POWER GRID COMPANY OF BANGLADESH LIMITED

BIDDING DOCUMENT

FOR

Design, Supply, Erection, Testing &Commissioning of Upgradation of the Existing 132kV Madunaghat Substation to 230kV GIS substation on Turnkey Basis

(Bid Identification No.: PGCB/DCMPGSP/BD-P81/SS/03)

Addendum No. 1

Following revisions/changes are made in the bidding documents which will form part of the bidding documents:

1. **Volume 2 of 3 (Part 1)**

a) **Page No. 3-29. Clause no. 3.5.6.14**

The paragraph-

"Gas Losses
The Manufacturer should be prepared to guarantee the equipment for a gas loss of not more than 0.5% per annum in any single gas compartment, and not more than 0.5% for the total installation."

is replaced by the following:

"Gas Losses
The Manufacturer should be prepared to guarantee the equipment for a gas loss of not more than 0.1% per annum in any single gas compartment, and not more than 0.1% for the total installation."

Consequently, page no. **3-29** has been replaced with **3-29(Rev-1)** which is attached herewith as **ATTACHMENT 01**.

b) **Section 12: Buildings and Civil Engineering & Works**

Section 12 Buildings and Civil Engineering & Works has been completely revised and replaced. Consequently, Page no. 12-1 to Page no. 12-45 has been replaced by Page no 12-1(Rev-1) to Page no. 12-73(Rev-1) which is attached herewith as **ATTACHMENT 02**

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2. **Volume 2 of 3 (Part 1)**
   a) Future Existing drawing of 132kV GIS SS Madunaghat overall layout is attached herewith as **ATTACHMENT-09.**
   b) Drawing Number DCMPGSP/PKSS-3/MAD/002 under Section 20, Volume 2 is replaced which has been attached herewith as **Attachment 10.**
   c) SLD of ACDB and DCDB of already under construction 132kV GIS SS Madunaghat is attached herewith **as ATTACHMENT-11**.

d) SLD of already under construction 132kV GIS SS Madunaghat is attached herewith as **ATTACHMENT-12**.

e) Cable Trench layout of already under construction 132kV GIS SS Madunaghat is attached **herewith as ATTACHMENT-13.**

3. **Volume 3 of 3**

a) **Schedule A: REQUIREMENTS**

Item 1B2 of page SA-6 has been replaced by the followings:

"

1B2	Three (3) Nos. of 245kV GIS Auto Transformer Feeder Bays, each comprising:	
	1 lot	245kV, 4000A, 50kA/3s, three phase double busbar
	2 Sets.	245kV, 1600A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism
	2 Sets	245kV, 50kA/3s, three phase earth switch complete with motor operating mechanism at both sides of CB
	1 Set	245kV, 1600A, 50kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism
	3 Nos.	245kV, 1600A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 1600/1A, Class X for Busbar Differential Protection and Breaker Failure - 1600/1A, Class 5P20 for Spare - 1600/1A, Class 0.2 for Metering
	3 Nos.	245kV, 1600A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 1600/1A, Class 5P20 for Main 1 Protection - 1600/1A, Class 5P20 for Main 2 Protection and Transformer Differential - 1600/1A, Class 5P20 for BCU & DFDR
	1 Sets	245kV, 1600A, 50kA/3s, three phase line disconnector complete with motor operating mechanism
	1 Lot	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements with gas-air bushing, busbar end covers or link to adjacent switchgear panel as appropriate
	1 No.	Local Control Panel

Consequently, Page No. SA-6 has been replace by SA-6(Rev-1) which is attached herewith as **ATTACHEMENT-03**.

b) **Schedule A**

Item 1M2 of page SA-12 has been replaced by the following:

PABX extension:
Two sets of subscriber telephone sets with necessary wiring and connection to be installed in SPR.

Consequently, Page No. SA-12 has been replace by SA-12(Rev-1) which is attached herewith as **ATTACHEMENT-04**

c) Schedule-A, Appendix: Schedule of Technical Requirements

Technical requirement for post insulators and surge arresters have been added as APPENDIX A9-1 and APPENDIX A12 respectively which are attached herewith as **ATTACHMENT-05**.

d) Schedule-B: Rates and Prices

Complete Schedule B has been revised and replaced. Please refer to ATTACHMENT-06.

e) Schedule E: Technical Particulars and Guarantees

Guaranteed Technical particular for insulator strings and post insulators have been added which is attached herewith as **ATTACHEMENT-07**.

f) Schedule-I

Type test reports for Transformers, Gas Insulated Switchgears (GIS) and Lightning Arresters shall be issued by STL member testing laboratories or manufacturer's own laboratories. Test carried out at manufacturer's own testing laboratory must have been witnessed and certified by a representative from the STL member testing laboratories.

Type test requirement for Current transformer and voltage transformer of GIS has been deleted.

Consequently page no. **SI-5, SI-6, SI-7 and SI-8** have been replaced by **SI-5(Rev-1), SI-6(Rev-1), SI-7(Rev-1) and SI-8(Rev-1)** which are attached herewith as **ATTACHMENT-08.**

bushing to the DC high voltage test kit fitted at a suitably safe place inside the switchgear room. Adequate precautions shall be taken to ensure that any section of bus bars insulated by SF6 gas is not subjected to any cable testing voltage unless able to withstand such voltages. Hence the bidder shall indicate if there is any deviation.

(b) Removal/Insertion of Links for HV Cable Tests and Primary Injection

The Contractor shall be responsible for the degassing, removal of the cable chamber links at the remote ends, and regassing to facilitate HV Cable Tests and Primary Injection. Once the tests are complete the degassing, insertion of the links and regassing shall be completed thus allowing normal operation of the switchgear. This shall include replacement of gaskets as necessary.

3.5.6.13 Sealing of Enclosures

To prevent ingress of moisture or leakage of gas during the service life of the equipment, the sealing materials used at all joints and interfaces shall satisfy the following requirements:

(1) Not affected by SF6 gas
(2) Non-hygroscopic
(3) Non-aging and non-shrinking
(4) Retain resilience for long periods under stress
(5) Stable under all temperature conditions

Seals including those at compartment partitions shall continue to function correctly throughout the temperature and pressure ranges in service and the pressure differentials, including vacuum and test pressures, during erection, maintenance and subsequent revisions.

Expansion bellows and diaphragms, pressure relief devices and inspection windows shall be designed to be free of leakage under the same conditions as stated for seals.

Where the use of cast aluminum is envisaged, the Contractor shall submit the Employer the evidence of tests carried out for porosity and extended pressure testing to show the quality of the castings used.

3.5.6.14 Gas Losses

The Manufacturer should be prepared to guarantee the equipment for a gas loss of not more than 0.1% per annum in any single gas compartment, and not more than 0.1% for the total installation.

3.5.6.15 Earthing System

12. Buildings and Civil Engineering Works

SECTION 12 A

BUILDINGS AND CIVIL ENGINEERING WORKS (FOR OUTDOOR GIS AND AIS)

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SECTION 10 A

BUILDINGS AND CIVIL ENGINEERING WORKS (FOR AIS)

12A.1 GENERAL

This section covers all earth work, foundations and buildings associated with the project together with site preparation, roads, surfacing, cable trenches and tunnels, boundary walls, guard houses, foul and storm drainage and water supply.

12A.1.1 Scope of Work

The work includes the design, detailing, construction and maintenance of the following:

(i) performance of site survey and subsoil investigation

(ii) site preparation including retaining walls, cutting or filling up to the level specified in 12A.1.4 and levelling as well as compaction.

(iii) foundations for all equipment to be installed in outdoor switchyards, control buildings, and any other building required for the project

(iv) complete buildings consisting of structural reinforced concrete frames, brick walls, concrete roof and floor slabs.

(v) road including access road and roadways within sites, surfacing the entire area within site boundary and surface water drainage.

(vi) cable trenches, cable tunnels, cable ducts and pipe ducts

Included in the scope of work is the detailing, construction and maintenance of the following items which shall generally be constructed to the Employer's standards but full working drawings shall be prepared by the Bidder:

(a) guard house

(b) boundary wall and entrance gate

(c) septic tank and soakway

(d) water supply tubewell and plumbing installations

(e) underground water storage tank

(f) surface water, foul and storm drainage

(g) air conditioning and ventilation

(h) lighting, small power, external floodlighting, emergency lighting and fire protection

Guardhouse, as stated in item (a) shall be designed as per enclosed drawing.

Boundary wall and entrance gate stated in item (b) shall be designed as per enclosed drawings.

Drawing and design of septic tank and soakway item (c) above, shall be prepared by the Bidder as per requirement of clause 12A.3.3 and shall be finalized during detailed Engineering.

12A.1.2 Bidder to satisfy himself as to all conditions

The Bidder shall assess:

(i) access conditions at site, plus ground condition and ground bearing capacity

(ii) transport costs, materials costs and restrictions of availability of supply of materials locally

(iii) importation restrictions and delay due to customs controls

(iv) restrictions imposed by existing equipment on sequence of construction, access, etc.

(v) restrictions caused by cable laying and overhead line Bidders

(vi) ground conditions and temporary works required to provide support during excavation

12A.1.3 Way leaves, Land Purchase and Planning Permission

The Employer will be responsible for the purchase of all land within the permanent site boundary and the purchase of all land required to the base of the fill of any batter slopes. The Employer will also be responsible for obtaining land to provide a permanent single access to site from a nearby road or waterway.

During the construction period the Bidder shall be responsible for maintaining this access road in a reasonable condition by reinstating damage caused by his construction traffic and Employer's traffic.

Should the Bidder require more than one single access to a site or require additional land for construction activities outside the permanent site boundary, he shall be responsible for the purchase or way leave of the required land.

The Employer will be responsible for applying for planning permission. The Bidder shall be responsible for completing the approved site survey and the approved site layout plan, together with the approved architectural elevations of all facades of any buildings, by the key date given in the programme so that the Employer may use these drawings to apply for planning permission.

12A.1.4 Site Survey Drawings

The Bidder shall prepare a survey at 1:200 scale showing existing ground levels on a maximum 10 metre grid and details of all features above and below the ground within the site boundary and up to 15 metres beyond it by the key date stated in the programme. Levels shall be related to bench marks clearly indicated on the plan. The plan shall be submitted to approval by the Engineer and the approved substation building plinth levels shall be given on site plan. The Bidder shall propose the building floor level to the Engineer. The final ground/formation level of the site will be 500mm above the crown of the nearest public road or the highest flood level whichever is greater. All building plinth level will be 450mm above the final ground/formation level.

12A.1.5 Earth Works

Fill where required shall be carried out by the Bidder. Source of fill material and Retaining wall shall be planned and approved by the Employer. The Bidder shall be responsible for providing a level or uniform sloping site to suit his substation layout design. The final ground/formation levels (i.e. the level below the brick surfacing) shall be stated on the site survey plan to be prepared by the Bidder.

12A.1.6.1 Engineer's and Employer's Accommodation/Surveying Equipment

On each major site the Contractor shall provide an office of approx size 5 x 8m equipped with desk, 1 executive chair, 2 visitor chairs, light, fan and air conditioner, toilet with wash basin etc for the sole use of the Employer's Engineer and his inspectors. Similar facilities are to be provided for the supervision consultant of the Employer.

12A.1.6.2 Surveying Equipment

The Contractor shall loan his surveying instruments with surveyor to the Engineer and his staff when required. Instrument checks shall be carried out at monthly intervals.

12A.1.7 Programme

The Bidder's programme shall at Bid stage define the following key dates. Where drawings are to be submitted for approval, they shall be submitted at least 6 weeks before the key dates to allow for the Engineer to comment and his comments to be incorporated in the drawings:

1 Issue of approved site survey drawing complete with soil levels and floor levels

2 Issue of approved electrical layout drawings

3 Completion of Site Investigation field work

4 Issue of approved Site Investigation Final report

5 Completion of loading tests on a foundation on fill site and any other site where settlement is likely to be a problem

6 Issue of approved drawings required for Planning Permission

7 Issue of a full complete set of civil building drawings

8 Construction start date

9 Date access will be given for:

   i) Installation of equipment in Buildings

   ii) Installation of outdoor plant

10 Construction finish date

The drawing programme shall ensure that complete set of approved civil building drawings will be issued at least 21 days before construction start, in accordance with the Project Requirements.

The Construction programme shall be expressed in an 'S' curve for the whole project, with the percentage (of the total value of work in the schedules) each month.

12A.1.8 Monthly Progress Certificates/Progress Reports

In accordance with the Project Requirements the Bidder shall submit agreed progress certificates before the seventh day of the next month. These certificates shall state the percentage completion of each item in the schedules and shall state the overall percentage completion. An updated 'S' curve shall be submitted with the progress certificates.

12A.1.9 Temporary Facilities

The Bidder shall provide all temporary buildings, workshops, cement and lime stores and latrines required for his use. The Bidder shall agree the location of these buildings with the Engineer, after submitting a drawing showing their proposed location.

When a Bidder is placed in possession of a site, or part of a site, he shall erect temporary fencing immediately to protect the site until the boundary wall shall be erected.

12A.1.10 Site Supervision

Although the civil and building works may be let as a sub-contract to an approved local Bidder, the main Bidder shall ensure that an expatriate supervisor in his direct employ is continuously available at site during construction. This supervisor shall have at least a working command of spoken English and be able to read, understand and discuss specifications and drawings.

The Bidder shall notify the Employer and Engineer in writing of major field works two days before the work starts for the activities as described below:

i) subsoil investigation

ii) every concrete pour and foundation casting

12A.1.11 Designs and Drawings

The Bidder shall obtain the Engineer's approval for the use of all design codes and standards before design work starts. The Bidder shall supply one copy of all of codes for employer’s Engineer. If non-English equivalent National codes are adopted, the Bidder shall supply English translations of these Codes to the Engineer.

One copy of calculations along with all soft (software) copies shall be submitted together with drawings. To avoid possible misunderstandings, calculations will not be approved separately from drawings.

The Bidder shall generally submit a complete set of of drawings of each item sequentially for approval after initially getting the electrical layout and section approved. Where possible, drawings shall be standardized and general drawings shall be issued covering several sheets.

The Bidder shall provide a co-ordination plan at scale 1:200 showing busbar sizes, structure types, foundation types, cable trenches, roads, ducts, buildings, boundary walls, earthing, drainage and all services in this Contract.

