

TECHNICAL REQUIREMENT OF PQR

Name of Project:- 400/230kV Switchyard at 2X660 MW Maitree STPP, Bangladesh for M/s BIFPCL

Name Of Item :- 400kV Current Transformer

Sr. No	Description	Supporting Document to be attached	Reference No. of supporting documents																
A)	Cl. No. 1.3 of Section-1 of TS																		
01	400kV Current transformers being offered should be from manufacturer who have manufactured and supplied at least fifteen (15) nos. of single phase current transformers suitable for Air Insulated Substation/ Switchyard of 400kV or above class which should have been in successful operation for minimum two (2) years prior to the originally scheduled date of techno-commercial bid opening, i.e. 22/09/2015.	a) Bidder to provide confirmation of fulfilling Technical Requirements mentioned in Cl. No. 1.3 of Section-1 of TS. b) Purchase Orders The details are to be submitted in following format, <table><tr><th>Sr. No</th><th>ITEMS SUPPLIED TO</th><th>ORDER REFERENCE No. & DATE</th><th>ITEMS</th><th>QUANTITY</th><th>ORDER FULLY EXECUTED. YES/NO</th><th>STATUS, IF ORDER UNDER EXECUTION</th><th>REMARK</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> c) Dispatch Instructions/ Material Receipt at site certificate/ Lorry Receipt details etc d) Letter/ Certificate/ MOM from customer/ end user for satisfactory operation	Sr. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED. YES/NO	STATUS, IF ORDER UNDER EXECUTION	REMARK									a) b) c) d)
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Note: Satisfactory operation means certificate issued by the customer/end user certifying the operation without any adverse remarks.

[Signature]
08/02/18

[Signature]
05/18



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-388-510-021	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	RD	VK	VK
TITLE 400kV Current Transformer		SIGN			
		DATE			
		GROUP	TBEM	W.O. No	86001
CUSTOMER	Bangladesh-India Friendship Power Co. Pvt. Ltd. (BIFPCL)				
CONSULTANT	FICHTNER				
PROJECT	400/230kV Switchyard at 2X660 MW Maitree STPP, Bangladesh				

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400kV Current Transformer complete with accessories as listed in this specification.

The fitment and equipments offered shall be of approved make of BIFPCL or its subsequent approval from BIFPCL shall be bidder's responsibility with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s BIFPCL, the bidder has to supply alternate BIFPCL approved make, meeting the specification, with no commercial implications to BHEL.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements and Quantities
- Section-2: Equipment Specification
- Section-3: Project Details & General Technical Requirements
- Section-4: Guaranteed Technical particulars (GTP)
- Section-5: Checklist

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Bangladesh-India Friendship Power Co. Pvt. Ltd. (BIFPCL)

Name of consultant: FICHTNER

Name of Projects: 400/230kV Switchyard at 2X660 MW Maitree STPP, Bangladesh

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 System parameters and technical requirements

Sl No.	Parameters	400kV CT (Outdoor, hermetically sealed, Oil-filled/SF6-filled, Porcelain/Polymer Insulator)
1	Nominal voltage (Phase to Phase) [kVrms]	400
2	Max. Continuous voltage U_m (Phase to Phase) [kVrms]	420
3a	1.2/ 50 micro sec Impulse withstand voltage [kVp]	+1425
3b	250/2500 micro sec Switching Impulse withstand voltage (Dry and Wet) [kVp]	± 1050
4	One min. dry and wet power frequency withstand voltage [kVrms]	650
5	One minute power frequency withstand voltage between secondary terminal & earth [kV]	As per Section-2
6	Rated frequency [Hz]	50
7	Rated Short Time current for 1 sec [kA]	50
8	Rated Dynamic current withstand [kA (peak)]	125
9	Rated Primary Current [A]	4000
10	Rated Extended Primary Current	120%
11	Rated secondary current [A]	1
12	Minimum creepage Distance (phase to ground) [mm/kV]	31
13	Max temperature rise over design ambient temp	As per Section-3
14	Type of Insulation	Class A
15	Partial Discharge level [pC max.]	As per Section-2
16	Number of Terminals	All terminals of control circuits are to be wired upto terminal box plus 20% spare terminals evenly distributed on all TBs.
17	Cantilever strength of CT at the terminal [kg]	600
18	Terminal Box - Ingress Protection	IP 65

1.2.2 Core Parameters for 4000A Current Transformer (6 core)

Core No	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class
1	4000-2000-1000/1 A	-	4000-2000-1000V	30-60-120mA	20-10-5 Ohms	PX
2	4000-2000-1000/1 A	-	4000-2000-1000V	30-60-120mA	20-10-5 Ohms	PX
3	4000-2000-1000/1 A	-	4000-2000-1000V	30-60-120mA	20-10-5 Ohms	PX
4	4000-2000-1000/1 A	-	4000-2000-1000V	30-60-120mA	20-10-5 Ohms	PX
5	4000-2000-1000/1 A	30	-	-	-	0.2s, ISF ≤ 5
6	4000-2000-1000/1 A	30	-	-	-	0.2s, ISF ≤ 5

1.2.3 Offered CT shall be as per BIFPCL specification (Annexure-I, Section-1, 5 pages)

1.3 TECHNICAL REQUIREMENTS

400kV Current transformers being offered should be from manufacturer who have manufactured and supplied at least fifteen (15) nos. of single phase current transformers suitable for Air Insulated Substation/ Switchyard of 400kV or above class which should have been in successful operation for minimum two (2) years prior to the originally scheduled date of techno-commercial bid opening, i.e. 22/09/2015.

1.4 BILL OF QUANTITY

Item No.	Description	Quantity (Main)	Quantity (Spare)	Total Quantity
01	Single Phase, 400kV, 4000A, 50kA for 1s, 6 core Current Transformer	6 Nos.	1 No.	7 No.

Note:

1. Marshalling Box for a set of three (3) CTs shall be provided by BHEL.
2. The above quantities are subject to change by ±20% at contract stage.
3. Hardware (Nut, Bolts and Washers) for Mounting CT on structure – 1set for each CT to be included by bidder in their offer.

1.5 TYPE TEST

All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not prior to **five years from 22.09.2015**. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.

However if contractor is not able to submit report of the type test(s) conducted within last 5 years from the date mentioned above, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.6 DRAWINGS

The documentation requirements detailed under Section-3 shall be submitted to BHEL at various stages of contract. Softcopy of the drawings are to be submitted at contract stage.

1.7 DOCUMENTS REQUIRED WITH OFFER

- a) "No Technical Deviation" Certificate
- b) Un-priced schedule
- c) Filled up Checklist
- d) Catalogue and Technical Leaflets for the offered Equipments

1.8 WARRANTY

Refer relevant clauses mentioned elsewhere.

1.9 Sea-Worthy Packing, Packing and Shipping Instructions

Refer Annexure-E of Section-3.

ANNEXURE-I

SECTION- 1

All earthing switchgear shall be interlocked with associated circuit breakers and disconnectors so that it shall not be possible to close an earthing switch onto a live circuit or to make the circuit alive when the earthing switch is closed.

Facilities for padlocking earthing switches in the open and closed positions shall be provided together with means for isolating the motor drives.

High speed earthing switches:

High speed earthing switches shall comply with the requirements of IEC 62271-104 and IEC 62271-203.

These earthing switches shall be capable of making short circuit current and suitable for high speed power operation. It shall be impossible to slow-close these earthing switches.

High speed earthing switches shall be fully type tested and shall be capable of withstanding the rated peak withstand current and sustaining the rated short-circuit current of the switchgear. They shall be located at all line feeder terminal points and bus bars or other location where there is no certainty that the point to be earthed is not energized. Power mechanisms operated by LV DC shall be self locking in both open and closed positions. High speed earthing switches shall be capable of making and breaking small induced inductive and capacitive currents, as may be necessary to operate the earthing switches for earthing of one out of two or more long parallel lines.

Facilities integral with the earthing switch for primary current injection or low voltage checks shall be insulated from earth and incorporate a disconnectable earth strap.

These earthing switches shall otherwise be in accordance with the requirements for maintenance of earthing switches.

B10.4.5.7 400 kV and 230 kV current transformers *UIS*

The current transformers to be supplied suitable for the duty specified and comply with the requirements of IEC 61869 and IEC 61869-2 as appropriate.

Current transformers shall be of the toroidal core type, compatible with the switchgear.

Current transformers shall comply with the requirements of the common sections of this Specification. Where separate terminal boxes are used for current transformer's secondary wiring, the identifying labels shall be fitted to the terminal boxes in a conspicuous position but not on removable covers.

Current transformers including primary conductors shall have a short time current rating and duration not less than that of the associated switchgear. All current transformers shall have sufficient overload capacity to permit continuous operation with currents up to ~~150%~~ ^{120%} of the rated current of the associated equipment.

Secondary windings of each current transformer shall be earthed through a disconnectable link at one point only, in the relay panel for protection circuits and in the control panel for instrumentation.

Current transformers for tariff metering shall not be used for any other purpose. Current transformers for statistical metering may also be used for other instruments except for protection.

Where double ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformer, indicating clearly the connection required for either ratio. These connections and the ratio in use shall be shown on the appropriate schematic and connection diagrams.

CT design calculations shall be submitted to the Employer/Employer's Representative for approval.

Where multi-ratio current transformers are specified and current transformers with multiple windings are bided, it shall be possible to select either ratio for each winding without alteration to the number of primary turns. All connections from secondary windings shall be led out and taken by means of separate insulated leads to a terminal board mounted in the local control cubicle.

The characteristics of current transformers used for protection circuits shall be fully compatible with the protection relays and shall include the following requirements:

- For overcurrent protection, they shall not saturate, change ratio or produce harmonic voltages in the secondary winding, which will affect the accuracy of the relay with primary currents up to 20 times rated full load current or maximum through fault current, whichever is higher.
- For earth fault protection and balanced forms of protection, when connected as in service, they shall not produce spill currents in excess of half the minimum operating current of the relay but provide stable equipment with primary currents up to 20 times rated full load or maximum through fault current whichever is higher.
- Provision shall be made to carry primary injection test of bushing CTs for 100% rating. The partial discharge level permissible shall be less than 10 pC at measuring voltage of $1.2 U_m/\sqrt{3}$.

The terminal board for CT connection shall have shorting, testing and disconnecting facilities which shall allow tests to be conducted with the circuit on load and which may be operated without disturbing the wiring.



It shall be possible to carry out primary injection testing of CT's with 100% rating when the switchgear is fully assembled or re-testing of the CTs during the service life of the switchgear without interruption of supply to adjacent circuits or any part of bus bar. The access for primary injection facilities for site testing shall be clearly stated by the Bidder/Contractor. Unless otherwise approved, current transformers shall be accommodated separately from the circuit breaker. Where it is required to accommodate free issue current transformers, the Contractor shall advise the limitations as to types and sizes of current transformers which can be accommodated and material limitations for the transformer to be compatible for use in SF6 gas.

The secondary windings of each set of current transformers shall be capable of being open circuited as per IEC standards with maximum voltage of 4.5 kV peak. The secondary wiring of all CTs shall be brought up to a common terminal block located within the local control cubicle.

The magnetization characteristic of all current transformers shall be checked up to 100% current rating to identify the current transformers with reference to the manufacturer's design curve. Special measures may have to be taken to ensure that the core is fully demagnetized before commencing the test.

CTs for protection shall not be used for metering. CTs for protection and metering shall be physically separate.

The rated short time thermal current on all taps shall not be less than the through fault capacity of the associated circuit breakers.

The characteristics of current transformers shall be submitted to the Employer/Employer's Representative for approval, together with details of the protection, instrumentation or measuring equipment with which each current transformer is to be used. Each current transformer shall be capable of providing the necessary output to operate the related devices satisfactorily at the burdens involved.

All technical parameters are specified in the Technical Data Sheets.

However Bidder/Contractor is free to decide any parameter (which is not in data sheet) to be decided according to prescribed standard.

Current transformers having accuracy classes between 0.1 and 2 may be provided with extended current rating in accordance with IEC 61869-2, up to an equivalent primary current rating not exceeding that of the associated switchgear circuit current rating.

The magnetic characteristics of the CTs of the circuit of each group shall be appropriate for the optimum operation of the protection system.

The polarity of the primary and secondary windings of each transformer shall be clearly indicated at the respective terminals and in addition, labels

shall be fitted in a readily accessible position to indicate the ratio, class and duty of each transformer winding.

Current transformers shall be located as shown in the Single Line Diagrams.

~~B10.4.5.8~~ 400 kV and 230 kV GIS voltage transformers

Primary connections shall have the same short time current rating as the associated switchgear.

Each secondary winding of the voltage transformers shall be protected by suitable approved fuses and links. Voltage transformers shall be of dry type, compatible with the switchgear and shall not contain any hygroscopic insulating material which could affect the SF₆ gas in either the voltage transformer or in the associated switchgear chamber.

Voltage transformers shall comply with the common sections of this Specification, with the requirements of IEC 61869, IEC 61869-3 for inductive VTs and IEC 61869-5 for capacitive VTs and shall be provided with three (3) secondary windings, as specified in the Technical Data Sheets.

- The rated secondary voltage per phase shall be $110/\sqrt{3}$ volts in the case of star connected windings and $110/3$ in the case of delta connected windings, and the rated voltage factor shall be 1.2 continuously and 1.5 for 30 seconds and 8 hrs. for ungrounded DELTA connection 1.9.

The ratio and phase angle error of the voltage transformers shall not exceed the permissible values specified in IEC standard.

VTs shall be rated for the highest equipment voltage per General Design Criteria.

Voltage transformers shall preferably be integrated with the compact switchgear system and they shall be compatible with the switchgears. Facilities for isolating the primary connections without having to lift the VT from the switchgear are required. Alternatively, performance VT withstanding high-voltage tests can be supplied.

