope.** Isometric Drawing along with BOM for interconnection piping, flanges/counter flanges for pipes, bends, fittings, distributors, nozzles and support installation materials inline with approved Installation Drawing to be submitted by the Bidder within 4 weeks after approval of the Installation Plan.

- i) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.

- j) Power and Control cables between starter Panel (Switch Gear) and various drives in bidder's scope of supply.

- k) Starter Panel (Switch Gear Panel) shall be as follows:

2 Sets of COLTCS shall have one Common Switch Gear Panel for DCS based control system. However, separate Local Control Panel (Starter Panel) shall be provided near to each COLTCS for its operation.

Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

- l) Control cables between field instruments and Switch gear panel.

- m) All the field instruments stipulated in this specification shall be in Bidder's scope.

- n) Commissioning balls and other commissioning spares on "As required basis" and to be supplied at the time of commissioning of COLTCS system.

- o) Set of mandatory spares as indicated in Data Sheet A. Spare balls (if applicable) to be supplied at the time of commissioning of COLTCS system.

- p) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.

- q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

- r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

- s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **3** OF **8**

t) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

u) Cathodic Protection of COLTCS along with Sacrificial Anode.

Any item not specified but required to make COLTCS a complete package shall also be in bidder's scope.

4.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE :

The bidder's scope also includes following services at site, for scope under this specification for COLTCS:

- a) Installation checks (Erection in BHEL's scope).
- b) Commissioning of equipment.
- c) Trial run for requisite period
- d) Performance Testing.

The trial run of equipment shall be generally conducted immediately after commissioning while PG testing shall be conducted at a later date. These activities for different units shall be timed separately.

- **For drawings/documents approval**

In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per cl. 10.0 (b) below.

Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer along with soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalization and Category-I approval.

- **Site Visits for installation check / commissioning:**

Two site visits for four days each for installation check / commissioning of each unit in their base price for combined activities of erection checks and commissioning for COLTCS for both sets of equipments of one unit.

5.0 EXCLUSIONS :

The following are excluded from the bidder's scope.

5.1 Civil foundation works required for installation

5.2 Erection of Equipment at site.

6.0 DESIGN CONSTRUCTION :

In addition to the requirements of Section-D the following shall also be complied.

6.1 Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III of Datasheet-A.

6.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **4** OF **8**

999-141-MO17 enclosed at enclosures at Annexure-II of Datasheet-A.

- 6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.
- 6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.
- 6.5 Cathodic Protection for COLTCS along with Sacrificial Anode shall be provided by the bidder in the equipment.
- 6.6 Any flow straightener for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details. Suitable Coating for protection against Sea Water and Touch-up Paint in sealed Container after welding in Condenser Outlet Pipe at Site to be provided by the Bidder.
- 6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 3.0 m/ sec. in other pipe work. All valves up to 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

Note: 1) For design & standards of COLTCS (Materials specification, pumps, piping, flanges, valves, testing procedures etc) please refer clause no B.0.6.2 of Appendix-1/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 inline with Note (1) above.

7.0 Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System.

Performance Parameters to be guaranteed by bidders under demonstration category under compulsory corrections shall be as under:

- i) Percentage recovery of balls (min. 90% recovery for 1000 hrs of normal plant operation with 8 hrs Operation of COLTCS per day)
- ii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day).
- iii) Max. Pressure drop in ball separator in clean condition (Test to be conducted along with commissioning) – not exceeding 0.2 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 0.2 MWC.



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **5** OF **8**

Any deviation to above balls life, percentage recovery and pressure drop will not be accepted.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchaser's approval.

In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.0 SPARES :

8.1 Mandatory Spares

Mandatory Spares shall be as per Data Sheet-A or annexure enclosed with data sheet A.

9.0 Quality Plan

Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself. If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

a. Delivery of Equipment shall be as per NIT.

b. The drawings to be submitted by bidder in event of award of contract.

BHEL DRG NO	DRG TITLE	Drg Sch for vendors
Primary Documents:		
PE-V2-421-165-N001	P&ID OF COLTCS SYSTEM	R-0 within 20 days (for all except Installation plan, for Installation Plan 30 Days) from LOI/PO & subsequent revisions within 7 days of comments received from BHEL.
PE-V2-421-165-N002	TECHNICAL DATA SHEET-COLTCS	
PE-V2-421-165-N003	INSTALLATION PLAN- COLTCS	
PE-V2-421-165-N004	GENERAL ARRANGEMENT OF BALL SEPERATOR	
PE-V2-421-165-N005	DETAILS OF BR SKID,BALL INJECTION PIPE & FIXING DETAILS	
PE-V2-421-165-N006	C&I Part-I,PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSOPHY FOR COLTCS	
PE-V2-421-165-N008	QP-COLTCS	

	TITLE: TECHNICAL SPECIFICATION COLTCS SPECIFIC TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-421-165-N004 SECTION: I SUB-SECTION: IA REV. NO. 0 DATE 02.01.2018 SHEET 6 OF 8
PE-V2-421-165-N007	C&I Part-II, GA & WIRING DIAGRAM OF PANEL- COLTCS	R-0 within 30 days from Cat-I(or)II approval of C&I Part-I document & subsequent revisions within 7 days of comments received from BHEL.
Secondary Documents:		
PE-V2-421-165-N009	O& M MANUAL -COLTCS	Within 30 days from MDCC
PE-V2-421-165-N010	PG TEST PROCEDURE -COLTCS (If Applicable)	R-0 within 20 days of Cat-I(or)II approval on COLTCS document.
Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account. c. Final documentation: Refer clause no. B.0.3.9.4 Appendix-1/SECTION-1A. 11.0 The makes of various bought out items shall be subjected to purchaser's approval in the event of order. 12.0 It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. <i>In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.</i> 13.0 The following documents shall be furnished by the bidder with his offer : • Compliance certificate duly signed and stamped (Enclosed at section-III). • Guarantee schedule duly signed and stamped (Enclosed at section-III). • GA drawings of following with empty/ filled-ups. ➤ Balls Collecting Strainers (as applicable). ➤ Balls recirculating Skids. ➤ Other equipments considered necessary for Layout/ Civil. • Electrical Load Data (Enclosed at section-1B of Specification) • Schedule of Deviation (As per NIT format) The bidder to note that load requirement furnished and finalised during tender stage shall only be provided by BHEL and any changes or additional requirement of Electrical load by bidder during contract stage shall be provided by BHEL with cost repercussions to the bidder. NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.		



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **7** OF **8**

14.0 COLTCS packing procedure before dispatch

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

14.1 Preparation for Packing:

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

14.2 Protection of parts:

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

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

- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.