12A.2 REFERENCES

12A.2.1 General

The design and construction shall conform to the latest edition of the relevant Codes and Standards. Any proposed substitution for the listed Standards by an equivalent Standard will be subject to approval by the Engineer. Relevant Standards include, but are not limited to, those listed in sub section 12A.2.2 below.

12A.2.2 Design and Construction Standards

BS12	Portland Cement
BS EN 124	Gully and Manhole tops for vehicular and pedestrian areas
BS 812	Testing aggregates
BS 882	Aggregates from natural sources for concrete
BS 1377	Methods of test for soils for civil engineering purposes
BS 1722:	Part 10Anti-intruder fences
BS 1881	Testing concrete
BS 2853	Design and testing of overhead runway beams
BS 3148	Methods of test for water for making concrete
BS 3921	Clay bricks
BS 4449	Steel bars for the reinforcement of concrete
BS 5262	External renderings
BS 5395	Stairs, ladders and walkways
BS 5572	Sanitary pipework
BS 5628	Code of practice for use of masonry
BS 5930	Code of practice for site investigations
BS 6031	Code of practice for earthworks
BS 6367	Code of practice for drainage of roofs and paved areas
BS 6399:	Part 1 Code of practice for dead and imposed loads
BS 6399:	Part 2 Code of practice for wind loads
BS 6465	Sanitary installations
BS 6651	Code of practice for protection of structures against lightning

BS 6700	Design, installation, testing and maintenance of services supplying water for domestic use
BS 8004	Code of practice for foundations
BS 8005	Sewerage
BS 8100	Lattice towers and masts
BS 8102	Code of practice for protection of structures against water from the ground
BS 8110	Structural use of concrete
BS 8206	Lighting for buildings
BS 8215	Code of practice for design and installation of damp-proof courses in masonry
BS 8290	Suspended ceilings
BS 8301	Code of practice for building drainage

12A.3 DESIGN

12A.3.1 Architectural and Structural Requirements of Buildings

All new buildings shall be designed to be architecturally pleasing in appearance and to withstand the tropical climate with minimal maintenance.

Architectural plan and all elevations of buildings shall be agreed before other detail plans are prepared.

Air conditioning units shall be provided in rooms listed in Section 13. Air conditioned rooms shall have a false ceiling such that the overall thermal transmittance of the roof shall be below 0.45 Watts/m^2˚C . The false ceiling shall be made from non combustible materials, and shall be easily removable to provide easy access to small power cables.

All buildings shall be reinforced by a reinforced concrete frame which shall be capable of resisting a horizontal earthquake force of 0.1G. An external concrete open staircase shall be provided up to panel room floor. An internal concrete staircase shall be provided up to the roof. The roof shall be a flat insitu concrete slab designed for 2.5 kN/m^2 live load.

The roof shall be waterproofed with lime terracing 2:2:7 lime, shurki (powdered brick) and brick chips 0.75" down, which shall be beaten in accordance with local practice or with any other approved water proofing system. The entire roof area shall be laid in one continuous operation. For lime terracing waterproofing system the minimum compacted thickness of terracing shall be 25mm at the low points of the roof with a 1: 150 slope to those points formed by a layer of terracing of increasing thickness. Once laid, the terracing shall be covered with a layer of bitumen emulsion and the edge of the terracing shall be protected against erosion into the downpipes. Downpipes shall be of 100mm diameter cast iron pipe placed outside the wall but shall be enclosed in a facing brick buttress. There shall be at least one downpipe per 100m^2 of roof. The Bidder shall guarantee the roof against leaks for a period of 3 years from the Taking Over Certificate date. The roof shall project at least 450mm beyond the face of all walls to form a sunshade and rain shelter to the walls below. The upper surface of this projection shall be sloped and a drip provided.

The main entrance to all buildings shall be shaded, either by a projection of the roof over the entrance veranda or by a separate roof at a lower level. This area of roof shall also be lime terraced and drained by rainwater pipes.

The roof parapet wall shall be about 0.8 metre high with an insitu concrete coping with DPC below it. Where facing bricks are used below the roof level, they shall also be used above roof level. An architectural feature shall be provided by panels of open decorative block work (Mirpur ceramics or similar approved) to ensure good air circulation over the roof. Three open decorative blocks of size 1000mm X 500mm should be provided on each side in solid portions of parapet wall.

The head of each downpipe shall be fitted with an enlarged hopper and purpose made cast iron grill set into a recess in the roof projection.

All external walls of main control room building/SPR shall be minimum 230mm first class brickwork plus one layer of Mirpur Ceramics or similar approved facing bricks. External walls of other buildings shall be minimum 230mm first class brickwork plus one layer of Mirpur Ceramics or similar approved facing bricks or rendered with cement render and painted as required by the architectural plan. The internal walls shall also be generally of minimum 115mm thick first class brickwork. Internal walls and ceiling outside & inside of false ceiling shall all be rendered and receive one sealer coat plus two finishing coats of emulsion paint. Externally, rendered walls shall receive primer plus two finishing coats of acrylic external quality paint or similar approved.

Particular attention must be given in the design of buildings and layouts to fire prevention and safety of personnel at all times. Buildings housing switchgear and control equipment shall be designed as far as practicable to exclude pollution under all likely weather conditions. Fire-proof or flame-retarding materials are to be used for floor, wall and ceiling finishes. Where areas are designed as having a fire resistance rating then materials shall be shown to have passed approved standard tests for that class of fire resistance.

The height of ground floor of two storey control building shall be 3.0 metre and the minimum minimum height of first floor control room shall be 4.0 metre. False ceiling should be provided in the control room floor. In the switchgear rooms, minimum 1 metre clearance shall be provided over the switchgear to the underside of the roof slab but the Bidder shall provide a greater clearance if it is required to remove equipment. The clearance maybe reduced below down stand beams provided no equipment is required to be removed from the top of the switchgear. All rooms in any building shall be of same height.

The false ceiling shall be made from non combustible materials, and shall be easily removable to provide easy access to small power cables. Suspended ceilings, with acoustic tiling and incorporating lighting and air-conditioning fixtures shall be used in corridors, offices, control and SCADA rooms of the buildings and as per schedule of finishes.

In main control room building, all structures shall be designed to carry the loads imposed by the structure itself, together with minimum floor live load (including stairs) of 5.0kN/m2 (minimum) or in accordance with an approved standard or code of practice. The roof shall be designed for 2.5 kN/m^2 live load.

All doors opening outwards from the buildings shall be provided with panic latches or bolts which override any locking device, for escape in the event of fire. All doors shall be provided with overhead door closures of adequate capacity. Door labels incorporating electrical hazard warning in Bangla and English shall be fixed to each entry door. Vision panels shall be provided to frequently used doors.

Window openings shall be fitted with protruding concrete sunshades above and at the sides of the openings.

The domestic water supply system shall include all plumbing, underground pipework, high and low level storage tanks, valves, fittings and pumps (including the provision of a standby pump) for the provision of a pressurized water supply system for the static water tank and all buildings within the compounds.

On completion of the installation and prior to putting to use, the system shall be sterilized in accordance with an approved Code of Practice.

The Bidder shall be responsible for the provision and installation of a water supply serving the substation buildings. Every cistern, sink, basin, etc., shall be provided with as stop-cock in the supply pipe adjacent to the fitting. Each basin, sink and shower unit is to be provided with both hot and cold water. Provision shall be made for connection to the drinking water supply.

Each Toilet shall be provided with 1 no. western type WC, 1 no. wash-hand basin, 1 no. wall mounted mirror, 1 no. towel rail etc. all necessary fittings and accessories shall be provided.

Battery rooms shall be supplied with sink and drainer & exhaust fans (if no air conditioning).

The Bidder shall provide the fire/heat detector and portable fire extinguishers for main control building and local control houses. The fire extinguishers shall be of the dry chemical type suitable for the protection against Class A; B; C; fires. Each fire fighting units should be clearly marked as to its type and method of operation and of refillable-type cylinder. The details of installation for the fire/heat detector and portable fire extinguishers shall be provided to the Employer for an approval.

12A.3.2 Ground Conditions, Foundations and Site Investigation

(a) Fill Sites

The Bidder shall impose the site layout on the survey to check for uneven depth of fill below any foundation and where uneven depth of fill exists his foundation proposals shall restrict final differential settlement to a 1 in 400 slope.

If a fill site has not been exposed to one wet season before foundation work starts, the Bidder shall flood the site to a depth of 50mm for 10 days (Not required on hydraulic fill sites). This requirement is because silty sands will generally compact to a denser condition on first time flooding.

On all fill sites the Bidder shall pipe rainwater from down pipes down to paddy level and shall prevent water ponding in open foundations and backfill all foundations as soon as possible.

When a filled site is handed over to the Bidder, the Bidder shall become responsible for maintaining the entirety of the fill in good condition, including all better slopes.

(b) Unfilled Sites

Original delta levels are generally below road level. Therefore most sites are historically fill sites but fill settlement can sensibly be considered complete, where fill is over 3 years old.

(c) Site Investigation

Detailed methodology for subsoil investigation shall be submitted before implementing the subsoil investigation. All laboratory tests shall be done at the test facility approved by the Employer.

The Bidder may appoint a sub Bidder to carry out the site investigation but all work and all lab work shall be witnessed by one of his Geo-technical engineer who shall countersign all recorded data.

1 borehole should be counted for every 600 square meter of proposed project area and provided on suitable points. At least three additional boreholes should be provided for control building and switchyard panel room building or any other building. For boundary wall/retaining wall additional boreholes shall be provided on in each corner point and at a maximum 50m interval point. Additional boreholes may also be required where uneven fill depth is encountered. The number and location of boreholes shall be approved with the site survey drawing showing existing ground levels specified in the section 12A.1.4. The boreholes shall be located to an accuracy of $\pm$ 0.5m and shall be located to site layout considering existing obstacles at the field.

Boreholes shall be a minimum of 25 metres depth or twice building footing width, whichever is greater. All boreholes shall be backfilled with compacted sand.

Borehole log together with a summary of all required laboratory tests is required to be prepared. Soil test locations are required to be indicated on the geographical map.

In each borehole the following tests shall be carried out:

- Standard Penetration tests at 1.5 metre intervals.
- Undisturbed samples shall be taken at around 2.0 metres, 3.0 metres depth for unfilled site; 2.0 metres, 3.0 meters, 5 meters and 7.5 meters depth for filled site and tested by unconfined compression tests.
- One dimensional consolidation tests shall also be carried out on undisturbed samples taken at each depth. The samples shall be saturated and the range of applied pressure shall fully reflect the insitu conditions. Graphs showing void ratio (e) and applied pressure shall be submitted along with the Coefficient of Compressibility for the range

of loading anticipated. Mv shall be in m^2/MN and shall be recorded at each stress increment. The coefficient of consolidation, cv, shall be given in m^2/year.

- Particle size analysis shall be carried out for each stratum and specific gravity, moisture content, liquid limit and plastic limit determined.
- Ground water level shall be determined by dipping the boreholes. Where collapse of the boreholes occurs, casing shall be used and left in until the water level remains constant for two days.
- In cohesive soils a vane test to BS 1377: Part 9 shall be carried out at three different depths. The Bidder shall check the sensitivity of soil and ground water at each site to concrete and take all measures necessary to ensure the long term durability of concrete.

The Bidder shall give the Engineer the requisite period of notice prior to commencing the geotechnical investigation at the field. The field sheets of each bore log shall be signed by the geo-technical engineer of Bidder and representative of the Engineer. The signed field sheets shall be include in site investigation report.

(d) Site Investigation Report

The site investigation and analysis of the data in a final report giving full details of foundation proposals shall be completed at each site by the programmed date. During site investigation, Geographical map shall be prepared indicating the locations of soil test.

The report shall be submitted by the key date at each site given in the programme. The Bidder shall submit 3 copies of the report to the Engineer. The report shall propose full details of foundations and loading thereon and shall provide estimates of likely settlements and differential settlements. The report shall be the work of the Bidder's own foundation engineers.

If the Bidder uses a local site investigation Bidder, he shall appoint one of his geo-technical engineer to oversee the entire operation and each piece of data shall be countersigned by this person.

Where estimated settlement exceeds 25mm, the Bidder shall construct one foundation at an early stage and test load this foundation to confirm settlement predictions.

(e) Foundations

Regardless of the result of soil investigation report, the foundations of control building, boundary wall, gantry structures and for auto-transformers shall be provided with piles. Piles shall be concrete (cast-in-situ or precast) complying with BS 8004.

Other foundations of outdoor equipment shall be provided shallow/deep as per subsoil investigation report, settlement test as well as plate bearing test. In case of shallow foundation for outdoor equipment the bearing capacity of proposed soil level shall be checked by the Plate Bearing Test.

For shallow foundations the minimum depth of foundations shall be 1.5m.

All formations shall be hand rammed or mechanically compacted before placing 70mm minimum thickness of Class B concrete blinding, within 24 hours of bottoming excavation, which blinding shall project 300mm minimum distance beyond all footings. Each footing shall be inspected by the Engineer. Where soil condition is poor (on fill sites or already filled sites) or where the Bidder leaves foundations exposed and soil conditions deteriorate, one of the following measures shall be carried out as agreed with the Engineer:

i) Blinding depth and projection shall be increased as necessary.
ii) Soft soil shall be removed and replaced with compacted viti sand with the top 300mm (Minimum) consisting of sand and khoa (brick chips) in 2:3 ratio with 95% level of compaction.

The cost of this work shall be borne by the Bidder.

The Bidder shall propose the allowable bearing pressure for all foundations based on soil strength parameters only and shall not be increased while wind loads exceeds 25% of dead load as well as shall not exceed 125kN/m^2 . Between column footings all walls, including all internal walls, shall be provided with a reinforced concrete strip footing of minimum dimension 800mm wide by 250mm deep placed at the same level as column footings and linked structurally to the footings. In addition column footings shall be tied at foundation level and also floor level by beams to every adjacent column in both orthogonal directions.

These beams shall be designed to resist 1 in 200 differential settlement without distress and shall be capable of resisting the earthquake load of 0.1G.

The deepest parts of any foundations shall be completed first. All foundations shall be completed and backfilled, including all cable tunnel and cable trench work inside buildings, before walls are raised above floor levels. All other foundations shall be backfilled within 7 days of completing concreting.