It shall not be possible for voltage transformer's secondary windings to be connected directly in parallel, except through interposing voltage transformers associated with a synchronizing scheme. To prevent any possibility of back energizing a VT secondary winding via synchronizing circuits, circuit-breaker auxiliary contacts which are of the late make-early break type shall be employed.

Voltage transformers shall be capable of carrying continuously, without thermal damage, 150% of their rated output.

taken to allow for thermal expansion of the oil contained. The HV terminal shall be suitable for accommodation of an adapter (to be included in the supply) for the bundled phase conductor.

A sealed and oil-filled enclosure at the base of the HV unit(s) shall enclose an inductive circuit with a transformer, secondary terminals, a ferro-resonance suppression device, an overvoltage protection device, earthing switch, draining coil. The ground pad shall be suitable for connection of a cable shoe for the earthing conductor of up to 120 mm².

The CCVT shall be mounted on a pedestal of galvanized steel lattice, to be included in the supply. The top fitting shall be suitable to carry a line trap.

Coupling Capacitors shall be tested in accordance with IEC 60186.

Additional to the tests required therein the following test shall be performed:

- measurement of capacitance
- measurement of dielectric dissipation factor.

✓ B10.4.10.3 400 kV outdoor current transformers (OUTDOOR)

Please refer to the requirements specified for 400 kV and 230 kV GIS, as applicable for AIS CT.

B10.4.10.4 Lightning arresters (conventional outdoor type)

Lightning arresters shall be selected and designed to protect the associated equipment. For required Technical Data please refer to the Technical Data Sheets.

The design data shall be proven by calculations and shall be subject to the approval.

Outdoor lightning arresters shall be of the metal oxide type without gaps and shall be designed to fulfill requirements of IEC 60099.

A lightning arrester arrangement shall be proposed to suitably protect the switchgear. The switchgear will be connected via strung bus and overhead lines to the network system.

The lightning arresters shall be designed as non-linear metal-oxide resistor type without spark gaps

Each lightning arrester shall be equipped with a suitable lightning counter and indicator for monitoring of the leakage current.

Lightning connectors shall be designed for continuous operation and shall be capable of passing repeatedly without distress the maximum discharge current of the arrester. The lightning connector shall be connected to the

SECTION-2

EQUIPMENT SPECIFICATION

CHAPTER - (INST)

INSTRUMENT TRANSFORMERS

1.0 GENERAL:

- 1.1 The instrument transformers and accessories shall conform to the latest version of the standards specified below except to the extent explicitly modified in the specification and shall be in accordance with the requirements in Section-~~GTR- 3~~ ,

Current Transformers: IEC: 60044-1 (or IS: 2705)

Capacitive Voltage Transformers: IEC: 60044-5 / IEC-60358

Inductive Voltage Transformers: IEC: 60044-2

- 1.2 The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.

- 1.3 The external surface of instrument transformer, if made of steel, shall be hot dip galvanized or painted as per Section-~~GTR-3~~. **External surface of aluminum can have natural finish.**

- 1.4 The impregnation details alongwith tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.

- 1.5 The instrument transformers shall be designed for use in geographic and meteorological conditions as given in Section-~~GTR- 3~~

2.0 CONSTRUCTION FEATURES:

The features and constructional details of instrument transformers shall be in accordance with requirements stipulated hereunder:

- 2.1
- a) Instrument transformers shall be of 800/420/245/145 kV class, oil filled/ SF6 gas filled, suitable for outdoor service and upright mounting on steel structures. 420/245/145 kV Instrument transformers and 800 kV CVT shall be with shedded porcelain/ polymer bushings/Insulators However, 800kV CTs shall be acceptable only with polymer Insulator.
 - b) Bushings/Insulators shall conform to requirements stipulated in Section-GTR. The bushing/insulator for CT shall be one piece without any metallic flange joint.
 - c) **Oil filling and drain plugs, oil sight glass shall be provided for CT & IVT. Oil sight glass shall be provided for electromagnetic unit of CVT.** The Instrument transformer shall have cantilever strength of not less than ~~500 kg, 600 kg, 500 kg, 350 kg and 350 kg~~ respectively for 800/420/245/145 kV Instrument

transformers. For CVT/IVT with polymer housing, the cantilever strength shall not be less than 150kg. Oil filling and drain plugs are not required for SF₆ gas filled CT/IVT.

- d) Instruments transformers shall be hermetically sealed units. Bidder/Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers *during detailed engineering*.

Bidder/Manufacturer shall also furnish the details of site tests to check the effectiveness of hermetic sealing for approval.

- e) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.
- f) In case of SF₆ filled CTs/Inductive VTs, it shall be provided with a suitable SF₆ gas density monitoring device, with NO/NC contacts to facilitate the remote annunciation and tripping in case of SF₆ leakage. Provisions shall be made for online gas filling. Suitable rupture disc shall be provided to prevent explosion.

2.2 Terminal box/Marshalling Box:

Terminal box shall conform to the requirements of Section ~~4~~ 3

2.3 Insulating Oil:

- a) Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to ~~IS-3357~~ IEC 60296 (required for first filling). Non-PCB based synthetic insulating oil conforming to IEC 60867 shall also be used in the capacitor units of CVT.
- b) The SF₆ gas shall comply with IEC-60376, 60376A and 60376B and shall be suitable in all respects for use in the switchgear under operating conditions.

2.4 Name Plate:

Name plate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current, extended current rating in case of current transformers and rated voltage, voltage factor in case of voltage transformers shall be clearly indicated on the name plate. The rated thermal current in case of CT shall also be marked on the name plate.

The intermediate voltage in case of capacitor voltage transformer shall be indicated on the name plate.

REFER SECTION-3

3.0 CURRENT TRANSFORMERS:

- a) Current transformers shall have single primary either ring type, or hair pin type and suitably designed for bringing out the secondary terminals in a weather proof (IP 55) terminal box at the bottom. PF Terminal for

measurement of tan delta and capacitance of the unit shall be provided. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. In case "Bar primary" inverted type current transformers are offered the manufacturer will meet following additional requirements:

- (i) The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
 - (ii) The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
 - (iii) The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.
 - (iv) Nitrogen if used for hermetic sealing (in case of live tank design) should not come in direct contact with oil.
 - (v) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.
- b) Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.
 - c) Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. **μ metal or nano-crystalline core can also be used for metering cores.**
 - d) The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.
 - e) Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.
 - f) Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
 - g) The rated extended currents for 800 kV and 420 kV class Current transformers shall be as ~~given below~~ *per section-1* ✓

Tap Ratio	800kV, 3000A	400kV, 3000A
	Rated extended currents in % of rated current	
500/1	200	200
1000/1	—	—
2000/1	180	180
3000/1	120 (200 for 15 min)	120

The secondary winding shall be rated for 2A continuously.

Further, the intermediate tapping at 3000-2000 of metering core of 3000 A rated 400 kV and 800 kV CTs shall be suitable for using as 1000/1 ratio. The Auxiliary reactor as referred at wiring diagram No.0000-000 T E L 028 shall be suitable for connecting to the selected taps. The requirements of 3000A CTs are given at TABLE II-A.

For 245/145 kV class CTs, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CTs as specified in the Section- Project.

- h) For 800/420/245/145 kV current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120%(or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.
- i) The current transformer shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit. The Contractor shall submit the details of packing design to the Purchaser for review.
- j) For 800 kV CTs the instrument security factor at all ratios shall be less than ten (10) for metering core. For 420/245/145 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminal blocks.
- k) The wiring diagram plate for the interconnections of the three single phase CTs shall be provided inside the marshalling box. A typical

wiring diagram No. 0000-000-T-E-L-028 (Sh. 1 & 2) is enclosed herewith ~~at Annexure-I~~ to be followed by the Bidder/Manufacturer.

- l) The current transformers should be suitable for mounting on lattice support structure (for 800 kV) or pipe structure (for 420 kV and below) to be provided by the Contractor in accordance with stipulations of Section ~~GTR-3~~.
- m) The CT shall be so designed as to achieve the minimum risks of explosion in service. Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.
- n) 800/420/245/145 kV current transformers shall be suitable for high speed auto reclosing.

4.0 VOLTAGE TRANSFORMERS:

- a) 800/420/245/145 kV Voltage transformers shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling.
- b) Voltage transformers secondaries shall be protected by HRC cartridge type fuses **or** MCBs for all the windings. In addition, fuses/MCBs shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the IVTs/CVTs shall be terminated to the stud type non-disconnecting terminal blocks in the individual phase secondary boxes via the fuse/MCBs.
- c) CVTs shall be suitable for high frequency (HF) coupling required for power line carrier communication. Carrier signal must be prevented from flowing into potential transformer (EMU) circuit by means of a RF choke/reactor suitable for effectively blocking the carrier signals over the entire carrier frequency range i.e. 40 to 500 KHz. Details of the arrangement shall be furnished along with the bid. H.F. terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling filters of the carrier communication equipment, when utilised. Further, earthing link with fastener to be provided for HF terminal.
- d) The electromagnetic unit comprising compensating reactor, intermediate transformer and protective and damping devices should have separate terminal box with all the secondary terminals brought out.
- e) The damping device, which should be permanently connected to one of the secondary windings, should be capable of suppressing the ferroresonance oscillations.

- f) The accuracy of 0.2 on secondary III for all **CVTs/IVTs** should be maintained through out the entire burden range upto 50 VA on all the windings without any adjustments during operation.
- g) 420/245/145 kV **CVTs/IVTs** shall be suitable for mounting on tubular GI pipe in accordance with stipulations of Section-GTR.
- h) It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.
- i) A protective surge arrester shall be provided *if required*, to prevent breakdown of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternate arrangement, bidder shall bring out the details in the bid.
- j) The wiring diagram for the interconnection of the three single phase **CVTs/IVTs** shall be provided inside the marshalling box in such a manner that it does not deteriorate with time. *A typical wiring diagram no. / 0000-000-T-E-L-029 is enclosed herewith at Annexure-II to be followed by the Bidder/Manufacturer. The Bidder/Manufacturer shall strictly adhere to it and deviations, if any, in this regard shall be brought out with justification for Purchaser's review.*

5.0 TERMINAL CONNECTORS:

The terminal connectors shall meet the requirements as given in Section-GTR: 3

6.0 TESTS:

- 6.1 In accordance with the requirements in Section-GTR³ Current and Voltage Transformers should have been type tested and shall be subjected to routine tests in accordance with IEC:60044-1/IS:2705 and IEC: 60044-5/60044-2 respectively.
- 6.2 The test reports of the type tests and the following additional type tests (additional type tests are required for Instrument Transformers, rated above 72.5 kV only) shall also be submitted for the Purchaser's review.
 - a) **Current Transformers:**
 - i) Corona test as per Annexure-A of Section-GTR and RIV test as per IEC-61869-1
 - ii) Seismic withstand test as per Annexure-B of Section-GTR.

- iii) Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit. (not applicable for SF6 filled CT)
- iv) Thermal co-efficient test i.e. measurement of tan delta as a function of temperature (at ambient and between 80°C & 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 $U_m/\sqrt{3}$) (not applicable for SF6 filled CT)
- v) The current transformer shall be subjected to Multiple chopped impulse test (not applicable for SF6 filled CT) to assess the CT performance in service to withstand the high frequency over voltage generated due to closing & opening operation of isolators. The method as per IEC: 61869-1 may be followed with the application of 600 chopped impulses.

b) **Voltage transformers:**

- i) High frequency capacitance and equivalent series resistance measurement (as per IEC-60358).
- ii) Seismic withstand test (~~as per Annexure B of Section GTR~~).
- iii) Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-60358).
- iv) Determination of temperature coefficient test (as per IEC-60358).
- v) Corona & Radio interference voltage test as per IEC-60044-5, IEC-60044-2 or as per ~~Annexure A of Section GTR~~. However the RIV level shall be as specified in clause Major Technical Parameters in Section GTR.
- vi) (Clause deleted.)
- vii) Apart from the above, report of all special tests mentioned in IEC-60044-5 for Capacitive Voltage Transformer shall also be submitted for approval.

6.3 The current and voltage transformer shall be subjected to the following routine tests in addition to routine tests as per IEC/IS.

a) **CURRENT TRANSFORMERS:**

ROUTINE TESTS:

For Oil filled CTs:

- i) **Measurement of Capacitance.**
- ii) **Oil leakage test.**

- iii) Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1 Um/√3.

For SF6 filled CTs:

- i) Dew point measurement
- ii) SF6 alarm/ lockout check.
- iii) SF6 gas leakage test: Gas leakage rate shall be maintained within 0.2% per annum.

b) VOLTAGE TRANSFORMERS:

Routine tests on CVT/IVT shall be done in line with IEC-60044-5/60044-2.

7.0 SPARE PARTS AND MAINTENANCE EQUIPMENT:

The Bidder shall include in his proposal spare parts equipment in accordance with Section-Project.

8.0 TECHNICAL PARAMETERS:

A. 420 kV CURRENT TRANSFORMERS:

A8.1	Rated Primary current	3000A 4000 A
A8.2	Rated short time thermal current for 1 sec.	40 kA/50kA/63kA (as applicable)
A8.3	Rated dynamic current kA (peak)	100 /125/157.5 (as applicable)
A8.4	Maximum temperature rise over design ambient temperature	As per IEC: 60044 1
A8.5	One minute power frequency withstand voltage sec. terminal & earth	5 kV
A8.6	Number of terminals	All terminals of control circuits are to be wired upto marshaling box plus 20% spare terminals evenly distributed on all TBs.
A8.7	Type of insulation	Class A

Current transformers shall also comply with requirements of ~~Table-1A~~ Section- 1

B. 245 kV CURRENT TRANSFORMERS:

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification. This shall include but shall not be limited to: engineering, manufacturing, shop testing, supply, supervision of erection, testing at site, commissioning, performance testing, training Employer's personnel.