TITLE:
**TECHNICAL SPECIFICATION
COLTCS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-421-165-N004**
SECTION: **I**
SUB-SECTION: **IA**
REV. NO. **0** DATE **02.01.2018**
SHEET **8** OF **8**

- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

14.3 Preservation

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

14.4 Photographs

Bidder to take photographs of all parts like Ball separators, screen, pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

14.5 Sea-worthy packing is applicable for complete self-cleaning strainers package. Details of Sea-worthy packing is enclosed with NIT

APPENDIX-1

B0

General Technical Specification



On 20/11/17



010

B0.3.4.3	Substation control and monitoring system	0-47
B0.3.4.4	Electrical	0-48
B0.3.4.5	Instrumentation and Control	0-48
B0.3.4.6	Civil	0-49
B0.3.5	Packaging and transportation	0-50
B0.3.6	Erection, commissioning and testing	0-50
B0.3.7	Training	0-50
B0.3.8	Spare parts, tools, appliances, and consumables	0-51
B0.3.8.1	Spare parts	0-51
B0.3.8.2	Tools and appliances	0-53
B0.3.8.3	Consumables	0-54
B0.3.9	Documentation	0-55
B0.3.9.1	Documentation with tender	0-55
B0.3.9.2	Documentation after Award of Contract	0-58
B0.3.9.3	Data and simulation models	0-68
B0.3.9.4	Requirements for documentation	0-71
B0.3.9.5	Approval procedure for drawings and documents	0-72
B0.3.9.6	Quality control procedure	0-75
B0.3.10	Options and Alternatives	0-78
B0.3.10.1	Option 3.1: Absorber made of concrete (alternative)	0-78
B0.3.10.2	Option 3.2: Combined Limestone System for Both Units (alternative)	0-78
B0.3.10.3	Option 4.1: Take-out of coal yard roof coverage	0-78
B0.3.10.4	Option 4.2: Take-out of coal blending silos	0-78
B0.3.10.5	Option 4.3: Limestone yard roof coverage	0-78
B0.4	Interfaces	0-78
B0.4.1	Battery limits of the plant	0-78
B0.4.2	Interfaces to electricity dispatcher	0-80
B0.4.2.1	Interface between the Power Plant and the NLDC	0-80
B0.4.2.2	Signal interface to NLDC for automatic generation control	0-81
B0.4.2.3	Interfaces between the 400/230kV substation and the NLDC	0-81
B0.4.2.4	Interfaces between the 400/230kV substation and the Power Plant	0-82
B0.4.2.5	Interface to power transmission system of Bangladesh Power Grid Company of Bangladesh	0-83



B0.4.3	Metering	0-83
B0.5	Technical Schedules	0-84
B0.6	General Technical Requirements	0-84
B0.6.1	General requirements	0-84
B0.6.2	Standards and codes	0-85
B0.6.3	Plant and equipment identification	0-88
B0.6.4	Marking and labelling	0-90
B0.6.5	Corrosion protection, coating and galvanizing	0-90
B0.6.6	Vibration	0-98
B0.6.7	Standardization of makes	0-100
B0.6.8	Accessibility	0-101
B0.6.9	Signs & colour code	0-101
B0.6.10	Units of measurement	0-104
B0.6.11	Ways, stairs, ladders, balustrades	0-105
B0.6.12	Hazardous areas, fire fighting & prevention systems	0-106
B0.6.13	Maintenance isolation	0-107
B0.6.14	Materials	0-107
B0.6.14.1	General material requirements	0-107
B0.6.14.2	Specific requirements for high temp./high pressure part materials	0-109
B0.6.15	Pre-service cleaning and protection of plant equipment	0-110
B0.6.16	Welding	0-112
B0.6.17	Mechanical equipment	0-114
B0.6.17.1	Pumps	0-114
B0.6.17.2	Piping and accessories	0-117
B0.6.17.3	Valves, steam traps, condensate drainers, safety valves	0-123
B0.6.17.4	Thermal insulation	0-125
B0.6.17.5	Vessels	0-128
B0.6.17.6	Heat exchangers	0-129
B0.6.17.7	Instrument and service air	0-130
B0.6.17.8	Cranes, hoists and lifts	0-131
B0.6.17.9	Cranes	0-131
B0.6.17.10	Hoists	0-132
B0.6.17.11	Lifts	0-134
B0.6.18	Electrical equipment and works	0-134



B0.6.18.1	Standards	0-134
B0.6.18.2	Voltage levels	0-135
B0.6.18.3	Insulation levels	0-136
B0.6.18.4	Installation conditions and protection class for electrical operational equipment and control and monitoring equipment	0-136
B0.6.18.5	Protective measures, earthing and lightning protection	0-138
B0.6.18.6	Earthing and lightning protection	0-141
B0.6.18.7	Technical conditions for high voltage motors	0-144
B0.6.18.8	Technical conditions for low voltage motors	0-148
B0.6.18.9	DC motors	0-149
B0.6.18.10	Actuator drives	0-149
B0.6.18.11	Frequency converters	0-150
B0.6.18.12	Cable and cable trays	0-154
B0.6.18.13	EMC measures	0-160
B0.6.18.14	Requirements for local cubicles and local housings for e.g. switchgear, control, measurement and signalling equipment	0-162
B0.6.18.15	Local control points and level control cabinets	0-163
B0.6.18.16	Terminal boxes and terminal cabinets	0-165
B0.6.19	Instrumentation and control equipment	0-166
B0.6.19.1	Main design criteria	0-166
B0.6.19.2	Distributed Digital Control, Monitoring and Information System (DDCMIS)	0-168
B0.6.19.3	Programmable logic controllers	0-168
B0.6.19.4	Control cubicles	0-169
B0.6.19.5	Racks, junction boxes	0-170
B0.6.19.6	Mimic diagrams	0-171
B0.6.19.7	Power supply and fusing	0-172
B0.6.19.8	Transmitters	0-173
B0.6.19.9	Temperature measurements	0-175
B0.6.19.10	Pressure measurements	0-177
B0.6.19.11	Flow measurements	0-178
B0.6.19.12	Level measurements	0-180
B0.6.19.13	Analysers and monitoring systems	0-181
B0.6.19.14	Electrical value measurements	0-187
B0.6.19.15	Control valves	0-187



B0.6.19.16	Actuators	0-189
B0.6.19.17	Solenoid valves	0-191
B0.6.19.18	Cabling and wiring	0-191
B0.6.19.19	Instrument and measuring impulse piping	0-192
B0.7	Inspection and Testing	0-193
B0.7.1	General	0-193
B0.7.2	Testing during manufacturing	0-194
B0.7.2.1	Material tests	0-194
B0.7.2.2	Manufacturing tests	0-199
B0.7.2.3	Mechanical equipment	0-205
B0.7.2.4	Electrical equipment	0-207
B0.7.2.5	Control and monitoring equipment	0-226
B0.7.3	Testing at site	0-229
B0.7.3.1	Civil works testing	0-229
B0.7.3.2	Erection tests	0-230
B0.7.3.3	Pre-commissioning tests	0-235
B0.7.3.4	Tests on Completion (Commissioning tests)	0-237
B0.7.4	Performance Tests	0-241
B0.7.5	Reliability test run	0-244
B0.8	Abbreviations	0-247
B0.9	Technical Schedules	0-251



B0. General Specification

B0.1 Subject of Specification

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

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

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

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

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

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



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

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

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

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

B0.2 General Plant Description

B0.2.1 General purpose of the plant

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

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

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



B0.2.2 General scope of supply

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

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



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



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

The following works are included in the infrastructure lot

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

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

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

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

- Retaining wall
- Revetment and Shore protection.

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

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



B0.2.3 Interface points

For interface points see below.

B0.2.4 Site conditions

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

Location, accessibility and present condition of the Site

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

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

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

Currently, the Site is accessible by boat only.

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

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

Soil conditions

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

In general the subsoil conditions can be described as follows:

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

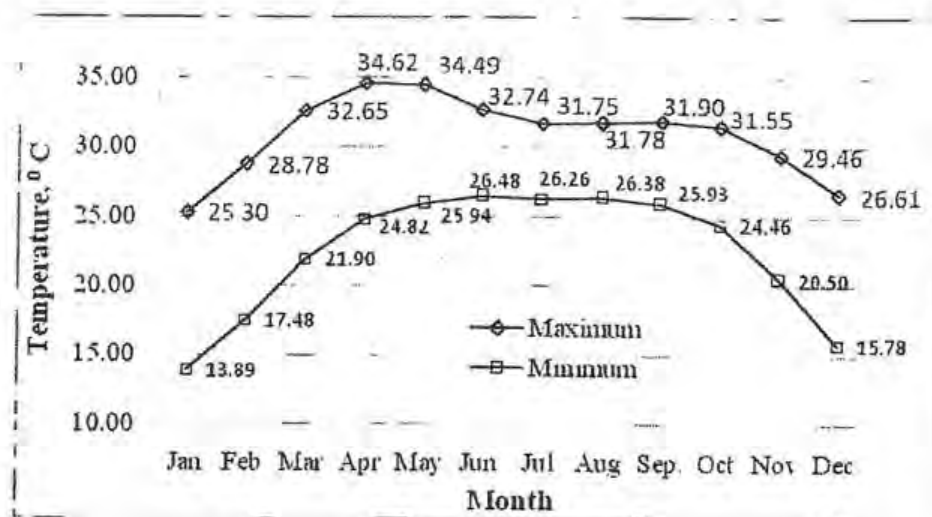
- summer season-March to May
- monsoon season-June to October
- winter season-November to February.