All exposed concrete and the outer surfaces of cable trenches and cable tunnels shall receive two coats of bitumastic paint before backfilling to reduce ingress of water. The Concrete surface shall be ground smooth and all air holes etc filled (rubbed down with a cement slurry) before painting.

The Bidder shall monitor settlement of all foundations each month and report this settlement to the Engineer until settlement has reduced to less than 1.5mm in 3 months.

The tops of all foundations shall terminate 200 mm. above site average finished surface level. All exposed edges shall have 20 mm x 20 mm. chamfers.

Excavation shall only be carried out when the ground water table is at least 1000mm below foundation level. The excavation shall be kept dry during the construction period by providing sumps and pumps as required. During the rainy season, shelters shall be erected over all open excavations.

Any over excavation shall be filled with Class B concrete.

All backfill shall be compacted to 95% maximum dry density as defined by BS 1377 test method part 4, 2.5 kg rammer.

Before starting foundation work the Bidder shall clear all sites of trees, tree roots, shrubs, debris, surplus soil, and any buildings.

Foundations shall be designed to resist uplift, assuming the water table is at ground level and the weight of soil resting on a foundation is that included within a 15° frustum.

One working pile of control building and one of auto-transformers at each site shall be load (compression) tested to 150% of design load in accordance with BS 8004. One working pile of gantry foundation at each site shall be load (uplift) tested to 100% of design load in accordance with BS 8004.

12A.3.3 Drainage

The entire surface within boundary walls shall be of uniform sloping site, sloping at 1 in 300 minimum slope to open channels around the entire perimeter. These channels shall be designed for a rainfall intensity of 60 mm per hour. Outside the boundary wall the Bidder shall be responsible for drainage up to 20 metres from the wall and will at some sites need to construct outlets with suitable erosion protection down to paddy level.

The concrete wall of cable trenches shall project at least 50mm. above brick paving level to prevent run off entering the cable trench. The floors of all cable trenches/tunnels shall be sloped to soak well as described in 12A.3.16.

The cable trenches will thus form barriers to surface water drainage. If the cut off area exceeds 30m^2 it shall be drained by a 200mm minimum diameter concrete pipe to the boundary drain. The Bidder's drainage design shall avoid all ponded water to avoid forming a mosquito breeding ground.

All drainage pipework within buildings shall be uPVC type, generally of 100mm diameter or as per requirement. Floor drains shall be placed in each battery room and toilet.

External pipework shall be 150mm. minimum diameter uPVC pipes at a minimum depth of invert of 700mm. Where pipes, including existing pipes alongside site, are less than 400mm above adjacent foundations they shall be surrounded in concrete. Where required, drainage pipes shall be kept below cables, allowing 1.1 m cover to top of pipes.

Manholes shall be of brick construction with 600mm. x 600mm clear openings and airtight ductile iron covers to BS EN 124. Manholes shall be located at each change of direction. Minimum fall on all pipelines shall be 1 in 80. Manholes shall not be located in roads.

The Bidder shall be responsible for all negotiations with local authority/WASA where a connection to a public sewer is proposed. Where high water levels in public sewers may cause effluent to back up into a site, non return valves shall be fitted. The Bidder shall provide all protection required to existing sewers and shall deepen foundations, including boundary wall foundations, where required to ensure all foundations are below adjacent sewers. The Bidder shall draw longitudinal sections of all pipelines.

Main control building shall be provided with a septic tank designed for 10 users and a soakaway of open brick construction 11m deep by 2.2m diameter filled with broken bricks. The septic tank shall be located at least 15 metres from buildings. Other buildings shall have septic tanks designed for the required number of users. All foul drains shall be vented by a vent pipe to above roof level. The inner surface of all manholes and septic tanks shall be painted with 2 coats of bitumastic paint to protect it against sulphate attack. The septic tank shall have access holes directly over the inlet pipes and outlet pipes. Where public sewers exist alongside a site, the Bidder shall connect directly to the foul sewer, provided effluent from the sewer is treated.

The Bidder shall construct the drainage first to ensure that at no stage is rainwater ponded on any part of the site. All rainwater shall be able to run off the site or shall be immediately pumped off site by the Bidder. The Bidder shall complete all necessary drains before casting any roof and large concrete area which will create large run off. The condensate drains for the air conditioning shall also be connected to the drainage. Two vents of minimum height 2.2m shall be provided on each septic tank.

If a town's water supply is unreliable, the roof rain water shall be collected in an underground tank of standard Employer's design.

12A.3.4 Surfacing

For the whole of the switchyard outdoor equipment area the ground shall be surfaced with gravel or other readily available local stone as approved by the Engineer. The switchyard surfacing shall be clean, thoroughly washed when necessary, and free from clay, soil or contaminating material and shall be graded from 20 - 45mm, laid and lightly compacted to a finished thickness of 175mm. Below the gravel layer there shall be a 75mm brick layer with cement mortar (1:6), laid over a 75mm level of fine sand spread over the finished fill site.

The substation plot, outside of the designated switchgear equipment areas, shall be turfed. Turf shall be of good quality, free from weeds and other impurities. Samples of the turf which is proposed to use shall be submitted to the Engineer for his approval. The turfs shall be laid to even surfaces on a bed of plastic/vegetable soil of 150mm thickness over Finished Ground level (FGL), which shall be raked and consolidated to provide a suitable bed.

On sloping surfaces the Bidder shall provide and fix wooden pegs to retain turfs.

All areas to be surfaced shall first be treated with a total weed killer in accordance with the manufacturer's instructions. Weed killer shall only be applied in dry weather when there is no risk of it being washed out to adjacent agricultural areas.

12A.3.5 Roads

Access road from outside the site boundary to connect to any adjacent public road and all roads within the site boundary shall be provided by the Bidder. The road surface shall be finished by concrete paving or equivalent. All roads shall be of reinforced slabs of minimum 150mm thickness fitted with construction joints at distances not exceeding 6.0 m. Paving schedule and methodology shall be approved by the Employer. The extent of roads required is shown

approximately on Bid drawings but the scope of the work may change. Road layout shall generally permit vehicles to turn easily to avoid having to reverse out. Road layout shall be designed by the Bidder. The bidder shall assess all practical requirements like culvert construction, removal of any obstacles, permission from local authorities etc. for access road. All necessary works shall be the bidder's responsibilities.

The width of access road from outside the site boundary to connect to any adjacent public road shall be 6 meters. All roads within the site boundary shall be generally 6 metres wide between the outer edges of kerbs for main road and 4.5 meter & 3 meters wide for sub road.

The road edge shall be formed by Class B concrete kerb 300mm wide by 250mm deep, placed over one layer of bricks laid flat. The road shall be a Class A concrete slab of average 150mm deep at each edge with 1:50 cross fall and stiff broom concrete finish reinforced with 8mm bars at 150mm centres longitudinally and 8mm bars at 150mm centres transversely placed 60mm below the upper surface. Expansion and contraction joins shall be detailed on site plans. Expansion joints shall have oil resisting grade polysulphide sealant. Below the slab shall be a layer of polythene 0.5mm thick laid over one layer of 1st class bricks laid on edge in herringbone fashion in and on cement mortar (mortar designation iv) laid over one layer of 1st class bricks laid flat in and on a layer of sand laid on insitu soil which shall be compacted as agreed with the Engineer. If the soil is clay a 75mm drainage layer of broken bricks shall additionally be placed over the soil.

The radius of the road edge at corners shall not be less than 3 metres and 1.2 metres either side of the road shall be kept clear of obstacles. Bollards or raised kerbs shall be provided where required to protect items alongside a road from vehicles. Ducts shall be provided below roads for all services in this Contract and for all future services.

Where mortar designations are referred to see BS 5628 Mortar designation iv is 1 cement: 2 Lime: 8 to 9 sand.

At each new substation site a two bay hard standing car port, complete with sun shades, is to be provided adjacent to the control building.

12A.3.6 Water Supply

The Bidder shall be responsible for providing a water supply both for construction and for operation of the completed sites. If a town's water supply is not available, the Bidder shall install a deep tubewell of 40mm minimum diameter and 100m minimum depth with necessary pumps including all fittings, pipes etc. as required. But in that case guideline specified by WHO for drinking water is required to be satisfied. The Bidder shall supply and commission power supplies and all pumps required by tube wells.

If a town's water supply is available, the Bidder shall be responsible for making all necessary arrangements with WASA to connect a supply. If the pressure in the supply is inadequate to supply the roof tank continuously, the Bidder shall install a 1800 litre low level tank and pumps. This tank shall be below ground with a 200mm minimum air void around the tank to protect it

from contamination. The pump control panel shall be located in the building. Water levels shall be controlled by float switches but the panel shall provide also for manual operation.

The supply shall be connected to a 2000 litre food graded plastic tank. This tank shall be raised 400mm clear of the line terracing on four brick piers of minimum 350mm square. All supplies in buildings shall be fed from the roof tank. The supply to the tank shall have a valve at waist height. The tank shall have an overflow returning to the location of this valve. No pipes shall pass through the roof directly over any room. Pipework shall be routed up the outside of the building and return pipes shall return down the outside of the building before entering through the wall. Pipework shall be galvanised steel secured by clamps at 1-5 metre intervals and painted with alkyd paint to match walls. All pipes should be concealed by brickworks on vertical walls.

12A.3.7 Plumbing and Sanitary Fittings

The Bidder shall prepare a drawing of all plumbing and building drainage for each building. Sanitary fittings and plumbing materials shall generally be of approved local manufacture.

In main control building each toilet shall have a single western WC. Each toilet outlet shall be vented by a 100mm diameter uPVC vent pipe passing up the outside of the building to 300mm above roof level. Beside each toilet shall be placed a low level tap. Main control Building toilets shall also have a wash basin and cold and hot water shower with 10 gallon capacity geyser for each toilet. Toilets and showers shall have all walls tiled upto the bottom of false celling.

Every tap and cistern shall have stop cocks in the supply pipe. One external tap shall be provided on each building. Battery rooms shall be provided with a stainless steel sink of approximate dimensions 900 x 600 x 200mm with a draining board to one side. The battery room floor drain shall be connected to the foul drainage. All floor drains shall have P traps.

Mirrors shall be installed over toilet wash basins. Care shall be taken in orientation of toilets to avoid offending religious sensitivities. Toilets shall generally be orientated North South where possible. Each shower shall have a wall on two sides and a porcelain shower tray sunk into the floor. Soap dishes shall be provided beside each shower.

Only foul water from WC pans shall be connected to septic tanks. All other water shall flow to surface water drains.

12A.3.8 Building Floors

All topsoil containing roots shall be removed and the insitu soil compacted before placing backfill. All backfill, including the backfill to column footings, below the floor shall be sandThe floor and all cable trenches shall be made of Class A concrete. The ground floor slab shall have a minimum 125mm thick reinforced Class A concrete furnished with floor tiles and shall rest on the compacted fill. Below the slab shall be placed a layer of polythene 0.5mm and a layer of sand khoa (2:3) compaction of minimum 100mm thick, hand rammed to a smooth upper surface.

All cables from cable trenches shall enter the building over grade beam level, no cable trench shall be allowed into main control room building. Where power cables traverse a building to reach a switchgear room on the far side they shall generally be contained within cable tray.

All sand backfill shall be compacted to 95% optimum density and shall be tested. The fill within a building, above ground level, shall not be placed until all backfill outside the building is completed. All floor slabs shall have a damp proof membrane of 0.5mm thickness.

Each control building shall have a ramp at a slope of approximately 1 in 7.5, of 1.5m minimum width with a Concrete Class A slab of min depth 125mm with a stiff brush concrete surface finish, or other agreed non slip surface.

All floors (including verandahs) except for cable basement, GIS room, control room and battery room shall have 25mm homogeneous floor tiles topping. All external steps where public access is given to buildings shall have marble tiles toppings. Elsewhere, concrete surfaces shall be used for all external floors/steps. Verandahs shall have a minimum 1:50 slope to shed rainwater away from buildings. Concrete floors and steps shall also be treated with 3coats of Lithurin or other approved concrete dust proofer.

Verandahs shall have a minimum shed of 1:50 slope to rainwater away from buildings.

If floor tiles are not adequately durable to withstand switchgear movement when rolled out to the maintenance position, then galvanized steel chequered plates shall be inserted in the floor to resist the abrasion from switchgear wheels.

12A.3.9 Cable Basement

Not used.

12A.3.10 Battery Room Floors

Battery rooms shall have a concrete floor sloping to a cast iron floor drain. The concrete surface shall be treated with Nitocote epoxy resin coating (Nitoflor primer plus two coats of Nitocote in accordance with manufacturer's instructions), or similar approved material, to ensure resistance to battery electrolyte. There shall be no cable trenches in battery rooms. Cable entrances through the floor shall be protected by a raised plinth 50mm high around the opening with the annulus around the cable sealed after installation.

12A.3.11 Control Room Floors

No raised floor shall be used.

12A.3.12 Site Clearance, Obstructions and Adjacent Structures

The Bidder shall be responsible for clearance of:

(1) Trees, shrubs and any vegetation including the extraction of all roots and compaction of backfill where roots have been extracted.

(2) The removal of all buildings, sheds or any other structures above or below ground including the removal of any septic tanks, drains or other underground services.

(3) The removal of any existing surfacing, roads, foundations or any other obstruction.

All material cleared away by the Bidder shall be the property of the Employer and shall be removed by the Bidder to a site in the Project area upon instructions of the Employer. The

Employer may remove any buildings or structures himself from sites before the commencement of site works.

Where an existing service, existing equipment or adjacent building is to be retained, the Bidder shall take all necessary measures to protect the item concerned from damage and shall be responsible for ensuring that no movement of foundations occurs during or after completion of construction.

Any existing electrical equipment/cables which have to be modified or repositioned shall be included in the works at no extra cost. Any buried gas or water main services which require to be diverted shall be deviated by the Employer at his cost. However, where it is possible to retain these existing services and build new structures around them, the Bidder shall take all necessary measures to build in the service at no extra cost.

12A.3.13 Guard Houses, Boundary Walls, Fences and Entrance Gates

The guard house serves for control of entrance. The gatekeeper shall be able to watch the area before and behind the guard house. The guard house shall be provided with toilet, water supply facilitates. Small power and lighting facilitates are to be provided in the Guard Houses.

The Bidder shall base his design of boundary walls and gates following bid drawing and subsoil investigation report. Where sites are within existing Employer's boundary walls, the Bidder shall erect a permanent fence 2.0m high in accordance with BS 1722 part 10 or similar approved.