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.

In case of a contradiction between different Sections of this specification or mentioned standards, the more stringent requirements shall be applicable to Bidder/ Supplier.

The Equipment shall be new and clean, and designed, manufactured and arranged so that it will have a functional design and a pleasant appearance. All parts of the Equipment shall be arranged in such a manner as to facilitate surveillance by the operator and to ease maintenance, operation and control.

The parts of the Equipment shall be designed and arranged so that they can be easily inspected, leaned, erected and dismantled without necessitating large scale dismantling of other parts of the Equipment. 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 Equipment. The following shall be considered in the design and engineering of the Equipment facilities:

- All parts of the Equipment 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 Supplier 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.

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- 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.
- 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.

Terminology:

Owner/ Employer: BIFPCL/ BHEL

Contractor: Supplier/ Bidder

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

Site conditions

The following information on local conditions is investigated or compiled by the Owner. The Contractor is hereby in no way relieved from his duties of carrying out all investigations required for satisfactory performance of his equipment/ 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

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and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively.

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

In general the subsoil conditions can be described as follows:

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

Seismic zone

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 (Attached as Annexure-A) 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.

Bidder to design equipment based on parameters of Seismic report (attached as Annexure-A), other relevant electrical requirements, standard codes etc. Foundation loading shall be provided as per parameters of Seismic report.

Site climatic conditions

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:

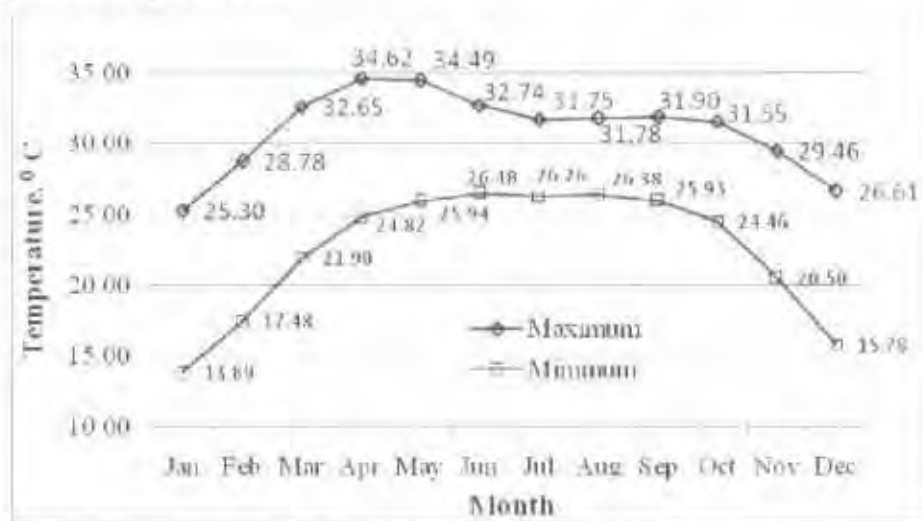
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- summer season-March to May
- monsoon season-June to October
- winter season-November to February.

During the Monsoon Season occasional cyclonic storms can occur.

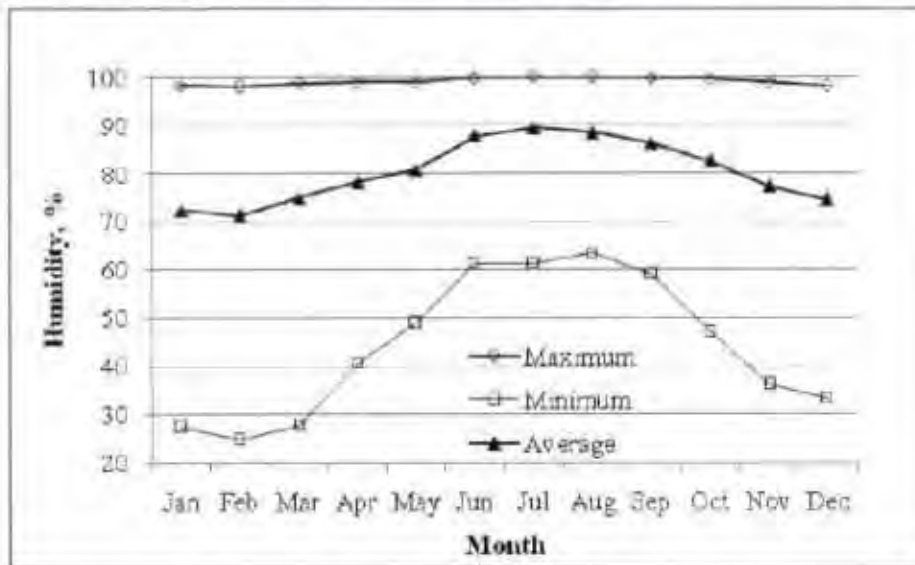
The climatic conditions in the area are continuously monitored by the Bangladesh Meteorological Department (BMD) at the Mongla Meteorological Station.

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.



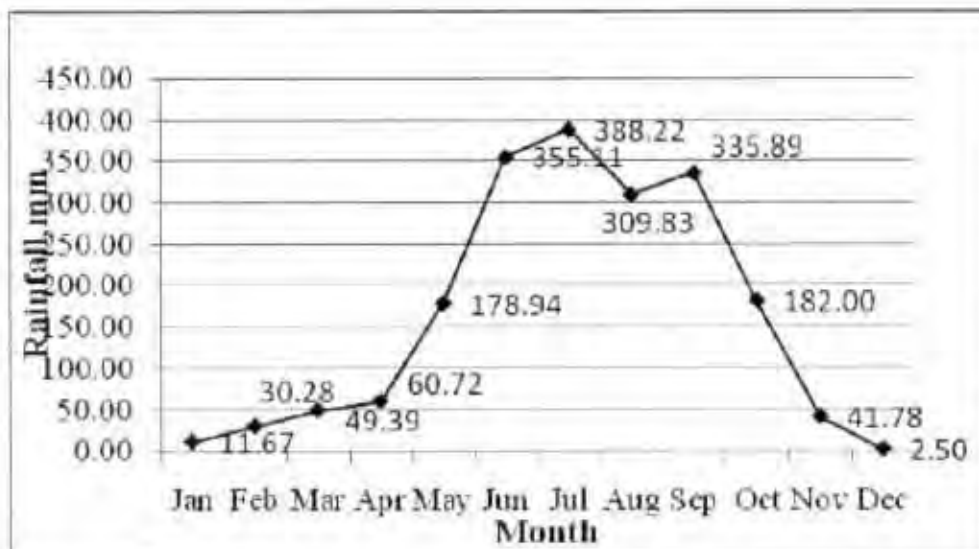
The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.

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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 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.

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

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

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

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

Design Wave Height 2.0 m

Design Wave Period 6.0 sec

Sedimentation and Siltation: Soft to stiff clay and alternations of very sandy and stiff clay.

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

Sl. no.	Date	Temp. °C	pH	EC µS/cm	Cl ⁻ mg/l	T. Alkalinity mg/l	Total dy mg/l	T.S mg/l	TDS mg/l	SS mg/l	DO mg/l	BOD mg/l	COD mg/l	Salinity mg/l
1	7-Jan	27.4	7.34	3010	279	30	68.7	2360	1516	55	5.1	0.8	55	1.0
2	7-Jan	27.1	7.32	3020	278.8	30	68.5	2370	1516	60	5.1	0.8	55	1.0
3	7-Jan	27.8	7.71	3030	279	30	68.8	2505	1516	55	5.1	0.8	55	1.0
1	11-Feb	29.8	7.66	4380	1262	36	182	2890	2180	210	4.7	1	78	2.8
2	11-Feb	29.2	7.63	4330	1260	36	178	2890	2180	200	4.7	1	78	2.8
3	11-Feb	28.1	7.63	4330	1260	36	179	2880	2180	200	4.7	1	78	2.8
1	9-Mar	32.6	7.30	11780	2944.4	38	175	6060	5290	190	4.7	1.2	79	6.7
2	9-Mar	32.6	7.37	11790	2945.2	38	178	6038	5290	190	4.7	1.2	78	6.7
3	9-Mar	32.1	7.33	11780	2940.4	38	177	6069	5290	200	4.7	1.2	78	6.7
1	15-Apr	32.6	7.38	23300	6273	36	185.6	12950	12700	230	4.8	0.7	136	15.5
2	15-Apr	32.6	7.39	23300	6273	36	186.2	12940	12700	230	4.8	0.7	136	15.5
3	15-Apr	32.6	7.39	23300	6273	36	184.8	12950	12700	230	4.8	0.7	136	15.5
1	5-May	32.6	7.38	28200	8480	36	188.6	14890	14800	300	4.3	1.2	177	17.6
2	5-May	32.6	7.34	28200	8470	36	188.6	14890	14800	300	4.4	1.2	177	17.6

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

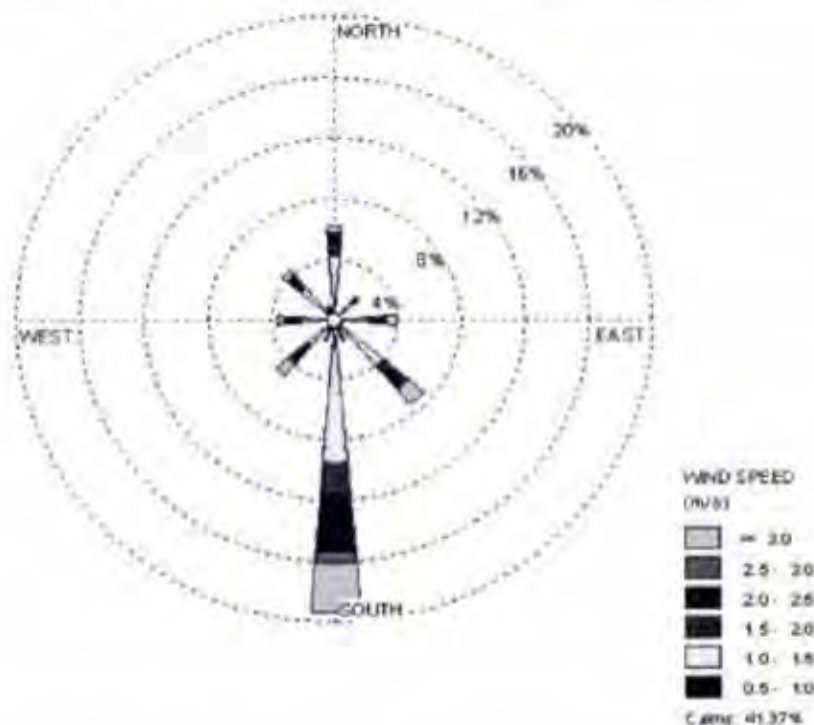
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Loc no	Date	Temp	pH	EC	Cl	T. Alkal	Turbid ity	T.S	TDS	SS	DO	BOD	COD	Salt con
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3	5-Mar	33.2	7.57	28200	8475	56	199 d	14000	14000	500	4.5	1.2	177	17.6
1	13-Mar	31.5	7.89	18300	7630	56	112 d	9300	8000	200	4.5	1.1	65	10.8
2	13-Mar	31.8	7.88	18700	7630	56	114 d	9300	8000	200	4.5	1.1	45	10.8
3	13-Mar	31.6	7.85	18500	7610	56	112 d	9300	8600	200	4.5	1.1	85	10.8
1	1-Jul	31.6	7.89	440	32.6	56	56 d	200	220	85	5.2	0.8	58	-
2	1-Jul	31.8	7.89	440	32.6	56	56 d	200	220	85	5.2	0.8	58	-
3	1-Jul	31.6	7.89	440	32.6	56	56 d	200	220	85	5.2	0.8	58	-
1	5-Aug	31.5	7.88	275	16.6	56	65 d	190	137	55	5.3	0.7	22	-
2	5-Aug	31.8	7.88	275	16.6	56	65 d	190	137	55	5.3	0.7	22	-
3	5-Aug	31.4	7.88	275	16.6	56	65 d	190	137	55	5.3	0.7	22	-
1	8-Sep	31.4	7.76	270	17.6	56	65 d	180	135	45	5.5	0.7	22	-
2	8-Sep	31.6	7.76	270	17.6	56	65 d	180	137	45	5.5	0.7	22	-
3	8-Sep	31.4	7.76	270	17.6	56	65 d	180	137	45	5.5	0.7	22	-
1	12-Oct	30.8	7.79	280	24.8	56	62 d	182	145	45	5.6	0.7	22	-
2	12-Oct	30.8	7.71	280	24.8	56	62 d	182	145	45	5.6	0.7	22	-
3	12-Oct	30.6	7.71	280	25.8	56	62 d	182	145	45	5.6	0.7	22	-
1	5-Nov	24.6	7.75	340	38.8	56	56 d	210	170	40	5.6	0.7	22	-
2	5-Nov	24.6	7.75	340	38.8	56	56 d	210	170	40	5.6	0.7	22	-
3	5-Nov	25.4	7.79	340	38.8	56	56 d	210	170	40	5.6	0.7	22	-
1	12-Dec	21.5	7.72	320	62.6	56	72 d	330	360	60	5.2	0.8	25	0.4
2	12-Dec	20.8	7.71	320	62.6	56	72 d	330	360	60	5.2	0.8	25	0.4
3	12-Dec	21.1	7.72	320	62.6	56	72 d	330	360	60	5.2	0.8	25	0.4

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

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.



The wind load calculation for the buildings and structures shall be as per Bangladesh National Building Code -2012, Part 6, Chapter 2.4.

Basic wind speed, V , shall be taken as 73m/s. Three second gust at 10m above ground in exposure C, having a return period of 50 years.

3.2 Design requirements

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 Owner/ BHEL.