During the Monsoon Season occasional cyclonic storms can occur.

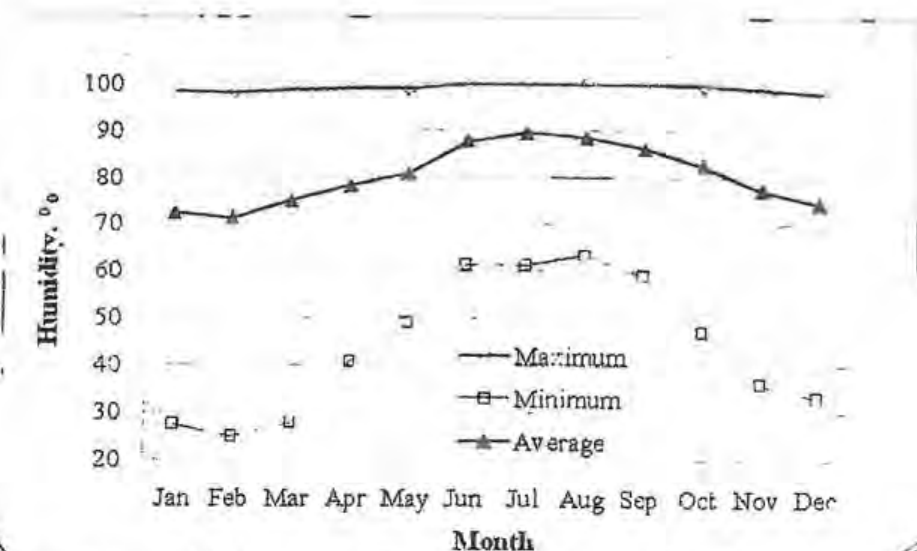
The climatic conditions in the area are continuously monitored by the Bangladesh Meteorological Department (BMD) at the Mongla Meteorological Station.

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.





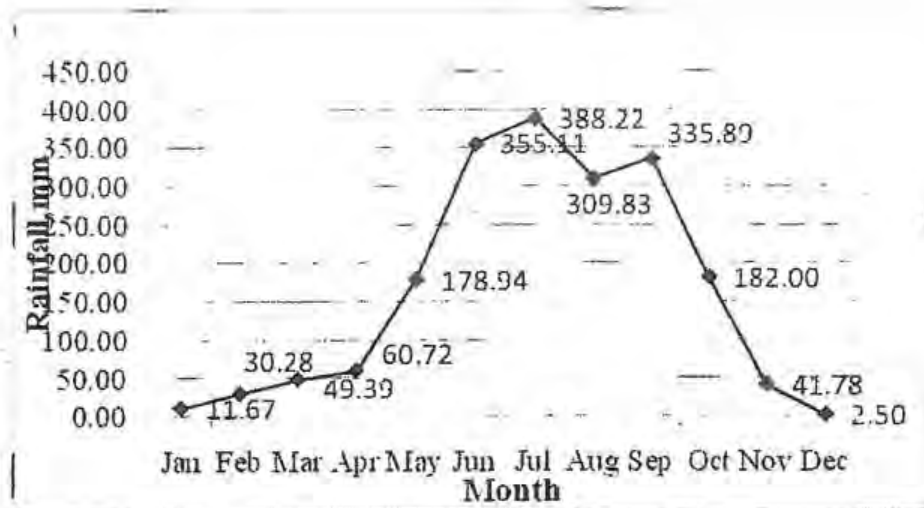
The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



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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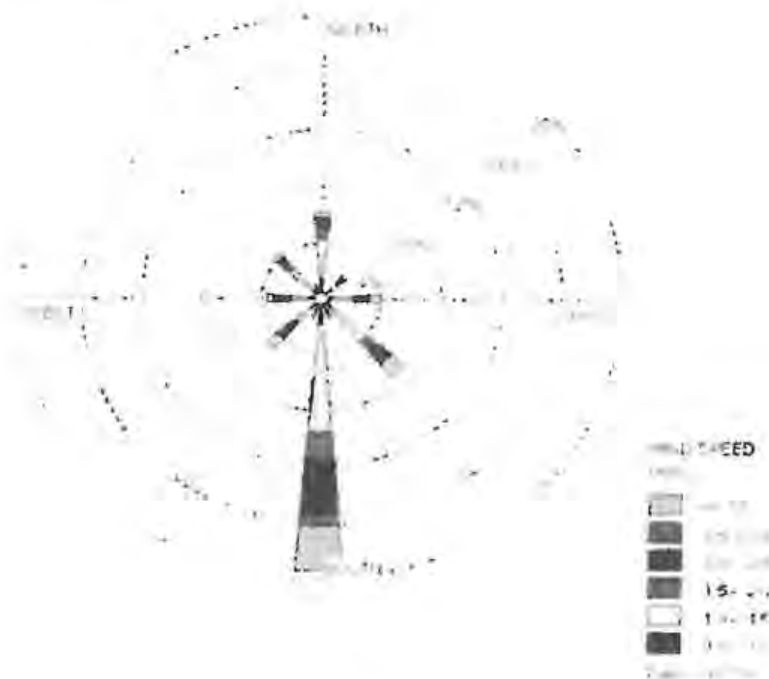


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Additional information on water quality parameters is shown in **Part C Annexes**.

Wind data

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



B0.2.5 Configuration

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

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



B0.2.6 Layout

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

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

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

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

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

B0.2.7 Design requirements

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

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



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

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

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

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

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

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

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

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

Redundancy concept

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

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

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

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

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

Future Extension

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

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

B0.2.8 Fuel

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

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

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

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

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

B0.2.9 Output, heat rate and availability requirements



B0.2.9.1 Guarantee definitions

The following guarantees are defined:

Acceptance Guarantees:

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

Special Guarantees:

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

Minimum Acceptance level (MAL):

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

Liquidated Damages (LD)

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

B0.2.9.2 Plant output

Gross Electrical Power Output

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

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

Net Electrical Power Output

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

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

Export Power Output

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

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

Dependable Capacity

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

MCR - Maximum Continuous Rating

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

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

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

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

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

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

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

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

BMCR - Boiler Maximum Continuous Rating

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

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



MNCR - Minimum Continuous Rating

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

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

B0.2.9.3 Net heat rate

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

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

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

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

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

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

Auxiliary Power Consumption

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

ICT Losses and Start-up Transformer Losses

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

Own Consumption

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



B0.2.9.5 Plant availability

The Contractor shall:

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

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

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

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

Where:

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



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

B0.2.9.6 Maintenance intervals

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

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

B0.2.10 Mode of operation

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

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

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

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

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

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



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

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

B0.2.11 Electrical network connection conditions

The Plant shall comply with:

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

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

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

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

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

B0.2.11.1 Essential Electrical Requirements of the PPA



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



PPA Section 11: Power Evacuation and Switchyard

11.1 Power Evacuation

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

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

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



11.2 Electrical

a. Communication link

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

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

b. Control of Switchyard

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

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

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

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



11.3 Electrical Protection, Communication and Instrument Systems

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

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

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

PPA Schedule 1: Minimum Functional Specifications

3. ELECTRICAL REQUIREMENTS

3.1 Generators

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



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

3.2 Excitation System

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

3.3 Power and Auxiliary Transformers

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

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

3.4 Control and Supervision

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



- 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 $\pm$ 2%). The User shall however be subject to the grid discipline directed by the Commission.