12A.3.14 Windows

Even natural light shall be provided by windows to illuminate all areas of buildings. Window area shall be about 6% of floor area to limit solar heat gain. Tops of windows shall generally be below 2.5 metres from floor level but toilet windows may be higher. The bottom of windows shall be generally at least 0.45 metres above floor level. Each window shall be provided with a sunshade projecting about 500mm from the wall above and at the upper sides of the window. Few windows shall be placed on south facing walls. Windows shall be spaced to give a wide view of the switchyard.

Windows shall have single glazing with 6mm thick glass, reinforced with wire mesh where windows are placed in or over doors.

Window frames shall be anodised aluminium.

Glass panels shall be placed over doors to provide natural light to internal corridors and rooms where required.

External cills shall have a sloping tile or similar detail with drip.

The Bidder shall prepare a window schedule for each building.

The schedule shall clearly indicate both fixed and opening windows.

The Control and Switchgear rooms in particular shall have opening windows to allow adequate ventilation. Approved quality of MS grill shall have to be provided to all windows. All MS grill will

be painted with one coat of red oxide primer and minimum two coats of approved quality synthetic enamel paint.

12A.3.15 Doors

Internal doors and door frames shall be anodised aluminium. Main Entrance/Exit doors and door frames shall be steel or anodised aluminium.

The minimum size of the structural openings for doors shall be 1550mm wide for double doors and 930mm wide for single doors. Door height shall generally be 2100mm but switchgear and control rooms shall have a removable transom and removable panel over the door or a taller door to provide a total height of about 2500mm. All door sizes and widths shall be adequate to get in and get out all equipment and future equipment.

All external doors shall have weather boards, hydraulic closers and cabin hooks to hold the door open. External doors shall open inwards, except for switchgear room doors which must open outwards and be fitted with panic release latches.

Each door leaf shall have minimum three 150mm heavy iron hinges equally spaced. Door furniture shall be of approved local manufacture and shall generally be of brass. All corridor doors, external doors and rest room (toilet) doors shall be fitted with hydraulic closers. Door stops shall be fitted where required. Door frames shall generally be set 200mm off a wall junction to enable the door to open fully through 90˚.

All external doors shall be shaded by either the roof canopy or a separate precast concrete canopy over the top and the upper sides of a door.

The Bidder shall prepare a schedule of all doors and all door furniture for each building.

12A.3.16 Brickwork

Brickwork shall be designed to BS 5628. External panels of brickwork shall be checked for wind pressure calculated in accordance with BS 6399 for a wind speed of 160 kph 3 second gust.

Bricks shall be first class bricks from approved manufacturers. 10 bricks shall be tested in accordance with BS 3921 to determine water absorption and crushing strength, which shall exceed 20N/mm^2. Mortar shall generally be of Mortar designation (iii), 1: 1: 5 to 6. Cement, lime, sand.

All brick panels shall be tied to the concrete frame with galvanised ties of approved design. Ties shall be painted with bituminous paint.

Facing bricks shall be approved quality and size from Mirpur ceramics or similar approved. Facing bricks shall be tied back to the main wall of control room building/SPR. External walls shall be 230mm thick brickwork, rendered internally and clad externally with facing bricks or rendered as required by the architectural plan.

Bricks shall be compacted down onto a full bed of mortar. Vertical joints shall be completely filled with mortar. Joints shall be raked out about 10mm deep where walls are to be rendered.

Brick walls shall be constructed so that tops of all meeting walls are about the same level with maximum variation of 0.75m. Only 18 courses per day shall be laid. New work shall be protected from sunlight and drying winds for 4 days.

Lime and cement for all brickwork shall be stored in a dry building with a raised dry floor.

Reinforcement by mild steel rods shall be provided where required by the design. Additionally openings over 500mm. wide shall be reinforced for 2 courses above and below the opening, two 6mm. bars per course extending 900mm beyond the opening both sides where possible.

All exposed brickwork shall be rendered and painted where not faced with facing bricks.

12A.3.17 Expansion Joints, Joint Fillers and Sealants

Not used.

12A.3.18 Cable Trenches in Switchyards

Cable trench sizes shall be standardised. Layout drawings shall be submitted for each substation showing layout and size of trenches. No trench shall cross a road; power cables shall be placed in ducts of minimum 150mm diameter with bell-mouthed ends. Ducts shall extend 1500mm minimum beyond the edge of roads. Spare ducts shall be installed for likely future development.

Floors and walls of trenches shall be constructed of Class A reinforced concrete of minimum 150mm thickness, with the external surface painted with two coats of bitumastic paint. Walls and covers shall protrude at least 70mm above site finish level and the top of the wall shall be flat with no rebate. Floors shall be sloped at 1: 150 minimum slope to brick soakaways placed below the trench at low points; the volume of each soakaway shall be 2.5m^3 per 150m^2 of trench.

Covers shall be of reinforced concrete Class A. Each cover weigh less than 55 kg. The minimum depth shall be 70mm, with downstand ribs along each side providing a minimum overall depth of 100mm. The ends of the cover shall overhang the wall by 15mm and in the centre of each end there shall be a hand hole of minimum size 100mm by 20mm high. This hole shall allow air to ventilate the trench so that heat built up in the trench shall be reduced. No gaps larger than 5mm shall be left between adjacent covers so that the cables are always shaded. Cover slabs shall sit squarely and uniformly on the trench walls without the need for bedding or shims. Because portable fire extinguishers will be rolled over and along trenches, each cover shall be capable of resisting a 250kg point load at mid span. The Bidder shall provide ramps up to the edge of covers in several locations, as agreed on site, to enable the wheeled extinguisher to mount the covers. Longitudinal edges may be inclined at 10˚ to the vertical, thus creating a larger gap at the bottom of adjacent slabs, again to reduce heat buildup. The upper surface of covers shall have a stiff broom non slip concrete finish. All sharp edges shall be stoned smooth. Outer edges shall be chamfered.

Longitudinal fire separation walls and transverse fire separation walls as required by the cable section, may be of brick or reinforced concrete.

12A.3.19 Cable Trenches in Local Control Building/SPR

No cable trench shall be allowed into main control room building, all cables from cable trenches shall enter the main control room building over grade beam level.

Inside local control building/SPR, entry of cable trenches may be permitted. The base and walls of the trench shall be of reinforced Class A concrete of minimum thickness 110mm with the outside face painted with 2 coats of bitumastic paint. Cable trays may be supported by Unistrut P3300 inserts, or similar approved, or drilled anchor bolts.

The building layout shall minimise trench lengths. Where power cables pass through a building to reach the far side, this shall generally be in a tunnel section. The Bidder shall be responsible for providing all trenches and ducts in a building, including ducts for outgoing power cables up to the site boundary and including any pulling pits required.

Trench covers shall be sheets of composite board, PERMALI YA 729 or similar approved, consisting of wood fibres impregnated and compacted in synthetic resin, or a computer flooring composite board. The weight of each cover shall be restricted to about 30 kg. The upper surface shall be skid resistant. Deflection shall be limited to 1/250 of span under a load of 3kN/m^2. Only one thickness of board shall be used to standardize the edge support detail. The recess to receive the cover shall be protected by steel or brass on the vertical edge and bedding surface. Covers shall fit snugly around all cables. Where cables enter the building, all ducts/trenches shall be sealed. Fire/oil barriers shall be required to separate hazardous equipment. The ends of all ducts entering trenches shall be bell-mouthed.

Any beams used to support large span covers shall be removable. All metal work shall be painted as specified in the paint section.

All covers shall bed down evenly. Full detailed fabrication drawings shall be provided for all covers.

12A.3.20 Rainwater Pipes

Down pipes shall be 100mm minimum diameter placed on the outside of walls but enclosed in a brick buttress of facing bricks. One downpipe shall be provided for each 100m^2 of roof area. The head of the downpipe shall be enlarged to 200mm diameter and a purpose made cast iron grill provided over the head. This grill shall be sited in a recess in the roof slab projection.

The foot of the pipe shall have a 90˚ bend and water shall be discharged into either:

i) a small open channel conveying the water to the boundary channel

ii) a pipeline conveying the water off the site. Rainwater shall not be connected to the septic tank or allowed to discharge directly onto switchyard paving.

12A.3.21 Switchyard Foundations

The tops of all foundations shall be set at the same level, which shall be raised above the Finished Switchyard Level (FSL) for the purpose of preventing surface water coming into contact with the equipment structures and holding-down bolts. The distance between the Finished

Switchyard Level (FSL) and the top of foundations shall be at least 200mm. All exposed concrete surfaces shall be painted with an acrylic weatherproofer or bituminous paint, and flat areas shall be sloped to shed water. No base shall permit ponding of water in any way, and free drainage shall also be possible from all areas inside any grouting.

Bases shall generally be of Class A reinforced concrete.

Bases shall have all recesses for cables and earthing detailed on drawings. The drawings shall clearly show the orientation of each base and the location of all recesses. Where new foundations are adjacent to existing foundations; the Bidder shall be responsible for verifying the extent of the existing foundation and ensuring its stability.

For anchorage design of switchyard foundations shear force, vertical accelerations, overturning moments and torsion due to mass eccentricities of the equipment for the earthquake load of 0.1G are required to be considered. Mild steel ductile bolts and headed studs cast-in-place anchor bolts shall be used. Thick plate washer is required to be welded to the equipment base plate. Normal washers shall be used under a nut in all cases.

12A.3.22 Transformer Bases

The transformer base, together with its surrounding bund shall form a raft to distribute the load from the transformer over the entire area within the bund wall. The bund shall extend at least 700mm beyond any part of the transformer and its radiators. The level of the top of the bund and the skids shall be 200mm above general switchyard level. Skids shall extend to the edge of the bund. Where separate transformer cooler banks are provided, the cooler banks shall also be protected by the bund.

50mm below the top of the wall shall be placed a layer of stone 225mm deep set on a galvanised grill painted with two coats of bitumastic paint. The effective volume of the bund below the stone shall equal 125% of the total volume of oil in the transformer and its radiators.

Rainwater will tend to collect in the bund. To evacuate rainwater a fixed submersible pump controlled by sensors and switches (Aqua Sentry or equal) shall be provided at each bund with power supplies and drainage manhole conveniently located. The bund water control system shall differentiate between water and oil to ensure that the pump will not be activated while oil is present in the bund.

The transformer base and the bund shall be founded a minimum 1.0 metres below Finished Ground Level (FGL).

The skid walls shall be at least 600mm wide. RCC piles shall be provided below each jacking point to lift the transformer. Top level of jacking pad should be at the same level of skid wall. Steel plates shall be inserted at the top of jacking pad.

The entire concrete surface of the bund and the transformer base which is not buried shall receive two coats of bitumastic paint. Skids shall receive 3 coats of bitumastic paint before being cast in.

Carriage way is required to be provided with rail connected to all transformer bases. Transformer shall be anchored in such a manner so that it can prevent the movement of transformer for 0.2G ground acceleration.

12A.3.23 Blast Walls

The Bidder shall construct blast walls to reduce the risk of fire spreading from each three phase transformer unit to an adjacent transformer unit or control building. Blast walls shall also be constructed to resist impact forces causing from a transformer explosion damaging adjacent equipment.

The height of the blast walls for transformers shall be 500mm higher than the tops of transformer or same height of the tops of the HV bushing (whichever is higher) and 300mm wider at both sides than the width of transformer. The minimum thickness of blast walls shall be 200mm.

The blast wall will be constructed with Class A reinforced concrete with all exposed edges chamfered, Surface of wall will fare faced concrete and painted as the colour of transformer body.

12A.3.24 Paints and Painting

All paints shall be of approved makes and colours and proven suitability for the prevailing climate and shall be approved by the Engineer. All surfaces for painting shall be cleaned down prior to being painted and rubbed down to a smooth finish.

All externally exposed concrete and render of the control buildings, boundary walls, blastwalls and guard posts shall be painted with a fungicide, Snowcem primer and two coats of Snowcem. All exposed facing bricks and Snowcern painted surfaces shall be treated with one coat of clear silicone (5%) water proofing solution.

All exposed parts of foundations, the outer faces of cable trenches and cable tunnels shall be painted with two coats of bitumastic paint.

All ungalvanized metalwork shall receive two coats of red oxide paint at least 4 days before installation and shall receive two finishing coats of paint after installation, each coat being of different colour. Surface preparation before painting shall be SA 2.5 or an agreed rust convertor acid shall be used. All galvanized steel, including all brick ties, boundary wall wire supports, cranebeams, baseplates and holding down bolts and concrete plinths shall receive two coats of bitumastic paint. Galvanized steel shall not be painted until the surface has weathered.

Internal walls when fully dry shall have the surface rubbed down with sandpaper and be painted with a sealer and 2 finishing coats of plastic emulsion paint before equipment is installed. A further finishing coat shall be applied after completion of installation.

One day shall be allowed for drying of each coat before the next coat is applied.

The interior of all septic tanks and manholes carrying foul sewage shall receive two coats of bitumastic paint.

12A.3.25 Furniture

The Bidder shall supply a complete set of tables, chairs, stools, desks, benches, storage shelves and drawing cabinets as described in the Project Requirements, Volume I with layout top, for drawing examination, lockable cabinets for spares and test equipment and key boxes in each control building. These shall generally be of steel of local manufacture and shall be of robust durable construction. In each rest room (toilet) two couches, approximately 900mm wide by 1900mm long with back rests against the wall, shall be provided.

The full details and specification of these materials shall be agreed before purchase. The Bidder shall arrange for a list of items to be handed over to the Employer, who will sign for receipt of a complete set as stated on the list.

12A.3.26 Concrete

Only two class of concrete shall be used. Class A shall be used for all structural work, piling and for all foundations which are not unreinforced massive blocks. Class B concrete shall be used for blinding, pipe surround and unreinforced or nominally reinforced concrete. Road slabs and floor slabs all shall be reinforced Class A concrete.

	Class A	**Class B**
Min Cement Content	360kg/m^3	170kg/m^3
Max Water Cement ratio	0.55	-
Coarse Aggregate type	Broken stone	Jhama brick
Max Coarse aggregate size	20mm (40mm for piling)	25mm
Method of Batching	Volume batching	Volume batching
Min Characteristic of Trial Mix at 28 days	30N/mm^2	
Min characteristic strength of trial mix at 7 days	14N/mm^2	-
Min characteristic strength of works cubes at 28 days	20N/mm^2	-
Slump Range		
Slump for concrete placed	30mm min-100mm max	
below water in piling	150mm min	

It should be noted that minimum specified cement content will produce significantly stronger concrete. The Bidder's design shall be based on a 28 day crushing strength of 20N/mm^2. Design shall be in accordance with this Contract and BS 8110 or other agreed standard.