The Owner/ BHEL has the right to refuse design features and vendors or subcontractors, if the supplier 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 this section 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.

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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 supplier 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.

Note: 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.

3.3 SYSTEM PARAMETERS

NOMINAL VOLTAGE (kV)	400 kV	230 kV	132kV
HIGHEST SYSTEM VOLTAGE (kV)	420 kV	245kV	145kV
RATED FREQUENCY (Hz)	50	50	50
RATED SHORT CIRCUIT CURRENT (1 SEC)	50	50	50
RATED PEAK WITHSTAND CURRENT /(kAp)	125	125	125
CREEPAGE DISTANCE (mm/Phase Voltage in kV)	53.7		53.7
CREEPAGE DISTANCE (mm/Line Voltage in kV)	31		31

3.4 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.5 PACKING FOR SHIPMENT

The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The Contractor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner / Purchaser.

Each consignment shall be marked with Equipment name, Owner /Purchaser's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner / Purchaser after dispatch.

Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The contractor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment.

3.6 TROPICAL PROTECTION

All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.7 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

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The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

Common equipment and services

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

3.8 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.8.1 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	6	6	3
2	Drawings "As Built"	-	-	6	3
3	Type Test Reports	1	6	6	3
4	Erection Manuals	-	6	6	3
5	Operating manuals, maintenance and service manuals, component documentation, assembly documentation, drawing and listing etc.	-	-	6	3
6	Operation and Maintenance Manuals (shall be translated into Bangla and provided as paper copies in electronic format).	-	6	6	3
7	Manufacturing Quality Plan	1	6	6	3
8	Field Quality Plan	1	6	6	3
9	Inspection Test Reports	-	-	6	3

Electronic copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well

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as in printable non-proprietary document format (e.g. PDF).

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

3.8.2 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/ Specification /Parameter Sheets Duly Signed by the Competent Authority.

3.8.3 DRAWINGS, DATA, INFORMATION AND MANUALS

Drawings, data, information & manuals shall be submitted as indicated below:

To be submitted after award of the Contract.

- a) Single line diagram giving rating of each equipment.
- b) Design calculations in support of selection of equipment rating and system design.
- c) Technical Data sheets, characteristic curves.
- d) Equipment layouts, layout of switchyard with sections.
- e) Grounding & lightning protection drawings and details.
- f) Cabling, cable trench and tray layouts with section and details with cable sizing calculation.
- g) Dimensional general arrangement drawing along with cross- sections for equipment.
- h) Foundation plan and loading data : design calculation and detail drawing of foundation.
- i) Design calculation and detail drawing for civil work related to this specification.
- j) Design calculation, GA drawing for GI structure and equipment supporting structure, and subsequently detailed drawings.
- k) Mounting details of equipment and structure.
- l) Fire fighting and sump arrangement.
- m) Control & operation write up/Block logic diagrams.
- n) Control schematic and wiring diagram.
- o) Cable schedule and interconnection and cable routing.
- p) Relay co-ordination.
- q) Civil & structural analysis, design calculations and working drawings including bar bending schedule and fabrication.
- r) Erection and maintenance manual.
- s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

3.8.4 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

- (i) The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hardcopies.

(ii) The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

(iii) The instruction manual shall be subject to the approval of Owner.

3.9 Electrical network connection conditions

The electrical equipment shall be designed according to the IEC standards (if not specified otherwise) and

The Plant shall comply with:

- a) the Essential Electrical Requirements of the Power Purchase Agreement (PPA);
- b) the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
- c) The Great Britain Grid Code.

The Contractor shall familiarize himself with such requirements. 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 bidder shall list all those grid connection requirements which cannot be met by the proposed Plant.

3.10 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 Manufacturers Association	AFBMA
• Architectural Institute of Japan	AJ
• 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

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• 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 Association (USA)	NEMA
• 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:

- a) Occupational Safety Board of Bangladesh
- b) Department of Inspection for Factories and Establishments, Bangladesh
- c) Department of Environment, Bangladesh
- d) Bangladesh Power Development Board
- e) Bangladesh Energy Regulatory Commission
- f) Ministry of Power, Energy and Mineral Resources
- g) Bangladesh Fire Service and Civil Defence Ministry
- h) All relevant Bangladesh National Statutory Regulations
- i) Bangladesh National Building Code
- j) Bangladesh Standards
- k) Local Authorities.

All 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.

3.11 Plant and equipment identification

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 supplier shall supply all labels (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.

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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 hand-wheel 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.

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.

3.12 Corrosion protection, coating and galvanizing

This specification shall be used for the corrosion protection of steel structures, components, piping 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/Supplier 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 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.

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.

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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.

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/m², on steel Sections 2 – 5 mm thick 600 g/m².**

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).

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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								
Syst em- No.	Surface location	Temp. °C	Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat µm	Total DFT µm
1	Structural steel works, piping, vessels, tanks INDOOR	up to 120	SA 2.5	Primer Finish	1 1	Zinc-Epoxy Epoxy High Solid	80 80	80 80 160
2	Structural steel works, piping, vessels, tanks OUTDOOR	up to 120	SA 2.5	Primer Intermediate Finish	1 1 – 2 1	Zinc-Epoxy Epoxy High Solid 2-Comp.Polyurethane	80 160 50	80 160 50 290
3	Piping, tanks, etc. INDOOR and OUTDOOR, Insulated	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	Pumps, motors, other equipment OUTDOOR	up to 120	SA 2.5	Primer Intermediate Finish	1 1 1	Zinc-Epoxy Epoxy High Solid 2-Comp.Polyurethane	80 110 50	80 110 50 240
5	Pumps, motors, other equipment INDOOR	up to 120	SA 2.5	Primer Finish	1 2	Zinc-Epoxy Epoxy High Solid	80 50	80 100 180
6	Piping, reactors OUTDOOR, Insulated	> 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
7	Stacks OUTDOOR	< 120 < 200	SA 2.5	Primer Finish	1 2	Zinc Ethysilicate Silicone Acrylic	75 50	75 100 175
8	Steel surfaces Uninsulated	200 - 450	SA 2.5	Primer Finish	1 2	Zinc Ethysilicate Silicone Aluminium	75 25	75 50 125
9	Galvanized surfaces	up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or	When Finish Coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid*	125	125

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			sweep- blasting with fine sand					
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						

* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 µm, when exposed to UV or weathering conditions and colour retention is required.

3.13 Documentation after Award of Contract

The documents required for design, construction, installation, operation and maintenance of the equipment shall be submitted by the bidder 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 bidder shall list all the drawings and submission schedule for the Employer's approval. 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 shall be listed. 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, 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.

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.

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.
- 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

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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.

3.14 Quality control procedure

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

The Supplier/Contractor shall adopt suitable quality assurance programme (QAP) to ensure that the equipment 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 Supplier/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.

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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 Supplier/ 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 Supplier/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.

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 equipment/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 equipment/works, and demand of the Supplier/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 Supplier/ 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 products/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 Supplier/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 which may adversely affect their properties and subsequent performance. The Supplier/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.

Interfaces

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

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.

3.15 Units of measurement

The Contract shall be conducted in the Systems International d'Units (SI) system of units in accordance with the provisions of ISO 31 and ISO 1000. In all correspondence, technical schedules, drawings and instrument scales, the following units shall be used:

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Quantity	Name of Unit	Symbol
Length	Millimeter	mm
Mass	Kilogram	kg
Time	Second	s
Temperature	Degree Celsius	°C
Temperature Difference	Kelvin	K
Electric Current	Ampere	A
Luminous Intensity	Candela	cd
Area	Square meter	m ²
Volume	Cubic meter Liter	m ³ l
Force	Newton	N
Pressure	Bar	bar
Pressure below 1 bar	Millibar	mbar
Stress	Newton per square millimeter	N/mm ²
Velocity	Meter per second	m/s
Rotational speed	Revolutions per minute	rpm
Flow	Cubic meter per day Cubic meter per hour Kilogram per hour Liter per second metric ton per hour	m ³ /d m ³ /h kg/h l/s t/h
	For gaseous substance: standard cubic meter per hour	Nm ³ /h
Density	Kilogram per cubic meter	kg/m ³
	Kilogram per standard cubic meter	kg/Nm ³
Torque, moment of force	Newton meter	Nm
Moment of inertia (mr ²)	Kilogram square meter	kgm ²
Work, energy or heat	Joule	J
Heat capacity, entropy	Joule per Kelvin	J/K
Specific heat capacity, specific entropy	Joule per kilogram Kelvin	J/kgK
Calorific value	Joule per cubic meter Joule per gram	J/m ³ J/g

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Quantity	Name of Unit	Symbol
Power, radiant flux	Watt	W
Heat release rate	Watt per square meter	W/m ²
Thermal conductivity	Watt per meter Kelvin	W/mK
Dynamic viscosity	Newton second per square meter	Ns/m ²
Kinematic viscosity	Meter squared per second	m ² /s
Surface tension	Newton per meter	N/m
Concentration	Parts per million	ppm
Electrical conductivity	Microsiemens per meter at 25 °C	μS/m
Frequency	Hertz	Hz
Electric charge	Coulomb	C
Electric potential	Volt	V
Electric field strength	Volt per meter	V/m
Electric capacitance	Farad	F
Electric resistance	Ohm	Ω
Conductance	Siemens	S
Magnetic flux	Weber	Wb
Magnetic flux density	Tesla	T
Magnetic field strength	Ampere per meter	A/m
Luminous flux	Lumen	lm
Illuminance	Lux	lx
Thermal resistivity	Kelvin meter per Watt	Km/W
Energy	Kilowatt hour	kWh

3.16 Materials

General material requirements

All materials shall be new and of the best quality for use in the conditions and the variations in river water quality, the temperature and pressure that will be encountered in service without undue distortion or deterioration or the setting up of undue strains in any part that might affect the efficiency and reliability of the Plant.

All materials shall correspond either to the approved standards and the respective code number or to exact analysis data, and full information concerning properties and applied heat, chemical and mechanical treatment shall be submitted.

Special attention must be paid to eliminating the possibility of corrosion resulting from galvanic effects. Design, selection of materials and all methods of erection shall be such as to keep these

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effects to a minimum. Materials complying with codes and standards listed below shall be used for the design and construction work.

Unless the materials meet these codes and standards the equivalent ASME/ASTM standard shall be used.

Materials and standards

Materials and standards

(A)	a.	Structural Steel Built-up Members	DIN EN 10 027-1 Formerly DIN 17 100 and EN 10 025	all steel brands S235 and S355 Formerly St, USt & RSt37-2, St37-3, St52-3 or Fe360B, BFU, BFN, C & D1, and Fe 510
	b.	Structural Steel Hot Rolled Members	DIN 1024 Series DIN 1025 Series DIN 1026 Series DIN 1027 Series DIN 1028 Series DIN 1029 Series	all steel brands S235 and S355, Formerly St, USt & RSt37-2, St37-3 and St52-3; or Fe360B, BFU BFN, C & D1, and Fe 510
	c.	Structural Steel Tubes	DIN EN 10 210-1,2	S235 and S355
	d.	Crane rail	DIN 4132	
(B)	a.	Bolts and Anchor Bolts	DIN ISO 898, DIN 18 800-1	4.6 ($f_y \geq 240 \text{ N/mm}^2$) 5.6 ($f_y \geq 300 \text{ N/mm}^2$)
	b.	High Strength Bolts	DIN ISO 898, DIN 18 800-1	8.8 ($f_y \geq 640 \text{ N/mm}^2$) 10.9 ($f_y \geq 900 \text{ N/mm}^2$)
	c.	Stud Bolts	DIN 32 500, Part 1 & DIN 18 800-1 DIN 32 500, Part 3 & DIN 18 800-1	4.8 ($f_y \geq 320 \text{ N/mm}^2$) St 37-3 per DIN 17 100, ($f_y \geq 350 \text{ N/mm}^2$)
(C)	Electrodes for Arc Welding		DIN 1913/ DIN EN 499	
(D)	Ordinary Portland Cement		DIN 1164-1 / 1164-2 EN 197-1	
(E)	Reinforcing Bars		DIN 488-2 / 488-4	

Structural steel

DIN 18800 / DIN 18801 / DIN 18807 shall be followed.

For all above mentioned material standards, the equivalent standards as per BS, ASME/ASTM are also accepted.

Structural steel works

Materials

All ferrous materials, their dimensions, forms, weights, tolerances, chemical and mechanical properties, shall be the best of their kind, complying with relevant international Standards.

All structural steel material shall be minimum S235 for rolled steel shapes, angles, tees, plates, etc. having a minimum yield stress of 235 N/mm².

In the case of structural steel work, care shall be taken that all parts in the assembly fit accurately together and corresponding parts shall preferably be interchangeable.

The supplier shall submit to the Employer for approval the country of origin and manufacturer of the steel he proposes to supply.

The structural steelwork and testing shall comply with the relevant clauses of BS 4, BS EN 10162, BS 4360 and BS 6323 or equivalent standards.

Each steel part shall be marked with the manufacturer's name or trademark.

The steelwork shall be manufactured by a specialist firm approved beforehand by the Employer. As much of the work of manufacturing of the steelwork as is reasonably and technically practicable shall be executed in the manufacturer's works, and facilities for inspection by the Employer shall be provided.

All steelwork before and after manufacturing shall be smooth, un-deformed, straight and free of cracks, twist and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length. All plates shall be truly at right angles to the longitudinal axis of the section. No work shall be painted, packed or dispatched from the manufacturer's works until it has been inspected and complies with or has been certified to comply with all the tests and requirements of the standard applicable to the material specified and until it has been inspected and approved.