Voltage variation on the Transmission System shall normally be $\pm$ 10% during emergencies and $\pm$ 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.

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.



B0-35

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 voltage.

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.



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 (NO _x)	mg/m ³	510

Table B0-5: Emission limits

Note:

NO_x refers to oxides of nitrogen, referenced to NO₂.

Reference conditions for NO_x, SO₂, and particulates are 6 % O₂, 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)



- 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 Contractor'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 expressly 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



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- 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.

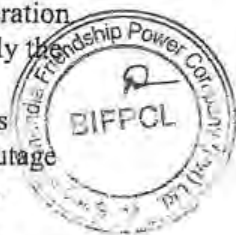
B0.3.8 Spare parts, tools, appliances, and consumables

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



- 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 relieve 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	A	with Bid	16
• List of subcontractors/ manufacturers	A	with Bid	12
• Proposed inspection and testing programs	A	12	24
• Noise propagation calculations	A	-	24







Handwritten signature



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 1 st 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 1 st 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

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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



Weeks after Contract Award

Document	Purpose	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	



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 1 st 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



Weeks after Contract Award

Document	Purpose	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, sanitarries, 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	A	6 months ahead of pre-commissioning	1 month after COD of the 1 st Unit
• 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			
• Service and maintenance manual	A	6 months ahead of pre-commissioning	1 month after COD of the 1 st Unit
• maintenance procedures and instructions with description of all equipment and facilities			
• Equipment data sheets			

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
Generator	Auxiliary power	kW
	Type	
	Manufacturer	
	Rated output	MVA
	Rated voltage	kV
	Connection	
	Inertia constant	
	Xd	%
	X'd	%
	X d	%
Turbine	X2 (Negative sequence)	%
	X0 (Zero sequence)	%
	MVA for base impedance	
	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 $\pm$ % 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:

- power flow
- short circuit
- 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:

- large frequency variations upwards (increasing) up to 52Hz,
- large frequency variations downwards (decreasing) up to 47.0Hz,
- grid system faults,
- 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:

- imodel software source codes (flects) as well as object (binary) codes,
- description of the models including the engineering of model derivations,
- user operation manuals
- user application guides
- model block diagrams
- values of parameters
- input data format
- 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.



TECHNICAL SPECIFICATIONS (TS)

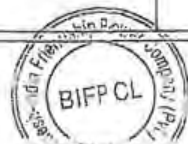
BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED
(A JOINT VENTURE OF BPDB AND NTPC LTD.)
(BIFPCL, DHAKA)



2x660 MW MAITREE SUPER THERMAL POWER PROJECT ON TURNKEY BASIS
BIDDING DOCUMENT NO.: BIFPCL/EPC-MAIN PLANT/2015

Section-V (TS)

001-1



- They have been examined in relation to compatibility of the items and equipment with the specification and respect of interconnections with other items, equipment or systems.
- The Contractor is not relieved of his responsibility under the Contract.

The Contractor is to arrange for the revision history of drawings and other documents as follows. The first revision shall be indexed by the letter "A" followed up by the respective letter in alphabetical order.

Once the drawing or document is approved for construction by the Employer or its representative the document shall be indexed with the number "0" followed up by the respective number in chronological order. Hence, the sequence of the revision index of a design document shall be as follows: A - B - C - [...] - 0 - 1 - 2 - [...]. Each revision is to be listed in the revision history with the respective date and a short description of the modification(s). In addition, all modification(s) shall be highlighted and/or marked up as specific and detailed as possible.

Furthermore, each drawing/document shall be indicated with a unique document number according to the following standard:

Maitree – Unit – KKS – DCC – 12345 – XYZ – REV

Where:

Maitree	Project-Denomination
Unit -	00 (for common), 01 (for unit 1), 02 (for unit 2)
KKS -	Function Key as per KKS system (1 to 3 letters)
DCC -	DCC code according to EN/IEC 61355
12345 -	Document number
XYZ -	Sub-/Contractor number
REV -	Revision index

For each comment, the Employer will allocate a priority in the TCS (Technical Comment Sheet). The priorities range from 1 to 3 as follows:

1	-	High Priority
2	-	Medium Priority
3	-	Low Priority

The TCSs are to be named with the above described identification key and the supplementary ending "... - RI" ("Revision Income") for TCSs being sent from the Contractor to the Employer and "... - RO" ("Revision Outcome") vice versa.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other documents supplied by him, whether such drawings or other documents have been approved or not.



B0.3.9.5.1 Documents which require Approval from Grid Operator/BPDB

Documents especially test procedures and protocols, which are due to approval by the grid operator or BPDB required following specific times for submittal and approval.

B0.3.9.5.1.1 Testing Procedure and Protocols

At least one hundred and twenty (120) Days before the scheduled commencement of the testing and Commissioning of the Plant, the Contractor shall, upon request from BPDB, submit to BPDB detailed procedures and protocols to be used during the corresponding testing. BPDB shall have the opportunity to provide written comments, if any, on the proposed procedure and protocols within thirty (30) Days of receipt from the Contractor of said documentation. If BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor.

On receipt of such comments, if any, the Contractor shall review and submit the final procedure and protocols, to be used for testing not later than sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning:

- if BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor; and 35
- if the Parties fail to reach agreement on the procedures and protocols within sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning,

the matter may be referred to the Engineer by either Party, and the Engineer shall make the decision on the protocol and procedures within the five (5) Days of the matter being referred to it, and such decision shall be binding on the Parties.

B0.3.9.5.1.2 Start-up and Test Schedules

At least ninety (90) Days before the scheduled commencement of testing and commissioning of the First Generating Unit or the Plant, as the case may be, the intended Start-Up and test schedule for such unit.

B0.3.9.5.1.3 Operating Procedures

- Not later than one hundred and twenty (120) Days before the then prevailing Scheduled Initial Operations Date, the Contractor shall, upon request from BPDB, provide BPDB with draft operating procedures



dealing with all operation interfaces between BPDB and the Contractor including, but not limited to:

- method of Day-to-Day communication
- key personnel list
- clearances and switching practices
- outage scheduling
- capacity and energy reporting
- operating log; and
- reactive power support

which shall be consistent with this Agreement, the designs of the Facility (including the Metering System), the Technical Limits and Prudent Utility Practices (together, the "Operating Procedures").

- Within thirty (30) Days after BPDB's receipt of the draft Operating Procedures, BPDB shall notify the Company of any requested deletions, amendments or additions.
- The Company shall make any deletions, amendments or additions that BPDB reasonably requests unless they would be inconsistent with this Agreement, the Technical Limits, the designs of the Facility (including the Metering System), or Prudent Utility Practices and provide such revised draft to BPDB, which shall be treated as final Operating Procedure, not later than thirty (30) Days before the then prevailing Scheduled Commercial Operations Date.
- Not Used
- Either Party may, from time to time, request revisions to the Operating Procedures subject to agreement from the other Party.

B0.3.9.6 Quality control procedure

A comprehensive **quality control procedure / quality assurance programme** for all aspects of the works shall be prepared by the Contractor and shall be submitted to the Employer for approval.