Minimum cover to rebars shall be 60mm where concrete is in contact with backfilled soil against a shuttered face, 100mm where concrete is cast against soil, and 30mm for all above ground concrete. In detailing bars which traverse a member, a reduction of 5mm shall be made for a

bent bar and 10mm for a straight bar to ensure adequate cover. Exposed ends of sunshades and roof projection shall have 70mm minimum cover.

All concrete design shall ensure easy access for vibrators of 50mm. minimum diameter. Because of the slowness of concreting using local methods of transport, congested reinforcement details and shapes which are difficult to concrete should not be used. The location of all cold joints shall be agreed in writing with the Engineer and all joint surfaces shall be scabbled. All joints shall be horizontal or formed against vertical stop ends. All cold joints shall be indicated on drawings. Roof slabs shall generally be cast in one continuous operation. Where curing compounds are used to protect exposed surfaces from solar radiation and improve moisture retention, they shall be subject to the approval of the Employer. This is a **Hold Point**.

12A.3.27 Concrete Reinforcement

The Bidder may use locally available mild steel bars from approved sources or import steel bars to any agreed standard. No bar or stirrup shall be smaller than 6mm diameter to ensure adequate rigidity during concreting.

If locally purchased bars are used, bending tests and tensile tests shall be carried out to ensure the bars meet the design standard adopted and weight per unit length shall be tested regularly.

Bar bending lists shall generally be shown on drawings, where possible with a diagrammatic representation of each bar to ensure clarity and ease site communication. The Engineer will not systematically check the accuracy of every bar on bar lists when approving drawings. The Bidder shall therefore arrange to check all bar lists. Drawings shall detail all chairs and ties and include these on bar lists.

Bars shall be tied at every intersection and the ends of tie wire bent away from concrete surfaces.

Anti crack bars shall be provided at changes in slab or wall thickness and at the corners of every rectangular opening.

12A.3.28 External Render

All brickwork which is not faced with facing bricks shall be rendered. Concrete columns and walls shall be rendered and painted in accordance with BS 5262 with a 3mm spatterdash coat a 12mm undercoat followed by a 9mm finishing coat. Surface preparation shall be as described in BS 5262. Joints shall be provided in all render where brickwork panels abut concrete columns and grade beams, as required by BS 5262.

A mix type II or III shall generally be used. The finishing coat shall be weaker than the undercoat.

The tops of all foundation blocks and all protruding concrete foundations shall also be rendered where required by the Engineer.

PVA Bonding agents shall not be used because of the risk of early drying in the tropics. All concrete surfaces to be rendered shall have the entire surface scabbled and brushed with a stiff brush to remove all loose material. The surface of the undercoat shall be roughened to ensure bonding of the finishing coat.

All render once completed shall be kept continuously damp for 10 days, after which if shall be treated with a fungicide. Any existing backgrounds shall be treated with a fungicide and all growth cleaned after 5 days of contact with the fungicide.

12A.3.29 Goalposts

In each outdoor switchyard with live conductors crossing roads the Bidder shall erect a permanent goalpost at the edge of the danger area with red and white metal warning boards hanging down from the goalpost to warn high vehicles of the overhead danger. This structure shall conform and match those supporting structures in Section 11 of this Contract for the high voltage switchgear.

12A.3.30 Lifting Beams (Not required for this contract)

Deleted.

12A.3.31 Stairs

Except where indicated otherwise in the schedules, all single/multi storey buildings shall have an internal/external staircase up to the roof; the minimum staircase clear width shall be 2.2 metre and the maximum slope about 33˚, all detail being designed in accordance with BS 5395. These staircases shall be enclosed. The design shall allow free circulation of air over the treads and through the risers. Non slip nosings shall be provided.

Main control building shall have one internal and one external staircase, which shall have a minimum clear width of 2.5 metre with a maximum slope of 30˚, all detailed in accordance with BS 5395. External staircases shall not be enclosed but shall be completely protected against rain by roof projections; steps shall be open with non slip nosings. Internal staircases shall have homogeneous floor tiles with non-slip nosings. Alll staircases shall be provided with stainless steel railings (38mm dia. for vertical railing & 50mm dia for horizontal railing).

All roofs which are not accessible by stairs shall be provided with a galvanised steel fixed ladder.

12A.4 CONCRETE WORKMANSHIP

12A.4.1 General

At all stages in the production, mixing, placing and curing of concrete, the work will be inspected by the Engineer's representative. If any material, dimension or practice is not at least equal to the standards set out herein, it shall be rejected and alternatives compliant with the said standards, and in addition to the satisfaction of the Engineer, shall be implemented.

12A.4.2 Aggregates

Coarse aggregate shall be capable of passing through a 20mm sieve and be retained on a 5mm sieve. Fine aggregate shall be not larger than 5mm and not smaller than 0.06mm and shall be sharp in texture.

All aggregates shall be free of harmful quantities of organic impurities, clay, silt, salt or unsound particles. The amount of clay, silt and fine dust present in aggregate, whether as coatings or separate particles, may not be more than:

15% by weight in crushed sand 3% by weight in natural or crushed gravel sand 1% by weight in coarse aggregate.

If the Engineer considers that any aggregate which the Bidder proposes to use contains an excess of fine particles or any harmful substances, the Bidder shall either replace the aggregate or, at his option and entirely at his expense, institute a series of approved tests at an approved laboratory to determine the nature and extent of the fine particles and harmful substances. Following receipt by the Engineer of the results of the analysis and tests, he will advise the Bidder in writing whether the proposed aggregate may or may not be used. The Engineer's decision in this respect shall be final.

Tests to determine the extent of impurities or fine particles shall include (but shall not be restricted to) the relevant tests specified in BS 882:1992, ASTM. C40-79 (Colormetric test) and ASTM. C33-82.

12A.4.3 Sampling

At least four weeks before he envisages first receiving aggregate from any source the Bidder, in the presence of the Engineer, shall obtain samples for testing. Samples shall be taken in accordance with the procedure quantities laid down in BS 812 and shall be subjected to those tests which the Engineer considers necessary to demonstrate the soundness of the material.

Such tests shall be carried out in an approved manner at the Bidder's expense and may include the manufacture, both in the laboratory and at site, of test cubes or cylinders to determine crushing strength.

12A.4.4 Grading

The Bidder shall ensure that his offer includes the full cost of obtaining and transporting suitably graded stone aggregates to site.

Grading of aggregates should, together with the required minimum cement content and water cement ratio, ensure adequate durability, density and characteristic strength of the finished concrete. The Bidder shall submit in writing to the Engineer the makeup of the mix he proposes to use, together with the grading analysis for the particular material and any details concerning his or others' experience with the use of aggregate obtained from the same source.

12A.4.5 Cement

Ordinary Portland Cement shall comply with BS 12A. The Bidder may obtain cement, bagged or in bulk, from any approved source in Bangladesh but shall always submit sufficient samples from each delivery, as required by the Engineer, to ensure that all cement complies with the minimum requirements of BS 12A. All cement shall be stored in a weathertight shed at least 300mm off the floor. Regular checks shall be made on the weight of cement in each bag.

12A.4.6 Water

All water used in the preparation of concrete for foundations shall be clean, fit for drinking and free from all earth, vegetable matter and alkaline substances, whether in solution or in suspension, and shall comply with BS 3148.

12A.4.7 Reinforcing

Where reinforcing is specified in any foundation design, it shall comply with BS 4449 or an approved similar standard. Before any reinforcing is used, the Bidder shall provide the Engineer with a certified mill certificate, verifying its grade and quality, and proof test such samples as the Engineer considers necessary. All reinforcement shall be clean and free from loose mill scale, dust, loose rust and paint, oil or any other coating which in the opinion of the Engineer may destroy or reduce bond.

12A.4.8 Storage

The Bidder shall ensure that all the materials he provides for the preparation of concrete shall be stored in a manner which prevents contamination by dust, clay, water or any other harmful material.

Heaps of coarse and fine aggregate shall be separated by at least one metre.

Where aggregate is tipped directly onto the ground, the bottom 20cm of the heaps shall not be used. Bagged cement shall be protected from rain, mixing water or damp soil during storage/transport. Cement from accidentally split or damaged bags shall not be used.

Where the Engineer considers it necessary, special precautions shall be taken to ensure that aggregate stored on site shall remain dust free. Such precautions may include the bagging of aggregate at the pit if sites are adjacent to dusty roads or if heavy rain is liable to wash out fine material or saturate the aggregate to an extent which might influence the water content of a mix.

Where the Bidder establishes central depots for receiving cement prior to despatch to individual sites, he shall ensure that the cement storage areas are sufficiently raised above the surrounding ground to prevent contamination of the cement by surface water. The material from which storage plinths are made shall be approved by the Engineer.

12A.4.9 Design Mix

Prior to ordering any aggregate the Bidder shall inform the Engineer of the source(s) of his aggregates and deliver samples to the Engineer. The Bidder will authorise at an approved laboratory tests to show the sieve analyses, relative densities, moisture content of the samples of aggregate from each source. At least four test specimens of concrete shall be mixed at an approved laboratory and tested after 7 and 28 days.

Depending on the moisture content of the samples of aggregate the Bidder will report to the Engineer on the expected water/cement ratio and the aggregate/cement ratio of concrete to be produced on site.

Following the successful testing of the laboratory samples the Bidder shall make trial mixes at site (from which he will take at least 4 test specimens) using the proportions advised to the Engineer (and in the presence of the Engineer) and using the equipment he intends to use in the normal day to day manufacturing of concrete. The minimum 28 day crushing strength of any such test specimen shall be not less than 20 N/mm^2.

After successful testing of the test specimens made at site, the Engineer may then approve the source(s) of aggregate and the mix design.

No changes to the approved mix design will be permitted unless the type or source of aggregate differs from those already tested, in which case further tests at both the laboratory and at site will be made.

Any concrete placed which does not conform to the approved mix designs, shall be removed and replaced by the Bidder at his own cost.

12A.4.10 Mixing and Placing of Concrete

Proportions of aggregates and cement and the quantity of water for each batch of concrete shall be closely monitored by an experienced mixer operator. Aggregate shall preferably be weight batched but, where this is not possible, volume batching shall be permitted, provided that the net volumes of the loading equipment are approved by the Engineer. Containers for measuring quantities of water shall be clearly marked and only approved quantities of water shall be used in the manufacture of concrete.

Mechanical mixers shall be in good condition and well maintained. After loading, the constituent parts of the concrete shall be mixed together for a period of not less than two minutes or 30 revolutions of the barrel, whichever is the greater. For mixers with a capacity greater than 1.5m^3 these periods may be increased if the Engineer so requires.

When the constituents are adequately mixed, the fresh concrete shall be discharged from the mixer and placed in the foundation with the minimum of delay. Chutes shall be used to ensure that fresh concrete is not dropped by more than 1.5 metres.

No concrete shall be placed until all form work, installation of parts to be embedded, and preparation of surfaces involved in the placing have been approved. No concrete shall be placed in or through water, except with the written permission of the Engineer, and the method of

depositing such concrete shall be approved by the Engineer. Concrete shall not be placed in running water and shall not be subjected to the action of running water until after the concrete has hardened for seven days. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed, mud or other foreign material, shall be cleaned of all such refuse before the surrounding or adjacent concrete is placed. Immediately before placing concrete, all surfaces of foundations upon or against which the concrete is to be placed shall be free from standing water, mud and other foreign matter. The surfaces of concrete which have set, and against which new concrete is to be poured, shall be thoroughly cleaned to remove all foreign material and laitance, and be saturated with water immediately before placing concrete. Concrete shall be deposited continuously and as rapidly

as possible until the unit being poured is complete. If for any reason the work is stopped before completing the unit of operation, a construction joint shall be installed in accordance with the instructions of the Engineer. Concrete shall be so deposited as to maintain, until the completion of a unit, a plastic surface approximately horizontal.

The method and equipment used for transporting concrete shall be such that concrete having the required composition and consistency will be delivered as near as practical to its final position without segregation or loss of slump. All concrete mixing and placing equipment and methods shall be subject to approval by the Engineer. Concrete placement will not be permitted when, in the opinion of the Engineer, weather conditions or other pertinent factors prevent proper placement and consolidation.

Bidders are reminded that, as a minimum standard, the following series of inspections should be carried out by the Bidder before concreting can begin:

1 Formwork coated with mould oil and correct in type, quantity and condition

2 Centre lines of template to coincide at the centre peg

3 Formwork to be well strutted and correctly located

4 Vibrator to be in working order

5 Mixer to be in working order

6 There is provision to maintain continuous mixing and pouring, by hand if necessary, in the event of a mixer breaking down

7 Where necessary, re-bar is on site ready bent and complete with tie wire, stirrups and concrete or plastic preformed spacer packs

8 A reliable level is at hand

9 There is sufficient aggregate, cement and water to complete the pour

10 Excavations are safe and not cluttered around the top edges

11 The mixer barrel is clean, and the paddles are complete and in place and the barrel will rotate at the speed specified by the Manufacturer

12 A suitable chute is in place

13 Both an air thermometer and concrete thermometer are on site

14 There is a large quantity of hessian sacking at hand

Where any of the above items are not complied with, the Engineer may suspend concreting pending their implementation.

12A.4.11 Testing of Concrete

Samples shall be taken and tested in accordance with BS 1881. Testing shall be carried out by an approved laboratory, who shall arrange to immediately notify the Bidder and the Employer in writing of any cube failure. Failed cubes shall be kept for reference.

Concrete for the test specimens shall be taken at the point of deposit. To ensure that the specimens are representative of the concrete, a number of samples shall be taken from different points. Each sample shall be large enough to make one test specimen and shall be taken from one point in the work.

The tests specimens shall be stored at the site at a place free from vibration, under damp sacks for 24 hours ± 1/2 hour, after which time they shall be removed from the moulds, marked and stored in water at a temperature of 10˚ to 21˚C until the test date. Specimens which are to be sent to a laboratory for testing shall be packed for transit in damp sand or other suitable damp material, and shall reach the laboratory at least 24 hours before test. On arrival at the laboratory, they shall be similarly stored in water until the date of the test.