Tests

The manufacturer's test certificate for all steelwork shall be supplied to the Employer. The certificates shall state the manufacturing process and shall include a test sheet giving the results of the mechanical tests and the chemical composition. The supplier shall provide free of charge any supplementary tests reasonably required by the Employer. Steel which do not conform to the

specified standards shall be rejected at the expense of the supplier. No steelwork shall be delivered from the manufacturer's works until it has been tested and the results comply with the requirements of the relevant standards.

Workmanship

Tolerances

Care shall be taken to ensure that the tolerances specified on the drawings or the relevant standards are worked to. The erection tolerance for cleated ends of members connecting steel shall be not greater than 2 mm at each end. No work shall be painted, packed or dispatched from the manufacturer's works until it has been tested and complies with all requirements of the standards.

Cutting

Cutting may be by shearing, cropping, sawing or machine flame cutting. Hand flame cutting shall be avoided. If rolled products for steel structures under predominantly static loading are cut by flame-cutting or shearing there will generally be no need for a finishing operation if the cut surface is free of defects.

Bolting

The threaded portion of each bolt shall project through the nut by at least one thread. Approved high strength friction grip bolts, preferably the type with indicated load, shall be used where specified and shall be tightened strictly in accordance with the manufacturer's instructions and the relevant regulations. The surfaces in contact shall not be painted and shall be free of oil, dirt, loose rust, burrs and other defects, which would prevent proper seating of the parts or interfere with the development of friction between them.

When connections are made using high strength friction grip bolts the relevant standards shall be observed.

Welding

The execution and testing of welding shall be in accordance with BS EN 1011-1, BS EN 1011-2 or equivalent standards.

All welds, unless otherwise stated shall be continuous minimum 6 mm fillet weld and shall be dressed smooth, free of porosity, cracks, holes and finished to match adjacent surfaces. When welding operations are completed, all welding flux shall be removed without delay. Cooling of welds shall not be accelerated by any special measures.

Site welding shall be restricted to the absolute minimum. Site welding is subject to approval by Employer. The examination of welded work and the inspection of welds during and after

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manufacture shall be carried out by responsible specialist welding engineers. Welding shall be carried out by expert trades men and in strict accordance with the current code of practice.

Painting

Surface treatment and painting before and after delivery to site shall be done.

Parts to be encased in concrete shall not be painted or oiled. Surfaces inaccessible after shop assembly shall receive the full-specified protective treatment before assembly.

Rejection

Any steelwork, which in the opinion of the Employer is not in accordance with the requirements of the standards or with the specifications, shall be mandatory rejected and removed from the site at the Contractor's expense.

Small non-structural steel parts

General

This Clause refers to the specifications covering the provision of all materials and labor in relation to supply and manufacture on site of articles made of steel or cast iron.

All steel structures and parts specified under this clause shall be hot dip galvanized and painted.

The list of small items to be furnished shall contain but not be limited to the following:

- steel sections, bent plate sections and square bars for construction of:
 - metallic stairs, platforms and walkways
 - railing for stairs, platforms, walkways and protective around floor openings
 - corner and edge protection for concrete steps and concrete
 - Structural parts such as columns, beams, removable cover slabs, etc.
 - support of any equipment foundation
 - joint covers
 - Anchors, ties, hangers, inserts, slots, embedded steel parts, etc.
- steel pipes and plain round bars for making guardrails and ladders
- steel plates, chequered and/or flat, for fabrication of removable covers
- Open steel grating for metal steps, platforms, and walkways.

Materials

The requirements for materials of structural steel specified herein are applicable to all steel sections, bars, plates, pipes and any sections as far as their quality, source, dimensions, mechanical characteristics and their delivery, handling, storage and tests on site are concerned.

Specific requirements for high temp./high pressure part materials

The purpose of this part is to provide the additional requirements for the purchase, manufacturing and fabrication of:

- austenitic stainless steels used for high temperature superheater and reheater tubing,
- ferritic/ martensitic steels used for high temperature pressure parts.

All manufacturers and suppliers of the base metals, from raw materials until finished products, shall be ISO 9001:2000 certified for the duration of the contract or being renewed during the duration of the contract as appropriate. Only seamless tubes and pipes are acceptable for power piping. For low pressure systems (< 6 bar (g)) welded pipes will be accepted. The welded pipes provided shall be of certified source.

All materials and manufacturing procedures shall be certified by an independent 3rd party. The approval shall be part of the quality documentation.

The use of SA213-T24 material for membrane walls is not accepted.

The material SA213-T23 is known for cracking sensitivity. It shall be demonstrated and documented in the final data package that all such materials are free from any cracks and that all hardness values are within the required limits.

For SA213-T23 the Contractor must provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected. For SA213 T91 and SA335 P91 the latest stress values and the latest information according to ASME code cases must be used. Also the EPRI „Guidelines and Specifications for High-Reliability Fossil Power Plants Best Practice Guideline for Manufacturing and Construction of Grade 91 Steel Components“ shall be respected.

For SA335 P92 the Contractor shall provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected. SA213-T92 may be used for header nipples outside of the flue gas pass, while meeting the above mentioned requirements for quality control. The details on preheating for welding and PWHT shall be stated in detail. Special consideration shall be given to record the metal temperatures during manufacturing, erection and operation.

In case of any repair of any of such materials at site the 3rd party engineer must be involved concerning the proposed repair method.

Pre-service cleaning and protection of plant equipment

This clause covers mechanical and pre-service cleaning and protection of the plant items and equipment at the Manufacturer's workshop and at site that are not subsequently to be painted.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturers' works or at site, as appropriate.

In the event of the surfaces not being cleaned to the Employer's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the Contractor's sole expense.

Mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for workshop cleaning except where this is precluded by design or access considerations.

Machined surfaces shall be protected during the cleaning operations. For recleaning small areas, hand cleaning by wire brushing may be permitted. Wire brushes used on austenitic materials shall have austenitic steel bristles. Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress-relieved before chemical cleaning.

At an appropriate time, the Contractor shall submit drawings of temporary pipework necessary to carry out the pre-service cleaning simultaneously with a list of works to be carried out on the pipelines, heaters, feedwater tanks, vessels etc. to connect the temporary pipework with the parts of equipment to be cleaned.

Further, the Contractor shall submit at the same time the basic draft of the cleaning procedure and of the treatment of wastes.

Not less than six months prior to the commencement of any site cleaning, the Contractor has to submit programs covering all procedures, lists of chemicals, calculations which quote the velocities, temperatures and pipework forces and movements imposed during site cleaning.

All necessary equipment, provisions, chemicals etc. are to be provided by the Contractor.

All tests, analyses, etc. as required are to be performed by the Contractor.

Besides this, the Contractor shall take over all responsibility for the treatment and disposal of wastes according to the local law and to the satisfaction of the Employer.

The date at which cleaning of plant equipment will be carried out at site shall be notified to the Employer at least 20 days in advance.

The Contractor shall take all necessary precautions to ensure that the internal surfaces of all plant are kept clean and free from injurious matter during erection.

When all plant has been erected and lagged or at such other time as may be agreed with the Employer for sub-assemblies, the installation shall undergo a procedure for site cleaning proposed by the Contractor and subject to the approval of the Employer.

Welding

All pressure part welding must follow the requirements of ASME and connected standards.

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Welding work and related heat treatment as well as inspections and test shall be performed in accordance with the specific and approved welding procedure specifications (WPS) and the respective material specifications.

WPS shall be prepared in accordance with relevant ASME standards, endorsed by 3rd party / inspector and submitted to the Employer.

Welding plans have to be prepared by every manufacturer for his scope of work.

No welding shall be undertaken until the applicable WPS and Procedure Qualification Record (PQR) are approved by the Employer.

The PQR shall be qualified in accordance with relevant ASME standard. Welding procedures must be qualified by a qualified independent testing authority engaged by the manufacturer.

Welding procedures shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned and in the case of critical plant items the tests shall be witnessed by an internationally recognized inspection authority.

Welders shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned for all types/positions of welding he may perform.

Welder tests shall be carried out in accordance with the approved standards within Contractor's scope. Test results are available for review in the workshops.

If at any time in the opinion of the Employer the work of any welder appears questionable, such welder is required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Any welder failing the retest may, at the discretion of the Employer be disqualified from further welding on items under this Contract.

The 2 first production welds of every welder shall be 100% examined by volumetric NDE and only when the results are acceptable, shall the welder be released for production welding.

A system of positively identifying the work of each welder shall be maintained and any welder whose work is the subject of multiple rejections shall be required to undergo a requalification test. Any welder failing the retest may, at the discretion of the Employer's Representative be disqualified from further welding on items under this contract.

Welded fabrications shall be stress relieved when specified by the applicable standard or for dimensional stabilization prior to machining.

Copies of temperature charts referenced with load items shall be included in the test certification supplied for the relevant items.

All welds shall be visually examined and shall be of smooth contour, free from cracks, undercut and other significant defects. Wherever possible the interior of tubes etc. shall be examined using a suitable optical device where necessary. The manufacturer shall make every effort to avoid any contamination of the tube interior during the manufacturing process. To ensure the tubes are free from obstruction and debris the tubes shall be cleared with a sponge being blown through.

Fillet welds shall be checked for size using suitable gauges which shall be available for use on request by the Employer's Representative during an inspection visit.

For single side butt welds, all root passes shall be welded using a TIG welding process.

Preheating shall be in accordance with the applicable WPS and the respective material specification. The preheat temperature shall be in function of welding process, wall thickness, type of welding consumables, ambient temperature and climatic conditions.

Welding performed outside a workshop is authorised if an approved wind and rain protection (welding bay) is installed around the working place. Anyway, when ambient temperatures falls below 5°C, preheat is required for all ferritic materials and thicknesses. Gas burners or oxy-fuel torches can be used for pre-heating. Preheat shall be maintained over a distance of not less than 4 times the nominal thickness with a minimum of 75mm on either side of the weld. If the material required pre-heating, the same pre-heating shall be done for oxy-fuel or plasma cutting.

Welding consumables such as TIG-rods, electrodes, wires shall be clearly marked in order to avoid any mix-up of material grades. Positive Material Identification to be carried out on where a doubt for mix-up exists.

Any post welding heat treatment (PWHT) shall be performed in accordance with an approved procedure. The procedure shall describe the method, the heat treatment parameters (e.g. holding temperature and time, heating/ cooling rates, heated/insulated band...), the number and location of thermocouples, records and calibration. The procedure shall be available on Site and or in the workshops.

Before welding and/or heat treating valves, valve-manufacturer instructions shall be taken into consideration.

In the case of sensitive materials, grinding of the welds or other grinding work may only be carried out with special grinding wheels so as to avoid overheating or an increase in the hardness of the material.

Welding defects of all kinds must be documented and be available to the Employer on Site or in the workshop.

The Contractor maintains and makes available to the Employer or his representative, both at works and Site, adequately indexed records of all welds, weld inspections, weld controls and repair.

3.17 Electrical equipment and works

Standards

The design and manufacture of all electrical equipment shall comply with the latest editions of the IEC Recommendations if not specified otherwise elsewhere in the specification. Compliance with ANSI/IEEE/NEMA, BS, EN or VDE standards will only be accepted in case no applicable IEC standards are available and subject to approval by the Employer/Engineer.

The Plant shall comply with:

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

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

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

Any other requirements of BPDB/PGCB shall also be considered (if available).

Voltage levels

The following voltage levels shall apply:

- 240/415 V + 10%, 50 Hz standard voltage for power supplies to small electric power consumers and motors below 160 kW lighting and domestic power outlets
- 240/415 V + 10%, 50 Hz voltage for power supply of essential electric power consumers - the system shall be operated with ungrounded neutral
- 220 V DC + 10%/-15% voltage for emergency users of electricity, like turbine emergency oil pumps, circuit breaker control, inverters
- 240/415 V ± 10%, 50 Hz uninterrupted voltage supplies to consumers, which require uninterrupted infeed like DDCMIS components, control actuators, burner control panels, VDUs.
- 24 V DC ± 15% for power supplies to the DDCMIS system components

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- 24 V $\pm$ 10%, 50 Hz for erection work in enclosed plant items of metal

Insulation levels

- The 400 kV system shall be designed to limit the switching surge overvoltage to 2.3 p.u. and the power frequency over-voltage for the 400 kV system and the 230 kV system to 1.5 p.u. The lightning arrestors associated with the 400 kV reactors shall be of 336 kV.

- Following insulation levels shall be considered:

	Description	400 kV	230 kV	Generator *	11 kV	3.3 kV
1.	Highest voltage for equipment	420	245	24 or 36	12	3.6
2.	Power frequency withstand voltage	650	460	50 or 70	28	10
3.	Lightning impulse withstand voltage	1425	1050	145 or 170	75	40
4.	Switching impulse withstand voltage (phase to earth)	1050	—	—	—	—

* According to manufacturer standard

- The creepage distance of the outdoor insulators shall be minimum 31 mm/kV.

Protective measures, earthing and lightning protection

In view of the potential dangers of electrical power, the following measures are required for the protection of life, equipment and materials. Basically, all 'live' parts, i.e. all parts of electrical, operational equipment at an electrical potential above or below earth potential when in operation, and with a rated voltage over 24 V, must be insulated or covered so that they cannot be touched accidentally.

In addition, measures must be taken by the Contractor to prevent the occurrence or persistence of excessively high contact potentials on conductive parts of electrical operational equipment (frames etc.) brought about by faults in insulation.

For installations up to 1000 V, voltages over 50 V are considered to be excessive contact voltages. Within enclosed electrical installations, with voltages over 1000 V, the contact potential shall be according to the values given in EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV: enclosure B.

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The following rules and regulations are to be observed in carrying out protective measures and in earthing procedure:

- IEC 60079 and 60364 for installations up to 1000 V.
- EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV.

In areas exposed to the hazard of explosion, the protective measures outlined in IEC 60079 and IEC 61241 are to be adhered to in the erection and installation of electrical plant and equipment.