The Contractor shall adopt suitable quality assurance programme (QAP) to ensure that the equipments and services under the scope of Contract whether manufactured or performed within Contractor's works or at his subcontractor's premises or at the site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the Contractor and shall be finally accepted by the Employer or his authorized representative after discussions before the start of work. The QAP shall be generally in line with ISO Systems.

The quality assurance program shall consist at least of the following:

- testing during manufacturing
 - workshop inspections and testing
 - factory acceptance tests (FAT)
- testing at site
 - construction inspections and testing
 - erection / mechanical completion
 - pre-commissioning and commissioning tests (cold and hot commissioning)
 - optimization of overall Plant
 - final inspection and testing
 - Bench mark testing
- completion test
 - performance tests
 - reliability test run.

An outline of the proposed comprehensive quality assurance programme is to be provided with the Tender and is subject to review by the Employer.

The Contractor shall provide complete laboratory facilities and staff to perform the required tests. The facilities could be fully or partially on site. Arrangements could be made with an experienced testing laboratory to support the site laboratory, all subject to the approval of the Employer.

Only approved fully qualified and experienced staff shall carry out the quality control all in accordance with the approved quality control procedure.

The Contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the project manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of Contractors QA&QC manpower required to be deployed at site shall be submitted with the Tender.

The results of the tests shall be made available to the Employer within 24 hours of obtaining the relevant test results. Acceptance of the relevant part of the work shall be subject to the performed tests showing satisfactory results. Individual construction completion certificates shall be issued by the Contractor to certify the readiness for equipment erection (see **Section B0**).

The Employer may instruct tests at no cost provided either the overall frequency governed by the specification is not exceeded and the notification given to the Contractor is equal to that currently being provided by the Contractor for his normal testing in formality and warning, or the Employer has due cause to suspect a change in the quality, such concern having been advised to the Contractor. The Employer may instruct sampling, testing or both which satisfy only some or none of the above criteria.



The Employer shall have the right to carry out independent inspections and testing either using his own resources or those of a third party. Should the Employer require the results to determine the conformance with the specification then he shall notify and inform the Contractor.

As far as is practicable the Employer shall have free access to the site, fabrication areas and suppliers work at all times without notice. Should he discover unsatisfactory work then he will invite a formal joint inspection. Either after such an inspection or if the Contractor declines the invitation the Employer shall issue instructions with regard to the faults and their reparation.

Should any materials, items or complete parts of the works fail to comply with the requirements of this specification when tested in accordance with this Section the Employer may reject such materials or items, or condemn complete parts of the works, and demand of the Contractor such replacement or modification as may be necessary to ensure their compliance.

Should modification or adjustment be deemed a satisfactory alternative to demolition and /or removal, the Contractor shall submit full details in writing such modifications to the Employer for approval, and should such approval be forthcoming carry them out without undue delay.

If however, the Contractor is required to demolish and /or remove any such items or materials this shall be carried out quickly and with as little disruption to the works as possible.

No claims of any sort whatsoever will be entertained arising from the rejection of any part of the works through failure to meet this specification, and repairs, demolitions, removals, additional testing etc. Such modifications, removal, demolitions etc, shall be entirely at the expense of the Contractor. No extension of the Contract period shall be granted for such a reason.

If for any reason materials or other items are received or made on site before approval of them has been granted, these shall be transported, handled and stored separately or labelled in such a way in order to, wherever possible, prevent them being incorporated into the works or, should such prevention not be possible, to accurately define the part(s) of the works in which such materials or items were used.

Approvals previously granted for any materials etc. shall be withdrawn if they are not properly transported, handled or stored and otherwise protected against weather or contaminants which may adversely affect their properties and subsequent performance. The Contractor has the option of removing such materials or having them retested for approval.

The Contractor shall submit to Employer, the quality plans and field welding schedules (for field weld of pressure parts only), along with test procedures

and WPS endorsed by designer wherever applicable, for checks to be done during manufacturing and erection, for review and approval by Employer.

B0.3.10 Options and Alternatives

B0.3.10.1 Option 3.1: Absorber made of concrete (alternative)

See **Section B3**.

B0.3.10.2 Option 3.2: Combined Limestone System for Both Units (alternative)

See **Section B3**.

B0.3.10.3 Option 4.1: Take-out of coal yard roof coverage

This take-out option covers the scope of supplies as given in **Section B4**

B0.3.10.4 Option 4.2: Take-out of coal blending silos

This option covers the take-out of the scope of supplies for 2 coal blending silos of 1000 m³, as given in **Section B4**.

B0.3.10.5 Option 4.3: Limestone yard roof coverage

This option covers the full roof coverage of the limestone yard, as given in **Section B4**.

B0.4 Interfaces

The Contractor shall actively clarify all interfaces with the Employer, the Operator, PGCB and all companies, authorities and any other entity participating in the project.

B0.4.1 Battery limits of the plant

The interfaces for the Plant shall be as follows.

The Contractor shall actively clarify all details of the interfaces with the Employer, the grid operator (NLDC), the coal supplier, the fuel oil supplier, the limestone supplier and all other interfacing companies.

All mentioned equipment, connections, connection materials, counter flanges, shut-off valves, safety valves, seal up material and works are included in the scope of supply:

Designation	Category	Interface / Terminal Points
TP1	HV overhead transmission line (OHL)	400 kV and 230 kV OHL conductors on the gantries for connection of the related GIS bushings. - OHL conductors for connection of the Line Traps.
TP2	OHL Protection	None <i>Remark: The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project</i>
TP3	OHL Telecommunication	- Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the PGCB/NLDC and for the teleprotection. - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC).
TP4	Earthing grid	- Terminals on the gantries for connection of the OPGW - Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels
TP5	Plant water intake	Intake from Possur river, all required supplies and services in scope
TP6	Plant water discharge	Discharge to Possur river, all required supplies and services in scope
TP7	Coal supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services)
TP8	Fuel oil supply	At and including Fuel Oil Truck Unloading Station near the Power Plant. All supplies and services in scope
TP9	Limestone supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services) (common equipment with coal supply)



Designation	Category	Interface / Terminal Points
TP10	Fly ash	Outlet connection at: • ship loading from fly ash storage silos • Truck loading from fly ash storage silos • Truck loading from intermediate fly ash silos • ash pond All supplies and services in scope
TP11	Bottom ash	Outlet connection at: • Truck loading from bottom ash storage silos • Truck loading from intermediate bottom ash silos • ash pond All supplies and services in scope
TP12	Gypsum	Outlet connection at: • ship loading from gypsum storage silos • Truck loading from gypsum storage silos • Truck loading from intermediate gypsum silos All supplies and services in scope
TP13	Raw water supply	Pipeline 1 m outside Plant boundary; interface with raw water supplier
TP14	Sewage water	Discharge to Passur river
TP15	Storm water	Discharge to Passur river, outside the Plant area; all required supplies and services in scope
TP16	Waste water for discharge	Discharge to Passur river
TP17	Waste water and scheduled waste for disposal	Interconnection to facility external disposal
TP18	Chemicals supply	Chemicals receiving facility
TP19	Township 11 kV Power supply	Terminals in the 11 kV unit board of the Power Plant
TP20	Construction Power	2 terminals at 33 KV line at the border of the Power Plant Site

B0.4.2 Interfaces to electricity dispatcher

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

B0.4.2.1 Interface between the Power Plant and the NLDC

In order to link the Plant to the 400 kV PGCB National Load Dispatch Center (NLDC) the Contractor shall make available all analogue and digital signals in accordance with the requirements of the Bangladeshi Grid Code and as requested by PGCB and the Employer. These will include command

signals from the NLDC to the Plant's automatic load control systems (AGC, see **Part B8**).