One compression plate of the testing machine shall be provided with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central point of the face of the plate. Test specimens shall be placed in the machine in such a manner that the load is applied to the sides of the specimen as cast.

Cube strengths for concrete are to be not less than 14N/mm^2 within seven days after mixing and 20N/mm^2 within 28 days after mixing.

One cube shall be tested at 7 days to obtain an indication of the concrete strength. The remaining three cubes shall be tested at 28 days and the average of their strengths shall be calculated. Should the average of the cube strengths fall below the specified 28 days cube strength, the Engineer may order the affected concrete to be removed and replaced at the Bidder's expense, or the Engineer may allow the Bidder to take a cylinder for further testing in accordance with BS 1881, if Schmidt Hammer readings indicate below strength concrete.

The diameter of the cylinder shall be not less than three times the size of the maximum aggregate and its length will be at least double the diameter, after allowing for preparation and facing prior to the test. Both a report and compression test will be completed for the sample in accordance with BS 1881. Only one such test will be permitted from any one sample and if the crushing strength of the sample is in excess of that required by the design the Engineer may, after the Bidder has made suitable repairs to the part disturbed by taking the sample, accept the concrete.

12A.4.12 Formwork

Formwork shall conform to the shape, lines and dimensions of the concrete as called for on the Plans and shall be sufficiently strong to carry the dead weight of the concrete without undue deflection or bulging, and sufficiently tight to prevent leakage of mortar. It shall be properly braced and tied together so as to maintain position and shape. Members used in forms at exposed surfaces shall be dressed to uniform thickness and shall be free from loose knots or other defects. Joints in forms shall be horizontal or vertical. At all unexposed surfaces and rough work, undressed timber may be used. Timber reused in shutters shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned before being reused. Formwork shall not be disturbed until a minimum of 48 hours has passed from time of placement and concrete has hardened sufficiently to support any construction loads that may be imposed. When stripping

forms, metal wedges or tools shall not be used to pry panels loose. If wedging is necessary, it shall be done with wood wedges lightly tapped to break adhesion. All columns and beams will have exposed edges chamfered 20 mm x 20mm.

12A.4.13 Reinforcing Steel

Steel reinforcing bars shall be positioned in the concrete at the places shown on the drawings, or where reasonably directed by the Engineer.

Before reinforcing bars are placed in position, surfaces shall be cleaned of heavy flaky rust, loose mill scale, dirt, grease and all foreign matter. Once in position, reinforcing bars shall be maintained in a clean condition until they are completely embedded in concrete. Reinforcing bars shall have at least the minimum concrete cover shown on the drawings. Reinforcing bars shall be accurately placed and secured in position, such that they will not move during placing of concrete. Precast concrete block spacers may be used for supporting reinforcing bars.

12A.4.14 Consolidation of Concrete

Concrete shall be consolidated to maximum practical density, without segregation, by vibration so that it is free from pockets of coarse aggregate and closes against all surfaces and embedded materials. Vibration of concrete in structures shall be by electric or pneumatic-driven immersion type vibrators of 50mm minimum diameter, operating at speeds of at least 8,000rpm when immersed in concrete. The vibrator shall be inserted vertically at close enough intervals so that the zones of influence overlap. The vibrator shall be inserted to the full depth of the layer being treated and withdrawn slowly. When concrete is being placed in layers, the tip of the vibrator shall extend approximately 100mm. into the underlying layer. Vibrators shall not be used to move concrete horizontally. Care shall be exercised to avoid over-vibration of the concrete and direct contact between the vibrator and reinforcing shall be avoided.

12A.4.15 Curing of Concrete

For foundations where excavations are to be backfilled immediately following the striking of shutters, the concrete is to be thoroughly wetted before backfilling commences. Where shutters are to be struck and backfilling of the excavation is not to take place immediately, the concrete is to be covered with wetted hessian sacking and be enclosed in polythene sheeting to avoid rapid drying of the concrete.

12A.4.16 Hot Weather Concreting

In hot weather the following additional precautions shall be taken.

(a) In hot weather suitable means shall be provided to shield the aggregate stockpiles from the direct rays of the sun or to cool the mixing water/aggregates to ensure that the temperature of the concrete when deposited shall not exceed 32˚C.

(b) In hot dry weather suitable means shall be provided to avoid premature stiffening of concrete placed in contact with hot dry surfaces. Where necessary the surfaces, including reinforcement, against which the concrete is to be placed shall be shielded

from the rays of the sun and shall be sprayed with water to prevent excessive absorption by the surfaces of water from the final concrete.

12A.5 WORKMANSHIP OF ALL OTHER MATERIALS

This specification only describes concrete work in detail. All other materials workmanship shall be in accordance with an agreed standard. Before starting any new item of work the Bidder shall submit samples of the materials to the Engineer for approval in writing and the method of installation shall also be approved. The first item of any type to be installed shall be inspected and checked in detail by the Engineer before other items are constructed.

12A.6 Land development work :

12A.6.1 Land development work shall be carried out by dredged filling material or by carried earth/viti sand using the following methods:

(a) Land development by dredge filling material:

Land development by dredge filling materials means dredging by cutter suction dredger for collection and direct pumping of dredged fill materials by 18" dia. or more cutter suction dredgers from the pre-selected river bed through pipe line to the proposed fill site in wet and liquefied condition. The dredged material will be placed at site directly and excess water will be removed out of the site. Spreading and compaction of fill material will be carried out in layers. The layer thickness shall be determined on the quality of dredged fill material. Each layer should be compacted to a minimum of 95% optimum density as defined by the Proctor Test.

(b) Land development by carried earth/viti sand:

The responsibility of selecting proper location of collection of fill materials (such as earth/viti sand) will rest on the contractor, subject to the approval of the employer. The contractor shall obtain prior necessary permission from the concerned owner/authority paying royalties, all taxes, duties etc. as per prevailing Govt. / semi Govt. / Autonomous organization rule with the intimation to employer for collecting the required fill material. In this case mini suction dredger can be used to collect fill material from nearby river. The crops compensation resulting from the damage of crops during pipe line installation and any other activities shall be paid by the contractor and the cost deem to be included in the price. All fill shall be compacted in layers not exceeding 150mm deep to a minimum of 95% optimum density as defined by the Proctor Test.

12A.6.2 The quoted rates are inclusive of all the costs for supply of materials and hire charges for equipment and accessories etc. required to execute the works by the Contractor.

12A.6.3 Before land filling, The Contractor has to construct necessary dyke/embankment for protection the developed land.

10.6.4 The rates are inclusive of all the royalties, taxes, VAT, octroi etc. to be paid to Govt. & semi-Govt. Organization or to any person for the earth borrowed from.

10.6.5 If the Contractor uses the land beyond the control of the Employer, the cost/hire charges, octroi etc. so required will be paid by the Contractor for carrying, laying & installation of equipment, tools & pipes etc. over that land.

10.6.6 The Contractor is responsible to obtain the permission/approval from the competent authority for the works as mentioned in clause no. 4 & 5 above.

10.6.7 The Contractor shall execute the pre-work measurements jointly with the representative of Employer for the area to be filled prior to start the land development work.

10.6.8 The Contractor, along with his bid shall furnish the detailed procedure of whole works with a list of manpower, tools & equipment required to execute the same. He shall, if the proposal is by dredged filling also show in the drawing location of the river bed to be dredged and the route of pipe lines from the dredging point to the filling area.

10.6.9 The Contractor shall clean and remove the unspecified & the unsuitable materials which do not mix with the earth at his own cost and responsibility.

The work may be increased or decreased as per site requirement and no extra price escalation by the contractor for such increase of work shall be entertained.

10.6.10 The Contractor will arrange the testing of the samples of the fill materials & compaction tests of developed areas by Laboratory approved by employer. The cost of any or all such tests shall be borne by the Contractor.

10.6.11 The Contractor shall protect & maintain all the materials, equipment etc. against any theft or damage etc. at his own cost until the final executed works are handed over to the Employer.

10.6.12 After 30 days of completion of the land development work, the contractor will arrange the joint survey (Post-work measurement) along with the employer representative. The quantity of land development shall be calculated by the contractor and checked by the employer according to this joint post-work measurement and the pre-work measurement taken prior to start the work (as mentioned in clause no.7). The rates in the schedule are inclusive of all surveys/pre & post-work measurements.

10.6.13 The security of the equipment and materials used and the safety of the personnel engaged in the work shall be at the risk and responsibility of the Contractor.

10.7 Fire Extinguisher :

10.7.1 Control Room/Communication Room/Battery Rooms :

These rooms shall be protected by portable CO_2 fire extinguisher system. The system shall consist of all equipment required for directing the CO_2 gas discharge at a fire including, but not limited to, CO_2 cylinders and necessary piping, a flexible hose along with a jet nozzle. The effective reach of CO_2 gas jet release shall be sufficient to fight small fires that could develop in a control room area. Fire extinguishers shall be placed at strategic locations as per instruction of

project engineer. The quantity of extinguisher at each new/up gradation AIS & GIS substation given in Table-1.

10.7.2 Outdoor Switchyard/Cable Room :

These areas shall be protected by portable dry type ABC powder fire extinguisher system. The system shall consist of all equipment required for directing the dry ABC powder discharge at a fire including, but not limited to, a wheel carriage(only for 15kg capacity) loaded with potable cylinders and necessary piping and a flexible hose along with a jet nozzle & pressure gauge. The extinguisher material shall be non-explosive, non-hazardous, non-corrosive, non toxic. The effective reach of jet release shall be sufficient to fight small fires that could develop in an outdoor switchyard, cable room & store room area. Fire extinguishers shall be placed at strategic locations as per instruction of project engineer. In addition sand buckets also shall be provided with a metal frame for hanging buckets and shall be placed at locations directed by project engineer. The quantity of extinguisher at each new substation given in Table-1.

Table-1: The quantity of fire extinguisher shall be provided at each new substation as follows:

Sl No	Description	Quantity
1	CO_2 Type: 3kg 5kg	 5Nos. 5 Nos.
2	ABC dry powder type: 5kg 8kg 15kg(including wheel carriage)	 6 Nos. 4 Nos. 3 Nos.
3	Sand bucket with metal frame	One(1)set with 5 buckets

SECTION 12B

BUILDING AND CIVIL ENGINEERING WORKS (FOR INDOOR GIS)

SECTION 12B

BUILDING AND CIVIL ENGINEERING WORKS (FOR INDOOR GIS)

12B.1 GENERAL

Under this Section the Contractor will be responsible for the design and construction of all civil engineering and building works and services for new indoor/outdoor GIS substation.

12B.1.1 Scope of Work

The contractor shall identify the borrow area locations in consultation with the owners, after assessing the suitability of the material, whether it is contaminated or not. The suitable sites shall be selected and finalized in consultation with PGCB and based on the confirmation that the quarry material is non-contaminated.
The Tender must cover all requirements of the tender documents and any other items not specifically mentioned but which are necessary for the satisfactory design, construction, operation and maintenance of all equipment to the satisfaction of the Employer. No additional costs will be considered for any items which have been overlooked but which are essential for the proper completion of the project in every respect.

The work shall include but not be limited to:

a) Site survey and subsoil investigation.
b) Site preparation, cutting or filling up to the level specified in 12B.1.4 and leveling.
c) Roadways, car ports, paths and surfacing.
d) Foundations for all equipment to be installed in outdoor switchyards, control building, indoor switchgear and any other building required for the project.
e) GIS and control building (complete building consisting of structural reinforced concrete frames, brick walls, concrete roof and floor slabs) with cable basement.
f) Motorized door for GIS entrance.
g) Floor finishing: screed for cable basement and GIS room, Nitocote epoxy resin coating in battery room, raised floor for control room and homogeneous tile for other floors.
h) Cable trenches, cable tunnels, cable ducts and pipe ducts.
i) Water supply and plumbing installations
j) Surface water and foul drainage.
k) Guard house and fences.
l) Air conditioning and ventilation.
m) Lighting, small power, external floodlighting, emergency lighting and fire protection.

For all substations and for individual rooms in substations suitable nameplates, signs and labels shall be provided to ensure identification, safe operation of plant and warning of danger. The text, which shall be both in Bangla and English, shall be approved by the Employer. The substation sign board(s) shall be 3 mm, Aluminum sheet powder coated and the text (Bangla & English) shall be UV resistant, PGCB logo on a separate circular plate to be fixed at the centre of sign board. The inscriptions shall be engraved with colored lettering. All nameplates, signs and labels shall be non-deteriorating and non-warping under aggressive weather conditions and shall be guaranteed for a minimum period of 10 years. Plates, etc., will be securely attached using bolts and nuts or screws; adhesive will not be permitted.

Included in the scope of work is the detailing, construction and maintenance of the following items which shall generally be constructed to the Employer's standards but full working drawings shall be prepared by the Contractor:

a) Septic tank and soakaway
b) Underground water storage tank

Drawing and design of septic tank and soakaway shall be prepared by the contractor and shall be finalized during detailed Engineering.

The Bidder shall state which approved local building contractor(s) he proposes to employ to carry out the work.

12B.1.2 Contractor to satisfy himself as to all conditions

The Contractor shall assess:

a) access conditions at all sites, plus ground conditions and ground bearing capacity
b) transport costs, materials costs and restrictions of availability of supply of materials locally
c) importation restrictions and delay due to customs controls
d) restrictions imposed by existing equipment on sequence of construction, access, etc.
e) restrictions caused by cable laying, equipment and line contractors
f) ground conditions and temporary works required to provide support during excavation

12B.1.3 Way leaves, Land Purchase and Planning Permission

The Employer will be responsible for the purchase of all land within the permanent site boundary and the purchase of all land required to the base of the fill of any batter slopes. The Employer will also be responsible for obtaining land to provide a permanent single access to site from a nearby road or waterway.

During the construction period the Bidder shall be responsible for maintaining this access road in a reasonable condition by reinstating damage caused by his construction traffic and Employer's traffic.

Should the Bidder require more than one single access to a site or require additional land for construction activities outside the permanent site boundary, he shall be responsible for the purchase or way leave of the required land.

The Employer will be responsible for applying for planning permission. The Bidder shall be responsible for completing the approved site survey and the approved site layout plan, together with the approved architectural elevations of all facades of any buildings, by the key date given in the programme so that the Employer may use these drawings to apply for planning permission.