Protective measures for installations up to 1000 V

Protection against direct contact

All 'live' parts of electrical operational equipment that can be reached by hand must be protected against direct contact either by means of insulation or through constructional design, position or arrangement, or by means of special devices. If, in the case of enclosed switchgear or control cabinets, access is required in the course of normal operation (e.g. for replacing fuses), protection against direct contact must still be ensured when the switchgear or control cabinet has been opened up.

Protective insulation

Protective insulation is to be provided by means of additional insulation over and above the insulation provided for operational purposes. This measure must prevent the occurrence of a dangerous contact potential.

Use of low voltages as a safety measure

This safeguard applies to all equipment, which is required to operate in metal enclosures, boilers, tanks etc. The operational voltage of tools and lighting equipment must not exceed 24 V AC. Isolating transformers shall be provided by the Contractor for the purpose of producing the protective low voltage. A separate 24 V system will not be provided.

Protective measures for installations over 1000 V

Protection against contact

At least the following measures are to be taken for all parts that are 'live' when in operation:

- Protection outside of closed electrical operating areas:
 - complete protection from all sides against contact, the degree of protection shall be at least IP23D according IEC 62271-202 and IEC 60529
 - protective devices may only be removed by means of tools.
- Protection inside closed electrical operating areas:
 - protection against contact with 'live' parts within reach of personnel.

- protection against accidental contact outside the reach of personnel.

The above-mentioned measures for protection against contact are also to be applied to 'dead' parts of the Plant where, in the case of a fault, a dangerous contact potential might arise, however, where the parts must not be connected to the protective earthing system for operational reasons.

Protection against contact voltages

Protective earthing is to be used as a safeguard against excessively high contact potentials for conductive parts of the installation, which do not form part of the operational circuit. Here, all normally 'dead' parts equipment and apparatus shall be earthed if it is possible for them to come into contact with 'live' parts as a result of faults due to the occurrence of surface leakage paths, arcs or direct connections to a 'live' part of the equipment.

In considering the dimensioning of the protective earthing system, the thermal loading and voltages on the earthing equipment are decisive factors and these should be based on the maximum possible earthing current, which can arise.

3.18 Inspection and Testing

General

This Section contains general requirements for inspection of material, parts, equipment and workmanship of the Plant during manufacture, assembling and erection and upon completion to demonstrate compliance with specification, codes and standards and to ensure overall reliability of Equipment operation and performance.

Development and implementation of test procedures for the construction inspection, start-up and performance testing and capacity demonstration of the Plant shall be the responsibility of the Contractor.

The Contractor shall be responsible for providing all supplies required for carrying out such tests.

The overall testing program for the Project shall consist of the following:

- workshop inspections and testing
- construction inspections, and testing

The Employer shall have the right to have their representatives present during inspections and tests of Plant equipment and systems in the workshops and during construction. The presence of the Employer's representatives during any inspection or test shall in no way relieve the Contractor of its responsibility for supplying the equipment or systems in accordance with the milestone dates.

The Employer will be notified by the Contractor in writing at least ten (10) days prior to such testing and inspection at workshop and two (2) days for test at site.

The Contractor shall submit to the Employer all relevant test documents, which shall include:

- inspection and test program.

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- test standards
- type of inspection and tests
- tests which are to be witnessed by third parties.

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Welding tests

Non-destructive examination of pressure and vacuum containment welds

Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. In addition the requirements of the following Table 1 shall be observed. Table 1 shall also apply in cases where the standards used for design and construction of an item of plant does not specify the quality requirements for welds. Fault limitations to be subject of agreement with the Employer's Representative prior to fabrication.

Hardness testing shall determine the hardness for welds and heat affected zone according to Vickers (HV10).

The test procedure ISO 6507-1 or equivalent shall be used. Minimum 3 hardness locations shall be tested for the weld. On circumferential welds the test locations shall be located at 120° distance. Hardness tests shall be conducted after PWHT.

Following percentages of welds shall be hardness tested.

Carbon steels or low alloy steels (<2%Cr)	10%
2.5% Cr steels	50%
9 - 12% Cr steels	100%
Austenitic steels	-

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TABLE 1

Type of Steel	Design factor	Wall thickness	Inside diam	Type and Extent of non destructive testing			Remarks
	(shell)	(mm)	(mm)	Butt	Nozzle	Fillet	
C and C-Mn steels with C content not exceeding 0.25%	≤ 0.85	≥ 10	all				Only applicable to Atmospheric systems (excluded systems, which handle chemicals, toxics or inflammable media)
		40±	all	20% R			
		≥ 30	all	100% R	10% M	10% M	
	≥ 0.85	≥ 40	≤ 100	20% R			Test after stress relief
			> 100	100% R	10% M	10% M	
		> 40	all	100% R	100% M	100% M	
C-Mn steels with C content 0.25 to 0.35%, CrMoV steels, C 1/2 Mo steels, low alloy steels, and CrMo steels except 12% Cr steels		≤ 30	all	20% R	10% M	10% M	Test after stress relief
		all	> 30	all	100% R	100% M	
		all	all	100% R	100% M	100% M	
Low alloy steels except CrMoV and 2 CrMo		all	all	100% R	100% M	100% M	Test after stress relief
12% Cr ferritic/austenitic steels	all	all	≤ 100	100% R	100% M	100% M	Test after stress relief
			> 100	100% R*	100% M	100% M	Test after stress relief
				100% U	100% U	100% U	

* Radiographic examination may be omitted if done on as-welded joint

** If feasible, otherwise 100% M

Type of Steel	Design factor	Wall thickness	Inside diam	Type and Extent of non destructive testing			Remarks
	(shell)	(mm)	(mm)	Butt	Nozzle	Fillet	
Austenitic Stainless Steels	≤ 0.85	≤ 15	all				Not applicable to: Butt welds made from one side only Operating temperatures exceeding 200 °C
		≤ 30	all	20% R			
		≥ 30	all	20% R	10% D	10% D	
	≥ 0.85	≤ 30	≤ 100	20% R			
			> 100	100% R	10% D	10% D	
		≥ 30	all	100% R	100% D	100% D	

Legend: R = Radiographic examination

U = Ultrasonic examination

M = Magnetic particle examination

D = Dye penetrant examination

Note:

- Where 10% examinations are shown for pipework under 100 mm diam bore this shall be the circumference of 10% of the welds by each welder selected at random with a minimum of one per welder.
- Where 10% examinations are shown for vessels or large diameter pipework this shall be 10% of each weld length and must include all intersections of longitudinal and circumferential welds.
- Where partial examinations reveal rejectable defects, adjacent welds or areas of weld shall be examined. In the event of rejectable defects being found welds shall be subject to 100% examination.
- Welds in clad materials shall be tested in accordance with the requirements of the base material and the surface of the overlaid welds shall be dye penetrant tested throughout their length.

Non-destructive examination of structural welds

Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. Where appropriate, the following requirements shall also be observed:

- magnetic particle testing of the tension side welds in major fabricated girders and Sections,
- ultrasonic examination of heavily restrained welds (e. g. cruciform joints) where there is a risk of lamellar tearing in the parent material.

Weld Repairs

Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be completely removed by chipping or thermal gouging and grinding. The resulting excavation shall be crack detected prior to rewelding.

Details of the original defects and repair shall be recorded.

Repaired welds shall be subjected as a minimum requirement to the same inspection requirements as the original welds and test records should indicate that a repaired weld is referred to.

3.19 Electrical equipment

Electrical equipment and material which is not covered by the tests specified elsewhere in this document shall be inspected and tested in accordance with the latest edition of standards listed hereafter. Alternatively, equivalent standards approved by the Employer's Representative may be used.

Type tests shall be carried out if type test certificates certified by an independent test authority are not available.

Installation Material

IEC 60130	Connectors for frequencies below 3 MHz
IEC 60364	Low voltage electrical installations/ Electrical installations of buildings
IEC 60423	Conduits for electrical purposes

Materials for earthing and lightning protection

IEEE 80	Guide for safety in AC Substation Grounding
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface potentials for Ground system
NFPA 780	Installation of lightning protection systems

Insulators and Bushings

IEC 60383	Insulators for overhead lines with a nominal voltage above 1000 V
IEC 60507	Artificial pollution tests on high voltage insulators to be used on AC systems
IEC 60137	Insulating bushings for AC voltages above 1000 V

Surge Protection Equipment

The surge protection equipment shall be tested in accordance with IEC 60099.

AC Switchgear for voltages above 1 kV

IEC 62271	High-voltage switchgear and control gear
IEEE C37.013	IEEE standard for AC-High-Voltage generator circuit breakers on a symmetrical current.

At least the following tests shall be performed in the manufacturer's workshop on the individual apparatus and on the complete installation, respectively, all in accordance with IEC Standards:

- Visual inspection
- Power frequency HV tests
- Dielectric tests of the auxiliary circuits
- Measurement of the main contacts resistance with dc
- Temperature rise test on circuit breakers (type test certificate)
- Test of mechanical endurance (type test certificate)
- Measurement of the contact opening period (type test certificate)
- Functional tests of the control circuits
- Check of the operational sequence
- Measurement of the instrument transformer's angle and ratio errors (according to IEC-standards 60044)
- Check of the denominations.

Note 1: All MV switchgear shall be type tested according IEC 62271-1, IEC62271-100 and IEC 62271-200 including internal arc classification IAC = AFLR. Related type test certificates shall be provided with the Tender. If the test has already been carried out on similar type switchgear, type test certificates may also be accepted.

Note 2: All GIS above 52 kV shall be tested according IEC 62271-1, IEC 62271-203.

Note 3: Generator circuit breakers shall be tested according IEEE Std C37.013.

High voltage fuses

IEC 60282	High voltage fuses
IEC 60644	Specification for high voltage fuse links for motor circuit applications

Dry type transformers

The following routine tests in accordance with IEC 60076 shall be carried out on all transformers:

- Measurement of winding resistance
- Measurement of voltage ratio and phase displacement
- Measurement of short circuit impedance and load loss
- Measurement of no-load loss and current
- Separate source AC withstand test
- Induced AC voltage test
- Lightning Impulse test
- Partial discharge measurement.

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The following tests in accordance with IEC 60076 to be carried out as type tests (type tests shall not be repeated if type tests certificates of an identical transformer issued by a recognized test laboratory are available):

- Temperature rise test
- Measurement of sound level
- Short circuit test
- Environmental Test according Class E2
- Climatic test according Class C1
- Fire behaviour test according to Class F1.

Fault withstand (fault versus time) curve for all transformers shall be submitted by the Contractor. Separate type and routine tests shall be carried out for all accessories like bushings, bushings CTs, tap changers, etc.

3.20 Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
AGC	Automatic Grid Control
ASC	Average Site Conditions
AVQR	Automatic Voltage and Reactive Power Control
BOP	Balance of Plant
BOQ	Balance of Quantities
BPDB	Bangladesh Power Development Board
CCR	Central Control Room
CCTV	Closed Circuit Television
COD	Commercial Operation Date
CT	Current Transformer
DC	Direct Current
DCDB	DC Distribution Board
DCS	Distributed Control System
DDCMIS	Distributed Digital Control Monitoring & Information System
DOE	Department of the Environment, Bangladesh
DOSH	Department of Safety and Health, Bangladesh
EHS - TTP	IFC Environmental Health and Safety Guidelines Thermal Power Plants
EHV	Extra High Voltage (500 kV)
EIA	Environmental Impact Assessment
EMC	Electro-Magnetic Compatibility
EPC	Engineering, Procurement, Construction
FTU	Field Mounted Termination Unit
G-EHS	IFC General Environmental Health and Safety Guideline
GJ	Gigajoule
GPS	Global Positioning System
GWh	Gigawatt hour
GSO	Grid System Operator
HART	Highway Addressable Remote Transducer
HAZOP	Hazard and Operability Study

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HDPE	High Density Polyurethane
HMI	Human Machine Interface
HRC	High Ruption Capacity Fuse
HV	High Voltage
HVAC	Heating, Ventilation, Air Conditioning
Hz	Hertz
I&C	Instrumentation and Control
IOD	Initial Operation Date
IPL	Independent Protection Layer
IR	Infrared
kV	Kilovolt
kW	Kilowatt
LAN	Local Area Network
LCC	Local Control Center
LIE	Local Instrument Enclosure
LIR	Local Instrument Rack
LV	Low Voltage
LVS	Large Video Screen
MCC	Motor Control Center
MCL	Maximum Continuous Load
MCR	Maximum Continuous Rating
MLSD	Land Survey Datum
MNCL	Minimum Continuous Load
MNCR	Minimum Continuous Rating
MOV	Motor Operated Valve
MV	Medium Voltage
MVA	Megavolt Ampere
MVAR	Megavolt Ampere Reactive
MWh	Megawatt hour
NCC	Network Control Center
NDE	Non Destructive Examination
NFPA	National Fire Protection Association
NLDC	National Load Dispatch Centre
NOR	Notice of Readiness
NRV	Non Return Valve
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OHL	Over head line
PA	Public Address
PABX	Private Automatic Branch Telephone Exchange
PLC	Programmable Logic Controller
PPA	Power Purchase Agreement
PQR	Procedure Qualification Record
PSS	Power System Stabiliser
PVC	Polyvinyl Chloride

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PWD	Public Works Department
PWHT	Post welding heat treatment
QA	Quality Assurance
RC	Reinforced Concrete
RSC	Reference Site Conditions
SCADA	Supervisory Control and Data Acquisition
SCS	Substation Control System
SER	Sequence of Events Recording
SI	Soil Investigation
SIL	Safety Integrity Level
SOE	Sequence of Events
SSC	Summer Site Conditions
TCS	Technical Comment Sheet
UHF	Ultra High Frequency
UV	Ultraviolet
VDU	Video Display Unit
VT	Voltage Transformer
WSC	Winter Site Conditions
WPS	Welding procedure specification

3.40 Enclosures:

- Packing & Shipping Instructions (Annexure-E) – 2 Pages
- Seaworthy Packing – 5 Pages

**ANNEXURE – E
TO
INTERNAL ORDER NO. INTORD0489**

PACKING & SHIPPING INSTRUCTIONS

1. All units/ sub vendors/ contractors are strictly advised to comply with packing instructions mentioned in contract documents (GCC clause 65: Packaging & Section V, FTS, Clause B0.3.5 Packaging and transportation).