The Contractor shall liaise with NLDC to facilitate necessary interfacing with the SCADA System in NLDC. All necessary firmware and software with suitable communication link through serial interface (to match the protocol of the existing system) shall be provided by the Contractor. Necessary reconfiguration is to be done by the Contractor to establish logical link with the existing SCADA system in NLDC. Further, reconfiguration of the database and various display builder functions of the SCADA system in NLDC to accommodate additional signals are under the scope of work of the Contractor.

The following reserve requirements shall be taken into account:

- Min. 10% of the equipment installed shall be a reserve to enable handling of an additional 10% of signals without the need for equipment extensions.
- Min. 15% of the equipment installed shall be a reserve to enable handling of an additional 15% of signals by extending the equipment but without the need to modify the existing structure of any of the interface marshalling cubicles installed.

B0.4.2.2 Signal interface to NLDC for automatic generation control

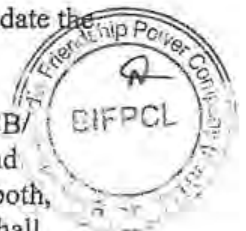
The power plant shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from NLDC.

The NLDC shall be able to link to the Automatic Generation Control (AGC) via telecontrol facilities so as to act on the turbine load control, adjusting the latter by decrease/increase load commands. All measurement data to indicate if the target load has been matched shall be transmitted by the telecontrol system to NLDC. Type and initial number of signals are defined in **Section B8**.

B0.4.2.3 Interfaces between the 400/230kV substation and the NLDC

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

The communication interface unit shall be adequate to fulfil the PGCB/ NLDC information requirement. Communication to the National Load Dispatch Center shall be provided by data communication, utilizing both, the IEC 60870-5-104 and the IEC 60870-5-101 protocols. Settings shall ensure interoperability with the remote National Load Dispatch Center.



For possible future extensions, it shall be possible to interface with two remote control centers simultaneously by using dual port capability.

From the National Load Dispatch Center, all related high voltage apparatus of the substations shall be remote controlled and monitored. Necessary interface shall be provided within the substation automation system for receiving the signals from PGCB grid control.

All signals of the substation required for the control and monitoring from the remote National Load Dispatch Center shall be made available for data transmission via the gateway.

The scope of supply includes all required equipment and installations to enable the substation for the proper connection of the required control and monitoring signals. Communication, telemetry, fiber optical terminal and tele-protection equipment (PLCC) will be supplied and installed by PGCB at Company substation end, matching with PGCB's remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48 VDC/AC auxiliary supply at Company substation end shall be provided by the Contractor. The Contractor shall supply and install the necessary cabling and cubicles. Cabling between these cubicles and the telecommunication equipment provided by PGCB shall be provided and installed by the Contractor.



B0.4.2.4

Interfaces between the 400/230kV substation and the Power Plant

The Contractor is responsible for the construction of the interconnections between the substation and the Power Plant. Provision and installation of all control and signal cables between the substation and the Power Plant is within the responsibility of the Contractor.



The Power Plant shall be able to supervise and control the substation via an OPC client workstation installed in the Power Plant's CCR. The Contractor shall provide and install the OPC Server/Client architecture as well as all necessary equipment required for the proper translation of the native data (either acquired directly from the IEDs or from connectivity with the station bus) in OPC-format and the data provision at the OPC-client in the Power Plant control room via a TCP/IP communication link.

In addition the SCMS may communicate with the DCS either by serial communication link or by hardwired connection. In the former, dual redundant links and communication apparatus must be provided. However, the watchdog signalling logic must be hardwired so that this will continue to operate effectively even during SCMS failure.

B0.4.2.5 Interface to power transmission system (PGCB - Power Grid Company of Bangladesh)

The interface between the power transmission system of PGCB and Maitree-STPP will be the following points of the 400/230 kV GIS:

- 400 kV and 230 kV Interconnection:
 - 400 kV and 230 kV OHL conductors on the gantries for connection of the GIS bushings. The gantries shall be provided under the Maitree-STPP project.
- 400 kV and 230 kV OHL Protection, Control and Synchronization:
 - None.

Remark: The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project.

- Telecommunication:
 - Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries
 - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the LDC and for the teleprotection.
 - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC).
- Earthing:
 - Terminals on the gantries for connection of the OPGW.
 - Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels.

B0.4.3 Metering

Sufficient metering devices shall be provided to enable an energetic balancing of the power unit, all fuel consumers and additionally the Plant comprising gross and net electric power, coal flow, fuel oil flow, calorific value of fuels, fuels heat energy, electric power, specific heat consumption, etc. for tariff metering and internal balancing purposes.

Metering devices of electrical signals such as frequency, voltage, active power, reactive power, and energy shall be provided:

- i for the power unit for tariff metering at the switchyard
- ii for the power unit and additional the Plant for internal balancing purposes at all switchgears and all generators.



The following directions, information and technical requirements for design, engineering, manufacturing, procurement, construction, commissioning, start-up and testing shall be observed as far as they are applicable for the equipment to be delivered. The requirements stated in this Section of General Technical Requirements are valid for all sections of the specification, except only where additional and/or special requirements are specified.

Any changes on the design of any part of the Plant, which may become necessary after signing of the Contract, have to be submitted by the Contractor in writing to the Employer for approval, being sufficiently substantiated and justified.

The parts of the Plant shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without necessitating large scale dismantling of other parts of the Plant. They shall be designed, manufactured and put into operation in accordance with the latest recognized rules of workmanship, modern engineering practice and with good standards of prudence applicable to the international electricity generation industry which would have been expected to accomplish the desired result at the lowest reasonable cost consistent with reliability, safety and expedition.

The regulations, standards and guidelines listed in the Specification as well as all applicable laws and governmental decrees, regulations, orders, etc. shall be observed in the design, calculation, manufacture, erection, installation, testing, commissioning and start-up of all parts of the Plant.

The following shall be considered in the design and engineering of the Plant facilities:

- All parts of the Plant shall be suitable in every respect for continuous operation at maximum output as well as part loads and expected transient operating conditions peculiar to the site and shall be able to safely withstand the stresses arising from the operating conditions without any reduction in its planned life.
- The Contractor shall familiarize himself with the conditions on site.
- Suitable and automatically acting protection and safety measures shall be provided for automatic load reduction or shut down of equipment in case of abnormal operating conditions.
- Switchover to stand-by units shall be automatically, as far as required for continuous Plant operation without interruption of Plant operation.
- In case of equipment and/or system shut down process conditioned drainage of components (such as pipelines, tanks, etc.) shall be performed automatically from the control room.
- Minor equipment which, in case of failure would cause a failure of a power generation unit and/or the Plant is to be provided with a stand-by facility in order to ensure further operation of the power generation unit or the Plant.
- All live, moving and rotating parts shall be provided with appropriate effective protection in order to avoid danger to the operating staff. All metal parts shall be electrically grounded.
- All equipment shall be designed to ensure start-up from any condition, i.e. from long term shut-down, cold, warm or hot condition without necessitating special or preparatory measures.
- The project language shall be English.

B0.6.2 Standards and codes

The work must be performed according to the most recent relevant codes, standards, accident prevention regulations and local rules and legal regulations.