12B.1.4 Site Survey Drawings

For each site the Contractor shall prepare a survey at 1:200 scale showing existing ground levels on a minimum 10 metre grid and details of all features above and below the ground within the site boundary and up to 15 metres beyond it by the key date stated in the programme. Levels shall be related to bench marks clearly indicated on the plan. The plan shall be submit to approval by the Employer and the agreed substation building floor levels shall be given on each site plan. The Contractor shall propose the building floor level to the Employer. The final ground/formation level of the site will be 500mm above the crown of the nearest public road or the highest flood level whichever is greater. All building plinth level will be 450mm above the final ground/formation level.

12B.1.5 Earth Works

Fill where required shall be carried out by the Bidder. Source of fill material and Retaining wall shall be planned and approved by the Employer. The Bidder shall be responsible for providing a level or uniform sloping site to suit his substation layout design. The final ground/formation levels (i.e. the level below the brick surfacing) shall be stated on the site survey plan to be prepared by the Bidder.

12B.1.6.1 Engineer's and Employer's Accommodation/Surveying Equipment

On each major site The Bidder shall provide an office of approx size 5 x 8m equipped with desk, 2 chairs, light, fan and air conditioner for the sole use of the Employer's Engineer and his inspectors. Similar facilities are to be provided for the supervision consultant of the Employer.

12B.1.6.2 Surveying Equipment

The Bidder shall loan his surveying instruments to the Engineer and his staff when required. Instrument checks shall be carried out at monthly intervals.

12B.1.7 Programme

The Bidder's programme shall at Bid stage define the following key dates for each site. Where drawings are to be submitted for approval, they shall be submitted at least 6 weeks before the key dates to allow for the Engineer to comment and his comments to be incorporated in the drawings:

a) Issue of approved site survey drawing complete with soil levels and floor levels
b) Issue of approved electrical layout drawings
c) Completion of Site Investigation field work

d) Issue of approved Site Investigation Final report
e) Completion of loading tests on a foundation on each fill site and any other site where settlement is likely to be a problem
f) Issue of approved drawings required for Planning Permission
g) Issue of a full complete set of civil building drawings
h) Construction start date
i) Date access will be given for:
   - Installation of equipment in Buildings
   - Installation of outdoor plant
j) Construction finish date

The Bidder's programme shall outline the number of sites he proposes to build at any time and shall show the order of completion of sites and how crews will move from site to site. This information shall be used to establish the number of expatriate site supervisors required.

The drawing programme shall ensure that complete set of approved civil building drawings will be issued at least 21 days before construction start at any site, in accordance with the Project Requirements.

The Construction programme shall be expressed in an 'S' curve for the whole project, with the percentage (of the total value of work in the schedules) given for each site each month. The overall percentage completion of the project each month shall also be given.

12B.1.8 Monthly Progress Certificates/Progress Reports

In accordance with the Project Requirements the Contractor shall submit agreed progress certificates for each site before the seventh day of the next month. These certificates shall state the percentage completion of each item in the schedules and shall state the overall percentage completion of each site and that site's contribution to overall project percentage completion. An updated 'S' curve shall be submitted with the progress certificates.

12B.1.9 Temporary Facilities

The Bidder shall provide all temporary buildings, workshops, cement and lime stores and latrines required for his use. The Contractor shall agree the location of these buildings with the Employer, after submitting a drawing showing their proposed location.

The Bidder is placed in possession of a site, or part of a site, he shall erect temporary fencing immediately to protect the site until the boundary wall shall be erected.

12B.1.10 Site Supervision

Although the civil and building works may be let as a sub-contract to an approved local contractor, the main contractor shall ensure that an expatriate supervisor in his direct employ is continuously available at each site during construction. This supervisor shall have at least a working command of spoken English and be able to read, understand and discuss specifications and drawings.

The Bidder shall notify the Employer in writing of every concrete pour and foundation casting the day before the work starts. This is a **Hold Point**.

12B.1.11 Designs and Drawings

The Bidder shall obtain the Engineer's approval for the use of all design codes and standards before design work starts. The Bidder shall supply one copy of all of codes for employer's Engineer. If non-English equivalent National codes are adopted, the Bidder shall supply English translations of these Codes to the Engineer.

One copy of calculations along with all soft (software) copies shall be submitted together with drawings. To avoid possible misunderstandings, calculations will not be approved separately from drawings.

The Bidder shall generally submit a complete set of drawings for each substation for approval after initially getting the electrical layout of each substation approved. Where possible, drawings shall be standardized and general drawings (00) issued covering several sites.

For each substation The Bidder shall provide a co-ordination plan at scale 1:200 showing structure types, foundation types, cable trenches, roads, ducts, buildings, boundary walls, earthing, drainage and all services in this Contract.

12B.2 REFERENCES

12B.2.1 General

The design and construction shall conform to the latest edition of the relevant Codes and Standards. Any proposed substitution for the listed Standards by an equivalent Standard will be subject to approval by the Employer. Relevant Standards include, but are not limited to, those listed in sub section 2.2 below.

12B.2.2 Design and Construction Standards

BS 12	Portland Cement
BS EN 124	Gully and Manhole tops for vehicular and pedestrian areas
BS 812	Testing aggregates
BS 882	Aggregates from natural sources for concrete
BS 1377	Methods of test for soils for civil engineering purposes
BS 1722: Part 10	Anti-intruder fences
BS 1881	Testing concrete
BS 2853	Design and testing of overhead runway beams
BS 3148	Methods of test for water for making concrete
BS 3921	Clay bricks
BS 4449	Steel bars for the reinforcement of concrete
BS 5262	External renderings
BS 5395	Stairs, ladders and walkways
BS 5572	Sanitary pipework
BS 5628	Code of practice for use of masonry

BS 5930	Code of practice for site investigations
BS 6031	Code of practice for earthworks
BS 6367	Code of practice for drainage of roofs and paved areas
BS 6399: Part 1	Code of practice for dead and imposed loads
BS 6399: Part 2	Code of practice for wind loads
BS 6465	Sanitary installations
BS 6651	Code of practice for protection of structures against lightning
BS 6700	Design, installation, testing and maintenance of services supplying water for domestic use
BS 8004	Code of practice for foundations
BS 8005	Sewerage
BS 8100	Lattice towers and masts
BS 8102	Code of practice for protection of structures against water from the ground
BS 8110	Structural use of concrete
BS 8206	Lighting for buildings
BS 8215	Code of practice for design and installation of damp-proof courses in masonry
BS 8290	Suspended ceilings
BS 8301	Code of practice for building drainage

12B.3 DESIGN

12B.3.1 Architectural and Structural Requirements of Buildings

All new buildings shall be designed to be architecturally pleasing in appearance and to withstand the tropical climate with minimal maintenance.

Architectural elevations of buildings shall be agreed before other detail plans are prepared.

The general layouts of buildings are to be maintained as shown, but minor modifications may be made to provide buildings wholly suitable for the equipment being provided by the contractor to satisfy the requirements of other parts of the Specification.

All buildings shall be designed to have reinforced concrete frames, with infill panel walls of reinforced concrete or brick which shall be capable of resisting a horizontal earthquake force of **0.2G.**

All external walls of control room building/SPR shall be minimum 230mm first class brickwork plus one layer of Mirpur Ceramics or similar approved facing bricks. External walls of other buildings shall be minimum 230mm first class brickwork plus one layer of Mirpur Ceramics or similar approved facing bricks or rendered with cement render and painted as required by the architectural plan.

Internal partition shall be fire barriers rated for minimum 1 hour and of approved material/design. Internal walls shall all be rendered and receive one sealer coat plus two finishing coats of emulsion paint of approved colour.

All brickwork shall be tied into the concrete frame by galvanized ties. Externally, rendered walls shall receive primer plus two finishing coats of PEP acrylic external quality paint or

similar approved. At least two air bricks shall be provided to each room in which staff work/rest.

Substation buildings shall be designed to withstand pressure due to internal arcing or arrangement shall be made for pressure release in such an event by providing wall dampers. Parameters considered in the building design shall be subject to PGCB's approval.

Particular attention must be given in the design of buildings and layouts to fire prevention and safety of personnel at all times. Buildings housing switchgear and control equipment shall be designed as far as practicable to exclude pollution under all likely weather conditions. Fire-proof or flame-retarding materials are to be used for floor, wall, door and ceiling finishes. Where areas are designed as having a fire resistance rating then materials shall be shown to have passed approved standard tests for that class of fire resistance.

All floor slabs shall be constructed of reinforced concrete supported on reinforced concrete beams. Floor finishes will be designed to provide high impact and abrasion resistance. The finishes shall be in accordance with the schedule of finishes.

Electric overhead traveling crane(s) shall be provided in the 400kV, 230 kV and 132 kV GIS switchgear room to facilitate erection and maintenance of the equipment

The minimum height of ground floor of shall be 3.0 metre The height of control rooms shall provide about 1 metre clearance over the top of the cabinets/equipments to the underside of the false ceiling and any fittings suspended from ceilings shall be the criteria governing room heights. In the switchgear rooms, about 1 metre clearance shall be provided over the switchgear to the underside of the roof slab but the Contractor shall provide a greater clearance if it is required to remove equipment. The clearance maybe reduced below downstand beams provided no equipment is required to be removed from the top of the switchgear.

Rooms shall have walls and roof slabs adequately insulated. Maximum thermal transmittance values for all rooms shall be 0.7 watts/m^2/°C for walls and 0.57 for roofs. Air conditioning units shall be provided in rooms listed in Section 11. Air conditioned rooms shall have a false ceiling such that the overall thermal transmittance of the roof shall be below 0.45 Watts/m^2/°C. The false ceiling shall be made from non combustible materials, and shall be easily removable to provide easy access to small power cables. Suspended ceilings, with acoustic tiling and incorporating lighting and air-conditioning fixtures shall be used in corridors, offices, toilet, control and communication rooms of the buildings and as per schedule of finishes

In main control room building, all structures shall be designed to carry the loads imposed by the structure itself, together with minimum floor live load (including stairs) of 5.0kN/m2 (minimum) or in accordance with an approved standard or code of practice. In GIS floor if converted UDL of machine loading exceeds 5.0KN/m2, then that value should be used instead of 5.0KN/m2 as live load. The roof shall be designed for 2.5 kN/m2 live load.

All doors opening outwards from the buildings shall be provided with panic latches or bolts which override any locking device, for escape in the event of fire. All doors shall be provided with overhead door closuers of adequate capacity. Door labels incorporating electrical hazard

warning in Bangla and English shall be fixed to each entry door. Vision panels shall be provided to frequently used doors.

Window openings shall be fitted with protruding concrete sunshades above and at the sides of the openings.

Roofs to the main buildings shall be insitu reinforced concrete slab and shall be insulated and waterproofed. The roof shall be waterproofed with lime terracing 2:2:7 lime, shurki (powdered brick) and brick chips 0.75" down, which shall be beaten in accordance with local practice. The entire roof area shall be laid in one continuous operation. The minimum compacted thickness of terracing shall be 25mm at the low points of the roof with a 1:150 slope to those points formed by a layer of terracing of increasing thickness. Once laid, the terracing shall be covered with a layer of bitumen emulsion and the edge of the terracing shall be protected against erosion into the downpipes. Downpipes shall be 100mm diameter cast iron pipe placed outside the wall but shall be enclosed in a facing brick buttress. There shall be at least one downpipe per 100m^2 of roof. The Contractor shall guarantee the roof against leaks for a period of 3 years from the Taking Over Certificate date. The roof shall project at least 450mm beyond the face of all walls to form a sunshade and rain shelter to the walls below. The upper surface of this projection shall be sloped and a drip provided. A steel staircase with necessary landing shall be provided to permit easy access to the roof and to equipment at roof level. Roof mounted equipments (if any) shall be covered by approved screens for better elevation/aesthetics.

The head of each downpipe shall be fitted with an enlarged hopper and purpose made cast iron grill set into a recess in the roof projection.

The roof parapet wall shall be about 0.8 metre high with an insitu concrete coping with DPC below it. Where facing bricks are used below the roof level, they shall also be used above roof level. An architectural feature shall be provided by panels of open decorative block work (Mirpur ceramics or similar approved) to ensure good air circulation over the roof. Three open decorative blocks of size 1000mm X 500mm should be provided on each side in solid portions of parapet wall.

The domestic water supply system shall include all plumbing, underground pipework, high and low level storage tanks, valves, fittings and pumps (including the provision of a standby pump) for the provision of a pressurized water supply system for the static water tank and all buildings within the compounds.

On completion of the installation and prior to putting to use, the system shall be sterilized in accordance with an approved Code of Practice.

The Bidder shall be responsible for the provision and installation of a water supply serving the substation buildings. Every cistern, sink, basin, etc., shall be provided with a stop-cock in the supply pipe adjacent to the fitting. Each basin, sink and shower unit is to be provided with both hot and cold water. Provision shall be made for connection to the drinking water supply.

Each Toilet shall be provided with 1 no. western type WC, 1 no. wash-hand basin, 1 no. wall mounted mirror, 1 no. towel rail etc. all necessary fittings and accessories shall be provided.

Battery rooms shall be supplied with sink and drainer & exhaust fans (if no air conditioning).

The main entrance to all buildings shall be shaded, either by a projection of the roof over the entrance verandah or by a separate roof at a lower level. This area of roof shall also be lime terraced and drained by rainwater pipes.

Substation buildings housing switchgear and control equipment shall include a cable basement to facilitate connection to the equipment. Basements shall be constructed so as to protect the building substructure from water in accordance with BS 8102.

12B.3.2 Cable Basement

Not used.

12B.3.3 Cable Tunnels and Cable Trenches

The Contractor is responsible for all civil works required for the installation of cables.

Main structure of cable tunnel is reinforced concrete and shall be designed enough bearing capacity caused by some parts of cable tunnel are under heavy equipment. Cable tunnel is used for cables from the 230 kV transformers to GIS building.

All cable runs in buildings shall be arranged within the ground floor.

12B.3.4 Ground Conditions, Foundations and Site Investigation

(a) Fill Sites

The Bidder shall impose the site layout on the survey to check for uneven depth of fill below any foundation and where uneven depth of fill exists his foundation proposals shall restrict final differential settlement to a 1 in 400 slope.

If a fill site has not been exposed to one wet season before foundation work starts, the Bidder shall flood the site to a depth of 50mm for 10 days (Not required on hydraulic fill sites). This requirement is because silty sands will generally compact to a denser condition on first time flooding.