2. Special Packing Instructions & Inspection Prior to Dispatch

- Packing (tare) shall be part of the Equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of Equipment during transportation. In case of Equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
- All packages to be wrapped in transparent polythene inside the crates for effective weather proofing
- Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly:

Destination:

Package number: BHEL/MTR/BD/XXX/YYYYY where XXX stands for Unit abbreviation e.g. RPT

YYYYY stands for package no.

Gross and Net weight

Dimensions

Lifting places

Handling marks and the following delivery marking:

"BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (Pvt.) LIMITED
2X660 MW MAITREE SUPER THERMAL POWER PROJECT
BANGLADESH"

EPC CONTRACTOR: BHARAT HEAVY ELECTROCALS LIMITED, INDIA

- Completeness of Contents of each packing case: Concerned CQA/Unit QC/Third Party Inspection Agency shall verify the completeness of contents of each package w.r.t packing list both in terms of quality and quantity before authorising dispatch of the consignment.
- Packing commensurate with international standards and accepted norms will be ensured by CQA/ Unit QC/Third Party Inspection Agency. Packing has to be **SEA WORTHY** and secure.
- As far as possible, the packing has to be rectangular in shape for optimum space utilization in the ship and economize on shipping costs. Projections on packages are prohibited.
- The packing list has to be checked and certified by the Inspection agency (ies) with due signatures.
- All packages shall be enclosed in suitable GI sheets on all sides.
- No loose items / Gunny bag packing are allowed for shipment.
- Proper pallets and crates are to be used for packing of Oil drums and Structures.
- Routing of Packing Lists: Packing list is an extremely important document, which forms a part of export documentation in connection with the processing of customs formalities. Packing List has to be generated by units/Unit vendors and sent to IO and ROD (both at

the same time), two weeks in advance, for processing and obtaining shipping bills' clearances and avoiding octroi payment through 'N' form at Mumbai.

- Advance Intimation to ROD & IO: All supplying units/vendors will give at least 15 days advance intimation to ROD & IO along with package details before actual dispatches to arrange for storage/shipping arrangements by ROD and customs invoicing by IO. Information must be sent to consolidate the details and arrange for shipments in time.
- Excise Attestation at Works: To avoid opening of big cases for examination by customs at port of shipment, the supplying unit may arrange to get the packing cases sealed by local excise authorities/ self-certification and the relevant invoices and packing lists to be endorsed from Superintendent, Central Excise. For this purpose, Units should send the packing lists to IO at least 2 weeks in advance to enable prepare Shipping Invoices for furnishing to the units for requisite attestation and sending to ROD through fastest means for a smoother and faster customs clearance. Also Units to provide "specification of packing with the indication of the number of cargo packages, type of packing and weight of packing in English" along with the packing list.
- Provision of Inspection Windows on Packages: Unit/Vendors should provide inspection window of size 6" x 4" (glass perplex) for customs examination for all packages (above 1.5 x 1.5 x 1.5 cu m) involving panels of any kind. Care would be taken to ensure that all packages are properly sealed to avoid ingress of moisture, rodents etc. Packing slip folders to be attached in each box.
- Drawings for Heavy Weight/QDC consignment: Any package/item weighing above 20000 kgs and/or size greater than 2.5 X 2.5 X 4 m. detailed engineering documents (at least 4 sets) for all items of the above category will be furnished by respective units to issue shipment enquiries in a proper manner. The drawing has to include centre of gravity of the item clearly (Units to identify such items and notify io as soon as the engineering documents are released).
- Lifting Beams: All heavy lifts for which safe handling is essential at the port of dispatch shall be accompanied by lifting beam on non-returnable basis.
- "Marking for Safe Handling: To ensure safe handling, packing case shall be marked to show the following:
 - ✓ Upright position.
 - ✓ Sling position and Centre of Gravity position.
 - ✓ Storage category.
 - ✓ Fragile components (to be marked properly with a clear warning for safe handling)



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SEAWORTHY PACKING

(PACKING INSTRUCTIONS FOR GENERAL COMPONENTS / ASSEMBLIES / EQUIPMENTS)

1.0 GENERAL

This standard lays down packing instructions for packing of Components /Assemblies/Equipments to be dispatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit for storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this standard, must appear in the Shipping list/Packing List.

2.0 SCOPE:

This procedure gives minimum guidelines to be complied with for packing of Components /Assemblies / Equipments. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage for periods more than one year.

3.0 CROSS REFERED SPECIFICATION:

Expanded Polyethylene Foam Sheet	: AA51420
Packing Wood	: AA51401
Silica gel	: AA55619
Thermocole	: AA51416
Packing slip holders	: AA7240901
Corrugated Fibre Board	: AA51414
Rubber sheet	: AA59001
VCI paper	: AA51406

4.0 WOOD SPECIFICATION FOR PACKING:

The wood shall conform to specification AA51401.

5.0 TYPE OF PACKING:

The following 5 types of packings have been standardized for packing of General Components /Assemblies.

'OP' - Open Type

'PP' - Partially Packed

'CP' - Crate Packing - Components/Equipments requiring physical protection

'CQ' - Case Packing - Small medium Components/ Assemblies/ Equipments which require corrosion & physical protection

'CR' - Case Packing - Electrical Components/Assemblies which require special packing viz. Water Proof, Shock Proof, etc.

Revisions: Refer 25 th MOM of MRC-M&CD			APPROVED: INTERPLANT MATERIAL RATIONALISATION COMMITTEE - MRC(M&CD)		
Rev No.00	Amd No.	Reaffirmed	Prepared	Issued	Dt. of 1 st Issue
Dt:17-08-2013	Dt:	Year:	HPBP, Trichy	Corp.R&D	17 Aug 2013

**6.0 DESCRIPTION OF TYPES OF PACKING:**

The various types of packing, as standardized above, are described below.

6.1 'OP' - Open Type:

In case, of components which are not affected by water & dust & do not require special protection &, are generally not machined, shall be sent as open packages. However these components may be sent in crates, wherever necessary.

6.2 'PP' - Partially Packed:

Components which need special protection, at selected portions only, shall be dispatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces after application of TRP should be protected with Polyethylene Coated Bitumen Hessain Kraft Paper to AA51409 or Polyethylene sheet to AA51408 of at least 100 micron thickness.

6.3 'CP' - Crate Packing - General:

Assemblies/Components which need only physical protection from the point of view of handling shall be dispatched duly packed in crates.

6.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipments:

- a) Small & Medium sized components/assemblies/equipments due to size/weight & to avoid handling, and pilferage, problems shall be packed in Case/Containers.
- b) Wherever required adequate quantity of silica gel to AA55619 or VCI Powder/ Tablets, packed in thin muslin cloth cotton bags shall be suitably placed.
- c) Small machines/components of less weight shall be provided with suitable cushioning. Wood Wool/Expanded Polyethylene Foam Sheet, if used, shall be sandwiched between polyethylene sheets and sealed.
- d) The components inside the case shall be entirely covered with a polyethylene sheet of at least 100 micron thickness to AA 51408, where-ever required.

6.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies:

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons.

- a) Adequate quantity of Silica gel to AA55619 packed in cotton bags, of 100 grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with a polyethylene sheet to AA51408 of at least 100 micron thickness, before being packed in the cases.
- b) VCI Powder/Tablets can be used as an alternative to Silica Gel to AA55619.
- c) Empty space in the cartons shall be filled with small chips of Expanded Polystyrene (Thermocole), Wood Wool etc. Polyethylene air bubble film shall conform to IS:12787/AA51420 Expanded polystyrene (Thermocole) shall conform to AA51416.
- d) The cartons shall be manufactured from corrugated Fibre Board, meeting requirements of AA 51414.

6.6 Volatile Corrosion Inhibitor (VCI) Paper:

- a) Un-protected surfaces of steel and cast iron components, tools bearing, shaft seals etc. are covered with VCI paper. VCI paper has been impregnated with



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corrosion inhibitors which by evaporation and chemical conversion protect metals in an enclosed area against corrosion.

- b) 7 m³ VCI paper is necessary for 1 m³ of packed item approximately as per AA51406.

Application Limitation:

VCI paper shall not be used for components made of aluminium, aluminium alloys as well as Zinc, copper, brass, cadmium and silver.

VCI powder is sprinkled inside the piping components ends shall be protected with end cover as specified in plant standards, drawings.

6.7 Moisture Absorber:

Silica gel is used for this purpose to protect the contents over sufficiently long time from corrosion. At the time of use, silica gel should be so dried that its colour becomes dark blue. These shall be filled in small cotton bags. Before sealing the equipment, the silica gel bags should be kept inside the polyethylene film cover at different locations. The quantity of silica gel should not be less than 1.0 kg per cubic metre volume of the packing box

7.0 TYPE OF CASES:

For specific requirement of packing the cases are to be provided with Tongue and Groove joints.

8.0 PREPARATION OF PACKING CASE:

- 8.1. The base of the case shall be made of wooden batons for planks giving necessary reinforcement, such that the bottom of the equipment is at a height of 100 to 200 mm from the ground level depending upon size, ft weight of equipment. However for packing cases of smaller size equipment can be at a height of -40 mm from the ground level.

- 8.2. In case of 'CR1 - Packing Viz. Electrical ft Electronic components for instruments /assemblies, a rubber sheet, Self-expanded polyethene foam sheet, preferably 10 mm thick, shall be fixed on to the base to act as cushioning to the equipment.

- 8.3. The four sides, shall be lined, from inside with packing paper water proof bitumen laminated to AA51410 Type - I or polyethylene sheet to AA51408 of at least 100 micron thickness and tacked at suitable places.

Whenever specified in addition to the bitumen laminated paper/polyethylene sheet the top cover will have a layer of bitumen felt over the cover. This should project about 100 - 250 mm on all sides.

It is preferable to have a single piece of the above Kraft paper fixed on the four sides. In case jointing is unavoidable, it should be done by overlapping of approximately 100 mm.

- 8.4. Place the Components/cartons with corrosion inhibitors duly applied wherever necessary for place suitably, thin muslin cloths bags containing 100 grams (approx.) of activated Blue Silica Gel to AA55619, wherever necessary. Alternatively VCI Powder or Tablet may be used.

- 8.5. In case, depression is formed, at the top, after the equipment is lowered, provide ply board/wooden batons.

- 8.6. Cover the whole equipment with polyethylene sheet of at least 100 micron thickness, on all sides preferably by a single piece.



- 8.7. For indoor panels/equipments, provide suitable packing batons with covering of Thermocole/expanded soft polyethylene foam/polyethylene air bubble film wrapped with suitable cords, to avoid cutting of the polyethylene sheet so that finished surface is not damaged.
- 8.8. Empty space in the box shall be filled with adequate cushioning material e.g. Thermocole Chips, Wood Wool etc. to avoid movement for shocks. Alternatively put wooden blocks/batons wherever necessary.
- 8.9. The inner side of the top cover shall be lined with polyethylene sheet, of at least 100 micron thickness, which shall project approximately 25 to 150 mm depending upon the size of the case on all sides of the top cover shall be provided below the top cover. This projection, after nailing the top cover, shall be folded over, on the sides of the crates it tacked, to, prevent ingress of water from the top.

9.0 STEEL CONTAINERS:

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies.

The containers are to be made of structural steel as per AA 10108 with proper reinforcement with I, C and T Sections.

Following precautions are to be taken during packing:-

Put the Components/Assemblies/Equipments in the steel container properly.

Cover the Components/Assemblies/Equipments with polythene.

To arrest the movement in the steel container necessary wooden Blocks/Batons may be put.

Put cover on steel container and Bolt Properly.

10.0 SEALED PACKING:

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture.

The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

11.0 SLING PLATE:

Sling plate shall be provided to prevent damage to the packing box during lifting. Size of the sling plate shall be selected depending upon the net weight of the consignment.

12.0 PACKING SLIP HOLDERS:

Two nos. steel packing slip holders, specification no. AA7240901 containing the packing list, sealed in thick polyethylene film, shall be fixed one inside and the other outside the packing box.

13.0 GENERAL PRECAUTIONS:

- a) While fixing nails during packing, necessary care shall be taken to ensure that materials used for protection inside the case e.g. paper, polyethylene sheet, coir etc. do not get damaged.



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- b) Sling protection brackets to be provided on cases wherever required.
- c) It shall be ensured that all stencil marks external, front & rear sides of the casing shall be of water proof Material to prevent obliteration in transit.
- d) The various caution signs shall be marked with stencil on both sides of the packing box.
- e) Do not pack any other Mechanical items with this case.

THE FOLLOWING DETAILS ARE TO BE MARKED ON THE PACKING CASES.

- a) Address of consignee.
- b) Purchase Order No.
- c) Description of item or title of packing list.
- d) Case identification Number.
- e) Net Weight.
- f) Gross Weight.
- g) Dimensions of box
- h) Marking showing upright position.
- i) Marking showing sling position.
- j) Marking showing umbrella (i.e. for machines/components to be stored under covered storage).