All materials and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of goods, methods of inspection, specific design features of equipment and parts and acceptances of partial plants shall comply in every respect with the applicable standards, codes and regulations to be chosen from the following:

- American Association of State Highway and transportation Officials

AASHTO



• American Concrete Institute	ACI
• American Gear Manufacturers Association	AGMA
• American Institute of Steel Construction	AISC
• American Iron & Steel Institute	AISI
• American Moving and Conditioning Association	AMCA
• American National Standards Institute	ANSI
• American Petroleum Institute	API
• American Public Health Association	APHA
• American Society for Testing and Materials	ASTM
• American Society of Civil Engineers	ASCE
• American Society of Heating, Refrigeration & Air Conditioning Engineers	ASHRAE
• American Society of Mechanical Engineers	ASME
• American Water Works Association	AWWA
• American Welding Society	AWS
• American Wire Gauge	AWG
• Anti-Friction Bearing Manufactures Association	AFBMA
• Architectural Institute of Japan	AIJ
• Association Francaise de Normalisation	AFNOR
• British Standards Institute	BS
• Chlorine Institute	CI
• Crane Manufacturers Association of America	CMAA
• Deutsches Institut für Normung	DIN
• Diesel Engine Manufacturers Association	DEMA
• European Norm	EN
• Expansion Joint Manufacturer Association	EJMA
• Fédération Européenne de Manutention	FEM
• Heat Exchanger Institute	HEI
• Hydraulic Institute	HI
• Illuminated Engineers Society	IES
• Institute of Electrical and Electronics Engineers	IEEE
• Instrument Society of America	ISA
• Insulated Power Cable Engineers Association	IPCEA
• International Electrotechnical Commission	IEC
• International Standards Organization	ISO
• Japanese Architectural Standard Specification	JASS
• Japanese Electrical Manufacturers Association	JEMA
• Japanese Electrotechnical Institute	JEC
• Japanese Industrial Standards	JIS
• Manufacturers Standardization Society	MSS
• National Association of Corrosion Engineers	NACE
• National Electrical Code (USA)	NEC
• National Electrical Manufacturer's	NEMA



Association (USA)	
• National Electrical Safety Code	NESC
• National Fire Protection Association	NFPA
• National Structural Code for Building	NSCB
• Occupation Safety and Health Administration	OSHA
• Portland Cement Association	PCA
• Properties of Water and Steam	IFC
• Scientific Apparatus Manufacturers Association	SAMA
• Society of Automotive Engineers	ASE
• Standards of Japanese Electrotechnical Committee	JEC
• Steel Structures Painting Council	SSPC
• Technische Vereinigung der Grosskraftwerksbetreiber	VGB
• Tubular Exchanger Manufacturers Association	TEMA
• Underwriters Laboratory	UL
• Uniform Building Code	UBC
• Verband Deutscher Elektrotechniker	VDE
• Verein Deutscher Ingenieure	VDI
• Vereinigung Deutscher Elektrizitätswerke (Association of German Power Plants)	VDEW
• Water Pollution Control Federation	WPCF

Generally, all internationally and nationally recognized standards as above will be applied, except if specific standards called for by:

- Occupational Safety Board of Bangladesh
- Department of Inspection for Factories and Establishments, Bangladesh
- Department of Environment, Bangladesh
- Bangladesh Power Development Board
- Bangladesh Energy Regulatory Commission
- Ministry of Power, Energy and Mineral Resources
- Bangladesh Fire Service and Civil Defence Ministry
- All relevant Bangladesh National Statutory Regulations
- Bangladesh National Building Code
- Bangladesh Standards
- Local Authorities.



steam boilers and unfired pressure vessels together with associated pipework and fittings shall comply with the Bangladesh Boiler Act, 1923 with amendments.

All pressure parts shall be designed in accordance with applicable ASME codes.



All services, supplies and works shall comply with the requirements of the relevant laws of Bangladesh and the IFC/World Bank Group Standards and Guidelines in their latest edition, including but not limited to:

- Environmental Conservation Rules
- Bangladesh Energy Regulatory Commission Act;
- BERC Licensing Regulation
- BERC Technical Quality Standards;
- Bangladesh National Building Code;
- other applicable laws in Bangladesh;
- IFC Performance Standards on Environmental and Social Sustainability;
- IFC / World Bank Group Environmental, Health and Safety (EHS) General Guidelines ;
- IFC / World Bank Group EHS Guidelines for Thermal Power Plants;
- IFC / World Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

It is the Contractor's responsibility to provide sufficient evidence that any national or other standard the Contractor proposes (other than those mentioned above) will ensure an equivalent or higher standard.

Immediately after effective date of the Contract the Contractor shall supply an indexed list of all standards, codes and associated standards referred to, to which the work is to be performed. A copy of all applied standards shall be forwarded to the Employer. The Contractor shall supply preferably two (2) searchable softcopies, else two (2) hardcopies each.

B0.6.3 Plant and equipment identification

The Contractor shall apply a plant identification system showing the name and number of each item of Plant and its respective arrangement drawing number and add any additional items necessary to fully identify the Plant.

All design submissions shall include a detailed labelling list indicating the label text, size of the lettering and fixing details for the approval of the Employer or its representative.

The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).

There is to be only one approved description for any one item of Plant and this must be used consistently for Plant, electrical and instrumentation designations throughout.

The Contractor shall supply all labels (Plant and Equipment Identification Plates), nameplates, manufacturer's equipment nameplate, instruction and

warning plates necessary for the identification and safe operation of the Plant, and all inscriptions shall be in the English language and Bangla language.

All labels, nameplates, instruction and warning plates shall be securely fixed to items of Plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives will not be permitted.

Nameplates for Plant and equipment identification and record purposes shall be manufactured from stainless steel or aluminium with a mat or satin finish, and engraved with black lettering of a size which is legible from the working position.

Warning plates shall be manufactured from stainless steel or aluminium engraved red lettering on a white background and sited in the position where they afford maximum safety of personnel.

All equipment within panels and desks shall be individually identified by satin or mat finish stainless steel or aluminium labels.

Each circuit breaker panel, electrical control panel, relay panel, etc. shall have a circuit designation label on the front as well as on the rear panels engraved with black lettering in accordance with the circuit designation system. Circuit designations must be precise and convey complete information. There should be no doubt whatsoever for the operation as to which area of the Plant a particular feeder is supplying with power. Labels such as interconnector 1 or feeder 2 are not acceptable. Corridor type panels shall in addition have circuit designation labels within the panels.

Pipework systems shall be identified with a colour identification systems in conformity with the colours according to the Employer's specification, with colours at the nameplates and, if necessary by colour bands and with KKS numbering and plain language. The direction of flow shall be shown.

Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.

Where possible valve nameplates shall be circular and shall be fitted under the handwheel captive nut. They have to be of such a diameter that there is no danger for persons operating the valve or that they do not prevent lock-off of this valve; on check valves and small valves the Contractor may provide rectangular nameplates fitted to brackets on the valve or attached to a wall or steelwork in a convenient position adjacent to the valve.



B0.6.4 Marking and labelling

Each crate or package is to contain a packing list in a waterproof envelope. All items of material are to be clearly marked for easy identification against the packing list.

All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, where the weight is bearing and the correct position of the slings and are to bear an identification mark relating them to the appropriate shipping documents.

All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.

B0.6.5 Corrosion protection, coating and galvanizing

This specification shall be used for the corrosion protection of steel structures, components, pipings and equipment in general which are installed in confined areas (indoors) or outdoors.

Surface preparation, as well as protective coatings and coating systems are based on this specification in order to assure that structural parts of different suppliers will get a corrosion protection of similar and high quality.

Coating material shall only be supplied by manufacturers with international experience and their products can be obtained internationally.

Regarding maintenance work (storage), application and supervision of coating work, choice of coating suppliers should be minimized. At any rate, similar parts of structures/components (such as structural steel, containers, piping, etc.) shall only be coated with products of one individual manufacturer.

The materials and equipment used, the methods of application and the quality of work shall at all times be subject to the inspection and approval of the Employer or his Representative.

To mitigate crevice corrosion, the designs and construction of structures and equipment shall ensure that no collection of water occurs in crevices which could lead to crevice corrosion.