MARKING ON PACKING BOXES



A



B



C



D



E

- A UPRIGHT
- B FRAGILE
- C PROTECTION FROM FALLING OR CONDENSING MOISTURE
- D SLING POSITION
- E PROTECTION FROM DIRECT RADIATION

GENERAL GUIDELINE FOR FILLING QA PLAN IN CUSTOMER FORMAT

[1] Suppliers are required to fill the necessary relevant details under each column for **QA activities** planned during realization of final product covering the following stages :

A) Raw material stage –Covers all significant raw materials which are **procured from various approved sources by supplier** and **processed in supplier works** before assembly & final inspection of finished product. Example: Structural material, Pipes, tubes, strips, Sheets, Casting, Rods, Wires, packing material etc.

B) BOI stage – covers all instruments, devices, equipments, assemblies & sub-assemblies which are **procured from approved sources by supplier** and are **used as sub assemblies / components** in finished product without any processing at supplier works. Example: Motors, transformers, switchgear [Circuit breakers, SFU, fuses etc.], MCC, Resistors, All meters, Relays, Contactors, Displays, CT/PT, Gears, Fans, cables etc.

C) In process stage – covers all processes [including outsourced processes] which are required for conversion of raw material & BOI into finished product. Example: Wiring, Fabrication, Soldering, Brazing, Welding, Surface preparation, Painting, Galvanizing, Electroplating, Assembly, Finishing etc.

D) Final inspection stage - covers applicable Routine tests[FRT] for 100% of lot size & Acceptance test[FAT] on samples drawn from population of Offered Finished product.

Routine tests are conducted on 100 % lot size for confirmation of proper manufacturing by checking for manufacturing defects.

Acceptance tests [include most routine test & any other test / check stated in standard/ specification] are conducted on specified sample size [usually mentioned in QA plan / IS /BS/ IEC Standards] for the purpose of acceptance [rejection] of offered lot of finished product.

Type test approval wherever necessary must be obtained prior to Final inspection.

E) Packing stage – covers all process including finishing, preservation & packaging of product prior to dispatch.

[2] For each of above stages, there will be components [in case of Raw material/BOI stage] and operations [in case of In-process stage, Final inspection & packing stages] involved. Under the 'COMPONENTS / OPERATION' column the name of respective item/component/operation will be mentioned.

[3] For each component / operation there will be a list of test /checks involved which will ensure that the desired characteristics [specified in Technical specification, IS/BS/IEC & Plant standards] are confirmed in the lot under test. It could include Chemical composition, Metallurgical examination for grain size, Mechanical properties like UTS/ % Elongation, hardness, impact test etc, Electrical characteristics like resistivity, capacitance / inductance/ PD/ Tan delta etc, Functional checks, Operation check, pressure test etc. Sample sizes should be adequate & in conformity with relevant specification & standards [IS/BS/IEC/ Plant standard]. Under the column 'CHARACTERISTICS' the list of relevant characteristics for all component/operation must be mentioned.

[4] The various Characteristics checked for any component /operation are further classified into Critical, Major & Minor categories. Under Critical category, the characteristics which are essential for the finished product to meet the specified performance criteria & the non-conformance of which will harm or impair the product, user/operator and to associated equipment. Under Major category, those characteristics whose non-conformance will impair the ability of final product to deliver the specified performance criteria is included. All other characteristics are under Minor category. Under Column 'CLASS' the relevant category [Critical/Major/Minor] shall be mentioned.

[5] The type of various check[s] for different characteristics for all components /operation shall be detailed as Chemical / Electrical / Mechanical / Measurement/ Metallurgical/ NDT/ Pressure test / Functional/ Visual/Physical etc. in the column 'TYPE OF CHECK' as applicable.

[6] The sample size must be mentioned clearly as % of lot / nos. / nos per lot/ nos. per shift etc. under column 'QUANTUM OF CHECK'. The sample size must be adequate & in line with relevant standards / Plant norms. Two columns are mentioned in Quantum check, first one "M" is for the manufacturer/sub supplier quantum of check, whereas the next column as "C/B" represents the Quantum of check to be verified or witnessed by B and/or C

[7] Reference documents includes all approved Engg. documents [GA & part Drawings/ Schematics/ isometrics/ GTP/ datasheet /catalogue/TT approvals] alongwith relevant plant standards / International standards mentioned in specification for the product. The applicable reference document no. / name for each characteristics of all components/processes shall be listed by supplier under the column 'REFERENCE DOCUMENT'

[8] Under the column 'ACCEPTANCE NORMS' , supplier shall include the relevant document name in which the acceptance criteria are listed / stated or referred. In cases where no such document exists , supplier shall detail the acceptance criteria itself

[9] The results of various checks for characteristics of all components /operation are recorded in the form of Inspection reports[IR], Test reports[TR]/ Joint inspection reports[JIR]/ Test certificate[TC]/ Log sheet/ QC register / Job card/ Third party lab report/ Certificate of Conformance [COC] etc. Under the column 'FORMAT OF RECORD' , relevant test record type will be mentioned. Wherever applicable the format no. of record format should be mentioned. Also the documents which are to be included as part of Final inspection report [QA documentation] will be identified by "Y" or tick mark under "D" sub column

[10] Column 'AGENCY' mentions the agency for each of the activity (namely Perform ,Witness , Verification.) Legend details are as below :

P- Performing the relevant characteristic test/check . W- for Witnessing the relevant characteristic test/check & V- verification of records pertaining to relevant characteristic checked.

Under each of the sub columns "M" ,"C" & "B" , supplier shall propose the agency as per below legend

M- Supplier /Manufacturer / Sub supplier C- BHEL/ BHEL nominated agency B- BIFPCL/ BIFPCL nominated agency.

"P" [i.e. perform] shall be mentioned under sub column M always [meaning supplier/sub supplier/ manufacturer shall be responsible for performing the test/check.]

Under activity sub-column "C and /or B", "V" shall be mentioned wherever applicable [i.e BHEL and/or Customer shall verify the necessary records for relevant Characteristics checked.] CHP stages will be identified by "W" in "C and/or B" sub-column

[11] Any special information like name & place of Sub supplier for the component / operation [if outsourced] shall be mentioned by Supplier under 'REMARKS' column.

[12] The Customer format of QA plan has 11 columns [suitable to fit paper of A4 size in Landscape orientation]. The header & footer should be as mentioned in blank format. QA plan must include the supplier name & address and the item name in left hand side of Header. Supplier must fill in the necessary relevant details against Project name, Package detail [like 400 KV Switchyard], QP no., Rev., date must be correctly. The QA plan must be signed & stamped by authorized QA representative of supplier in the left hand side of footer before submission to BHEL.

MFGR's LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN					PROJECT :							
		ITEM :		QP NO.:			PACKAGE :							
		SUB-SYSTEM:		REV. NO.:			CONTRACT NO. :							
				DATE:			MAIN-SUPPLIER:							
				PAGE: OF....										
SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / B					M	C	B	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.	11.	

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER; C: MAIN SUPPLIER, B: BIFPCL P: PERFORM, W: WITNESS AND V: VERIFICATION AS APPROPRIATE. CHP: BIFPCL SHALL IDENTIFY IN COLUMN "B" AS "W"	DOC. NO.:		REV..... CAT.....				
MANUFACTURER/ SUB-SUPPLIER			MAIN-SUPPLIER						
SIGNATURE					FOR BIFPCL USE				
				REVIEWED BY		APPROVED BY		APPROVAL SEAL	



SECTION 4

GUARANTEED TECHNICAL PARTICULARS

1. Name and address of manufacturer
2. Manufacturer's type designation
3. Standards applicable
4. Rated frequency (Hz)
5. Rated voltage (kV)
6. Rated current
 - i. Rated continuous normal current (A)
 - ii. Rated extended primary current (A)
7. Short time thermal current withstand for 1 second (KA).
8. Dynamic current withstand (kA peak).
9. 1.2/50 micro second impulse withstand voltage (kV peak)
10. 250/2500 micro seconds switching surge withstand voltage (kV peak dry and wet)
11. One minute dry and wet power frequency withstand voltage (kV rms)
12. No. of cores per CT
13. Transformation ratio
14. No. of secondary turns (Nominal)
15. Rated output (VA) at different taps
16. Accuracy class
17. Knee-point voltage (V) at different taps

18. Secondary data
 - a. Secondary resistance at different taps.
 - b. Oversize factor and transient error under CO-t-CO duty condition with $t=400$ ms and duration of fault(100 ms)
19. Maximum exciting current
 - a. 100% kpv (mA)
 - b. 25% kpv (mA)
 - c. 20% kpv (mA)
 - d. 10% kpv (mA)
20. Instrument security factor at different ratios
21. Radio interference voltage at $1.1U_r/\sqrt{3}$ kV (rms) at 0.5 to 2.0 MHz (micro volts)
22. Whether auxiliary CT/reactors provided for metering winding.
23. Corona extinction voltage (kV rms)
24. Partial discharge level (pico coulombs)
25. Total creepage distance (mm)
26. Primary
 - a) No. of primary turns
 - b) Material and cross section of primary(cm^2)
 - c) Whether bar type or ring type primary
27. Whether CT is suitable for transportation horizontally

28. Composite error at rated burden and at
 - a) 20% rated current
 - b) 120% rated current
29. Composite error at 25% rated burden and at
 - a) 20% rated current
 - b) 120% rated current
30. Quantity of oil per CT (kg)
31. Whether spark gap/surge arrester provided at the primary
32. Standard to which oil conforms generally
33. Characteristics of Oil (Prior to filling)
 - a) Breakdown voltage (kV)
 - b) Dielectric dissipation constant at 90°C
 - c) Water content(ppm)
 - d) Gas content (ppm)
 - e) Interfacial tension at 27°C (N/m)
 - f) Specific resistance
 - i) at 90°C (ohm-cm)
 - ii) at 27°C (ohm-cm)
34. Whether current transformers are hermetically sealed. If so, how.
35. Total weight (kg)
36. Transport weight (kg)

37. Dimensional details
 - i) Overall height from mounting plane
 - ii) Height up to terminals from mounting plane
 - iii) Mounting dimensions & diameter of mounting holes
 - iv) Terminal pad diameter and length
 - i) Material of terminal pad
 - ii) Diameter of insulator at
 - a) top end
 - b) bottom end
38. Temperature rise over an ambient temp. of 50° C (°C)
39. Transient over voltage withstand for
 - a) 30 seconds (kV peak)
 - b) 1 minute (kV peak)
40. Whether CT characteristic curves enclosed
41. Details of recommended support structure enclosed
42. Drawing showing clearance from earthed objects enclosed
43. Type test reports enclosed
44. OGA drawing enclosed
45. Details of spark gap provided at the primary enclosed

Project: 400/230kV Switchyard at 2X660 MW
Maitree STPP, Bangladesh
Customer: BIFPCL
Consultant: FICHTNER
Technical Specification: 400kV Current Transformer

Bharat Heavy Electricals Limited
Document No. TB-388-510-021

SECTION 5

CHECK LIST FOR 400kV CURRENT TRANSFORMER

Put a tick mark (✓) on 'YES' if the specified requirement is met, or put a tick mark on 'NO', if the specified requirement is not met and give comments in the "Remarks" column.

Sl. No.	Parameters	Data	YES/NO	Remarks
1	Manufacturer's type designation	Bidder to furnish in Remarks Col.		
2	Type of CT			
	a) Insulating medium	Oil	YES/NO	
		SF6	YES/NO	
	b) Installation	Outdoor	YES/NO	
	c) Mounting	Upright	YES/NO	
	d) Tank design	i. Live tank	YES/NO	
		ii. Dead tank	YES/NO	
3	Standards Applicable	IEC 61869, IEC 60044-1, IEC-60044-4, IS-2705-(P1 to P4), ANSI-C5713	YES/NO	
4	Rated Voltage (kV rms)	400KV	YES/NO	
5	Rated Primary Current	4000A	Yes/No	
6	Rated short time thermal current	50 KA for 1 Sec	YES/NO	

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Sl. No.	Parameters	Data	YES/NO	Remarks
7	Rated dynamic current	125 kA _p	YES/NO	
8	Max. Temperature rise over design ambient temperature	As per Section-3	YES/NO	
9	One minute power frequency withstand voltage - Secondary Terminal and Earth	As per Section-2	YES/NO	
10	Cantilever Strength of CT at the terminal	As per clause 1.2.1 of Section-1	YES/NO	
11	Class of Insulation	As per clause 1.2.1 of Section-1	YES/NO	
12	Core parameters	As per table at clause 1.2.2 of Section-1	YES/NO	
13	Technical parameters	As per table at clause 1.2.1 of Section-1	YES/NO	
14	External Surface			
	Tank and Top Metallics	As per Section-3	YES/NO	
16	Specific requirements for Oil CT's			
	a. Oil filled CT's:			
	i. Grade of oil	ELIV grade	YES/NO	
	ii. Standard to which oil conforms	IS-335 / IEC-60296	YES/NO	
	iii. Oil filling and drain plug provided.		YES/NO	
	iv. Oil sight glass provided		YES/NO	

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Sl. No.	Parameters	Data	YES/NO	Remarks
17	Hermetic Sealing			
	a. Hermetically Sealed		YES/NO	
	b. Details of arrangement made for Hermetical sealing of the CT's are available and shall be furnished at contract stage.		YES/NO	
	c. Details of Site test to check the effectiveness of the hermetic sealing are available and shall be furnished at contract stage.		YES/NO	
18	Polarity of CT permanently marked		YES/NO	
19	Name Plate			
	As per IEC standards and Section-3 , and shall clearly indicate Year of manufacture, Rated current , Extended current rating & rated thermal current.		YES/NO	
20	Terminal Box - Ingress Protection	As per clause 1.2.1 of Section-1	YES/NO	
21	Rated extended current	As per clause 1.2.1 of Section-1	YES/NO	
22	Packing & Transportation			
	a. CT suitable for horizontal transportation.		YES/NO	
	b. Details of packing design shall be furnished for review at contract stage.		YES/NO	
23	CT suitable for High speed auto-reclosing.		YES/NO	