It is the responsibility of the Contractor to ensure that, for all supplied equipment (including that from sub suppliers):

- The protection system is perfectly suitable for the Site conditions and for the specific purpose.
- The shop paints provide a sufficient protection during transport, storage and erection.



- The shop paints are suitable for handling and erection conditions (slinging, Site welding works etc.) and are compatible with the Site finishing coats
- All necessary precautions are taken in order to prevent damage to paints during storage, handling, welding.
- The necessary repairs are carefully executed as soon as possible.
- The colour RAL number of the finishing coat has been approved by the Employer, including identification code for piping.
- Standardised equipment will be painted according to the manufacturer's standard.
- All corrosion protection and coating on site shall be done in a workshop specifically for the purpose of the application of corrosion protection and coating.

Codes and standards

Applicable standards are:

- Product data of coating manufacturer
- DIN 2403 Indication of pipe-lines according to flowing material
- DIN 4762 Surface roughness
- ISO 8503 Surface roughness
- DIN 8201 Part 1-9 tight blasting agents
- DIN 50976 Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing
- DIN 55928 Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats
- ISO 8501 Preparation of steel substrates before application of paints and associated products
- ISO 12944 Paints and varnishes – corrosion protection of steel structures by protective paint systems
- RAL Colour card
- ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SSPC Vol. 1 and 2 Steel structure painting council



SURFACE PREPARATION AND CLEANING OF SURFACES IN THE SHOP

Prior to blasting, areas have to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser, or solvent for more severe grease contamination. The cleaning should be to provide a "water break free surface".

Sharp edges have to be rounded off.

Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the Weber Reilly test method (or similar approved) and pH is to be tested using universal indicator paper strips prior to continuation with the blasting.



The preparation of substrates shall be carried out on the basis of the specifications of ISO 12944 part 4 and ISO 8501. The preparation of steel before application of paint and related products shall be in line with ISO 11124 for metallic blast cleaning abrasives and ISO 11126 for non-metallic blast cleaning abrasives. No recycled blast grit may be utilised.

After blasting, an anchor profile of 25 - 50 μm shall be achieved. Blasted surfaces have to be provided with a prime coat of the approved coating system immediately within 4 hours of blasting. All blasting and priming must take place outside of the high humidity periods of the day (i.e. maximum relative humidity of 80%).

Cleaning to be performed on site

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil, etc. before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming, , unless the specific coating system allows for coating onto damp concrete, in which case only with approval from the Employer.

If a protective coating of concrete is required, concrete shall be allowed to cure before painting.

Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels, and abrasive blasting according to DIN ISO 8501-1.

Cleaning of prime and intermediate coats (if required)

To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

Application procedure

When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain the maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed. For a multi-layer coating system each layer has to have a different colour shade in order to clearly identify number of coats applied.



The last finish coat has to be applied in the specified colour shade.

All paintings shall be performed according to ISO 12944. The durability of all paintings shall be "high" which corresponds to 15 years.

The interval between applying the different coats has to follow according to supplier's precautions. Each layer has to be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Following application procedures are allowed:

- prime coats by airless spray
areas like disconnections, angles, corners, etc. which are difficult to be reached can be applied by brush or roller
- repair of prime coat by brush
- finish coats
 - at works by airless spray, roller or brush
 - at site by roller or brush or airless spray.

When applying coating systems by roller, rollers have to be of kind and quality which make an appropriate application possible.

Control areas in accordance with the coating supplier's instructions have to be applied. For this procedure, a schedule for control areas has to be prepared by the Contractor and coating supplier which corresponds with the requirements of the warranty agreement.

Number and performance of the control areas have to be done in accordance with ISO 12944 part 7 and have to be documented in writing.

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No application shall take place either in the condition of the relative humidity not within the given limit or in case of poor weather conditions such as fog, dust, rain, snow, hail or when it can be assumed that such conditions of poor weather will arise within 2 hours after application.



Temperature of the coated parts has always to be above 5 °C and 3 K above dew point.

All specified dry film thicknesses (DFT) are minimum thicknesses.

Welding seams executed at site have to be taped with an adhesive tape of about 30-50 mm after surface preparation (blasting or manual derusting) and prior to application in the manufacturing plant and to be coated with stripping coat.



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Chequered plates, nap plates, etc. have not to be covered with adhesive tape, but have to be coated with stripping coat in a dry film thickness of at least 150 μm .

Edging lines on steel structure have to be taped prior to application and after blasting in sufficient width or have to be protected with varnish before application. Thickness of prime coat may be 50 μm maximum.

During repairing works at site on shop-primed structures, it is important that different coats will have different colour shades. Numbers of layers have to be the same as the original coating system to be used.

Application of temporary primer on structures which have to be insulated has to be in accordance with a sufficient corrosion protection for the period of storage respectively erection time.

Galvanizing

Galvanizing work shall conform in all respects to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed to suit the requirements of the process. They should be in accordance with ISO 12944.

Vent holes and drain holes shall be provided to avoid high internal pressures and air locks during immersion and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in Table 1 of BS 729. Structural steel items shall be first grit-blasted to BS 4232, second quality, (Sa 2 1/2) or pickled in a bath, and the minimum average coating weight on steel Sections 5 mm thick and over shall be 900 g/m^2 , on steel Sections 2 - 5 mm thick 600 g/m^2 .

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Protected slings must be used for off-loading and erection. Galvanized work, which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation for all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored by:

- cleaning the area of any weld slag and thorough wire brushing to give a clean surface
- The application of two coats of zinc-rich paint, or the application of a low melting point zinc alloy repair rod or powder to the damaged area, which is heated to 300 °C or the treatment with suitable cold galvanizing paint, such as ORAPI n.z.a.b 706. All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

Connections between galvanized surfaces and copper, copper alloy or aluminium surfaces shall be protected by suitable tape wrapping.





Coating Systems		Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat μm	Total DFT μm
System-No.	Surface location + Temp. $^{\circ}\text{C}$						
1	Structural steel works, piping vessels, tanks INDOOR	SA 2.5	Primer Finish	1 1	Zinc-Epoxy Epoxy High Solid	80 80	80 <u>80</u> 160
2	Structural steel works, piping, vessels, tanks OUTDOOR	SA 2.5	Primer Intermediate Finish	1 1-2 1	Zinc-Epoxy Epoxy High Solid 2-Comp. Polyurethane	80 160 50	80 160 <u>50</u> 290
3	Piping, tanks, etc. INDOOR and OUTDOOR, Insulated	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	Pumps, motors, other equipment OUTDOOR	SA 2.5	Primer Intermediate Finish	1 1 1	Zinc-Epoxy Epoxy High Solid 2-Comp. Polyurethane	80 110 50	80 110 <u>50</u> 240
5	Pumps, motors, other equipment INDOOR	SA 2.5	Primer Finish	1 2	Zinc-Epoxy Epoxy High Solid	80 50	80 <u>100</u> 180
6	Piping, reactors OUTDOOR Insulated	SA 2.5	Primer	1	Zinc Ethylsilicate	75	75
7	Stacks OUTDOOR	SA 2.5	Primer Finish	1 2	Zinc Ethylsilicate Silicone Acrylic	75 50	75 <u>100</u> 175

Coating Systems								
System-No.	Surface location	Temp. °C	Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat μm	Total DFT μm
8	Steel surfaces Uninsulated	200 - 450	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
				Finish	2	Silicone Aluminium	25	50
9	Galvanized surfaces	up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine sand	When Finish Coat is required such as sea climate with chloride exposure	1	Epoxy High Solid*	125	125
10	Steel surfaces permanently in contact with water, also river water splash zone	Medium temp. °C up to 60	SA 2.5	Prime and Finish Coat in One	1	Glassflake reinforced High Solid Epoxy	500	500
11	Plant / Cooling water pipes	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						



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