On all fill sites the Bidder shall pipe rainwater from down pipes down to paddy level and shall prevent water ponding in open foundations and backfill all foundations as soon as possible.

When a filled site is handed over to the Bidder, the Bidder shall become responsible for maintaining the entirety of the fill in good condition, including all better slopes.

(b) Unfilled Sites

Original delta levels are generally 4 metres below road level. Therefore most sites are historically fill sites but fill settlement can sensibly be considered complete, where fill is over 3 years old.

(c) Site Investigation

Detailed methodology for subsoil investigation shall be submitted before implementing the subsoil investigation. All laboratory tests shall be done at the test facility approved by the Employer.

The Bidder may appoint a sub Bidder to carry out the site investigation but all work and all lab work shall be witnessed by one of his Geo-technical engineer who shall countersign all recorded data.

1 borehole should be counted for every 600 square meter of proposed project area and provided on suitable points. At least three additional boreholes should be provided for control building and switchyard panel room building or any other building. For boundary wall/retaining wall additional boreholes shall be provided on in each corner point and at a maximum 50m interval point. Additional boreholes may also be required where uneven fill depth is encountered. The number and location of boreholes shall be approved with the site survey drawing showing existing ground levels specified in the section 12A.1.4. The boreholes shall be located to an accuracy of + 0.5m and shall be located to site layout considering existing obstacles at the field.

Boreholes shall be a minimum of 25 metres depth or twice building footing width, whichever is greater. All boreholes shall be backfilled with compacted sand.

Borehole log together with a summary of all required laboratory tests is required to be prepared. Soil test locations are required to be indicated on the geographical map.

In each borehole the following tests shall be carried out:

- Standard Penetration tests at 1.0 metre intervals.

- Undisturbed samples shall be taken at around 2 metres depth and 3 metres depth and tested by unconfined compression tests.

- One dimensional consolidation tests shall also be carried out on undisturbed samples taken at 1.5, 3 and 4.5 metres depth. The samples shall be saturated and the range of applied pressure shall fully reflect the insitu conditions. Graphs showing void ratio (e) and applied pressure shall be submitted along with the Coefficient of Compressibility for the range of loading anticipated.

- Particle size analysis shall be carried out for each stratum and specific gravity, moisture content, liquid limit and plastic limit determined.

- Ground water level shall be determined by dipping the boreholes. Where collapse of the boreholes occurs, casing shall be used and left in until the water level remains constant for two days.

- In cohesive soils a vane test to BS 1377: Part 9 shall be carried out at three different depths. The Contractor shall check the sensivity of soil and ground water at each site to concrete and take all measures necessary to ensure the long term durability of concrete.

Prior to commencement, the Contractor shall submit to the Engineer detailed schedules for the site survey and soil investigation. This is a **Hold Point**.

(d) Site Investigation Report

The site investigation and analysis of the data in a final report giving full details of foundation proposals shall be completed at each site by the programmed date. During site investigation, Geographical map shall be prepared indicating the locations of soil test.

The report shall be submitted by the key date at each site given in the programme. The Bidder shall submit 3 copies of the report to the Engineer. The report shall propose full details of foundations and loading thereon and shall provide estimates of likely settlements and differential settlements. The report shall be the work of the Bidder's own foundation engineers.

If the Bidder uses a local site investigation Bidder, he shall appoint one of his geo-technical engineer to oversee the entire operation and each piece of data shall be countersigned by this person.

Where estimated settlement exceeds 25mm, the Bidder shall construct one foundation at an early stage and test load this foundation to confirm settlement predictions.

(e) Foundations

Regardless of the result of soil investigation report, the foundations of control building, boundary wall, gantry structures and for auto-transformers shall be provided with piles. Piles shall be concrete (cast-in-situ or precast) complying with BS 8004.

Other foundations of outdoor equipment shall be provided shallow/deep as per subsoil investigation report, settlement test as well as plate bearing test. In case of shallow foundation for outdoor equipment the bearing capacity of proposed soil level shall be checked by the Plate Bearing Test.

For shallow foundations the minimum depth of foundations shall be 1.5m.

All formations shall be hand rammed or mechanically compacted before placing 70mm minimum thickness of Class B concrete blinding, within 24 hours of bottoming excavation, which blinding shall project 300mm minimum distance beyond all footings. Each footing shall be inspected by the Engineer. Where soil condition is poor (on fill sites or already filled sites) or where the Bidder leaves foundations exposed and soil conditions deteriorate, one of the following measures shall be carried out as agreed with the Engineer:

i) Blinding depth and projection shall be increased as necessary.

ii) Soft soil shall be removed and replaced with compacted viti sand with the top 300mm (Minimum) consisting of sand and khoa (brick chips) in 2:3 ratio with 95% level of compaction.

The cost of this work shall be borne by the Bidder.

The Bidder shall propose the allowable bearing pressure for all foundations based on soil strength parameters only and shall not be increased while wind loads exceeds 25% of dead load as well as shall not exceed 125kN/m2 . Between column footings all walls, including all internal walls, shall be provided with a reinforced concrete strip footing of minimum dimension 800mm wide by 250mm deep placed at the same level as column footings and linked structurally to the footings. In addition column footings shall be tied at foundation level and also floor level by beams to every adjacent column in both orthogonal directions.

These beams shall be designed to resist 1 in 200 differential settlement without distress and shall be capable of resisting the earthquake load of 0.2G.

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The deepest parts of any foundations shall be completed first. All foundations shall be completed and backfilled, including all cable tunnel and cable trench work inside buildings, before walls are raised above floor levels. All other foundations shall be backfilled within 7 days of completing concreting.

All exposed concrete and the outer surfaces of cable trenches and cable tunnels shall receive two coats of bitumastic paint before backfilling to reduce ingress of water. The Concrete surface shall be ground smooth and all air holes etc filled (rubbed down with a cement slurry) before painting.

The Contractor shall monitor settlement of all foundations each month and report this settlement to the Engineer until settlement has reduced to less than 1.5mm in 3 months. All exposed edges shall have 20 mm x 20 mm chamfers.

Excavation shall only be carried out when the ground water table is at least 1000mm below foundation level. The excavation shall be kept dry during the construction period by providing sumps and pumps as required. During the rain season, shelters shall be erected over all open excavations.

Excavations shall be adequately supported or formed to ensure stability of the sides and prevent any damage to the surrounding ground or structures. The design of suitable sheet

piling and/or timbering for excavation shall be in accordance with the recommendations of BS 8004 Section 5.

When the Contractor requested shall submit details of his temporary support to the Employer.

Excavation shall not be carried out below or adjacent to existing building foundations until under-pinning and shoring have been completed by the Contractor.

The Contractor shall not permit water to accumulate in any excavation unless otherwise agreed. Any water whether arising from the excavation or draining into shall be drained or pumped to an approved location well clear of the excavation area in a manner that does not cause erosion, silting or contamination of existing drains and watercourses. Before the method of ground water lowering is selected, adequate knowledge of the ground and water conditions has to be obtained from the results of a soil investigation and/or information

The Contractor shall take adequate steps to prevent adjacent ground from being, adversely affected by loss of fines in any de-watering process.

Any over excavation shall be filled with Class B concrete.

All backfill shall be compacted to 95% maximum dry density as defined by BS 1377 test method, 2.5 kg rammer.

Before starting foundation work the Contractor shall clear all sites of trees, tree roots, shrubs, debris, surplus soil, and any buildings.

Foundations shall be designed to resist uplift, assuming the water table is at ground level and the weight of soil resting on a foundation is that included within a 15° frustum.

On fill sites where the depth of fill exceeds 3 metres, the Contractor shall provide piled foundations in accordance with BS 8004 for substation buildings. One working pile chosen by the Engineer shall be load tested at each site to 150% of design load in accordance with BS 8004.

12B.3.5 Fire Criteria

The Contractor shall make provision in the design of the building structure for minimum periods of fire resistance in accordance with "The British Building regulations 1985 - Part B - Fire - B2/3/4 Fire Spread.

The minimum periods of fire resistance (hours) shall be related to the maximum dimensions, i.e height, floor area or cubic capacity, of buildings or compartments of buildings.

For calculating the maximum dimensions the following definitions shall apply: -

(a) "Area", in relation to a building, means the area calculated by reference to its finished internal faces:

(b) "Basement" means a storey of which the floor is at any point more than 1.2 metres below the finished surface of the ground adjacent to it.

(c) "Floor area" means the aggregate area of every floor in a building or extension, calculated by reference to the finished internal faces of the walls enclosing the areas, or if at any point there is no such wall, by reference to the outermost edge of the floor.

(d) "Height" means the height of the building measured from the mean level of the ground adjoining the outside of the external walls of the building to the level of half the vertical height of the roof of the building, or to the top of the walls or of the parapet, if any, whichever is. the higher.

To restrict the spread of fire, certain walls and floors shall be designated as fire compartment barriers. Fire compartment barriers shall provide complete barrier-to spread of smoke heat and other products of combustion. The barriers shall have a rating of 2 hours minimum. All openings in walls/floors for entry/exit of cables shall be sealed with approved fire sealant rated for minimum 2 hours.

12B.3.6 Drainage

The entire surface within boundary walls shall be of uniform sloping site, sloping at 1 in 300 minimum slope to open channels around the entire perimeter. These channels shall be designed for a rainfall intensity of 60 mm per hour. Outside the boundary wall the Bidder shall be responsible for drainage up to 20 metres from the wall and will at some sites need to construct outlets with suitable erosion protection down to paddy level.

The concrete wall of cable trenches shall project at least 50mm. above brick paving level to prevent run off entering the cable trench. The floors of all cable trenches/tunnels shall be sloped to soak well as described in 12A.3.16.

The cable trenches will thus form barriers to surface water drainage. If the cut off area exceeds 30m2 it shall be drained by a 200mm minimum diameter concrete pipe to the boundary drain. The Bidder's drainage design shall avoid all ponded water to avoid forming a mosquito breeding ground.

All drainage pipework within buildings shall be uPVC type, generally of 100mm diameter or as per requirement. Floor drains shall be placed in each battery room and toilet.

External pipework shall be 150mm. minimum diameter uPVC pipes at a minimum depth of invert of 700mm. Where pipes, including existing pipes alongside site, are less than 400mm above adjacent foundations they shall be surrounded in concrete. Where required, drainage pipes shall be kept below cables, allowing 1.1 m cover to top of pipes.

Manholes shall be of brick construction with 600mm. x 600mm clear openings and airtight ductile iron covers to BS EN 124. Manholes shall be located at each change of direction. Minimum fall on all pipelines shall be 1 in 80. Manholes shall not be located in roads.

The Bidder shall be responsible for all negotiations with local authority/WASA where a connection to a public sewer is proposed. Where high water levels in public sewers may cause effluent to back up into a site, non return valves shall be fitted. The Bidder shall provide all protection required to existing sewers and shall deepen foundations, including boundary wall foundations, where required to ensure all foundations are below adjacent sewers. The Bidder shall draw longitudinal sections of all pipelines.

Main control building shall be provided with a septic tank designed for 10 users and a soakaway of open brick construction 11m deep by 2.2m diameter filled with broken bricks. The septic tank shall be located at least 15 metres from buildings. Other buildings shall have septic tanks designed for the required number of users. All foul drains shall be vented by a vent pipe to above roof level. The inner surface of all manholes and septic tanks shall be painted with 2 coats of bitumastic paint to protect it against sulphate attack. The septic tank shall have access holes directly over the inlet pipes and outlet pipes. Where public sewers exist alongside a site, the Bidder shall connect directly to the foul sewer, provided effluent from the sewer is treated.

The Bidder shall construct the drainage first to ensure that at no stage is rainwater ponded on any part of the site. All rainwater shall be able to run off the site or shall be immediately pumped off site by the Bidder. The Bidder shall complete all necessary drains before casting any roof and large concrete area which will create large run off. The condensate drains for the air conditioning shall also be connected to the drainage. Two vents of minimum height 2.2m shall be provided on each septic tank.

If a town's water supply is unreliable, the roof rain water shall be collected in an underground tank of standard Employer's design.

12B.3.7 Surfacing

For the whole of the switchyard outdoor equipment area the ground shall be surfaced with gravel or other readily available local stone as approved by the Engineer. The switchyard surfacing shall be clean, thoroughly washed when necessary, and free from clay, soil or contaminating material and shall be graded from 20 - 45mm, laid and lightly compacted to a finished thickness of 175mm. Below the gravel layer there shall be a 75mm brick layer with cement mortar (1:6), laid over a 75mm level of fine sand spread over the finished fill site.

The substation plot, outside of the designated switchgear equipment areas, shall be turfed. Turf shall be of good quality, free from weeds and other impurities. Samples of the turf which is proposed to use shall be submitted to the Engineer for his approval. The turfs shall be laid to even surfaces on a bed of plastic/vegetable soil of 150mm thickness over Finished Ground level (FGL), which shall be raked and consolidated to provide a suitable bed.

On sloping surfaces the Bidder shall provide and fix wooden pegs to retain turfs.

All areas to be surfaced shall first be treated with a total weed killer in accordance with the manufacturer's instructions. Weed killer shall only be applied in dry weather when there is no risk of it being washed out to adjacent agricultural areas.

12B.3.8 Roads

Access road from outside the site boundary to connect to any adjacent public road and all roads within the site boundary shall be provided by the Bidder. The road surface shall be finished by concrete paving or equivalent. All roads shall be of reinforced slabs of average 150mm thickness fitted with construction joints at distances not exceeding 6.0 m. Paving schedule and methodology shall be approved by the Employer. The extent of roads required is shown approximately on Bid drawings but the scope of the work may change. Road layout shall generally permit vehicles to turn easily to avoid having to reverse out. Road layout shall be designed by the Bidder. The bidder shall assess all practical requirements like culvert construction, removal of any obstacles, permission from local authorities etc. for access road. All necessary works shall be the bidder's responsibilities.

The width of access road from outside the site boundary to connect to any adjacent public road shall be 6 meters. All roads within the site boundary shall be generally 6 metres wide between the outer edges of kerbs for main road and 4.5 meter & 3 meters wide for sub road.

The road edge shall be formed by Class B concrete kerb 250mm wide by 400mm deep, placed over one layer of bricks laid flat. The road shall be a Class A concrete slab of average 150mm deep at each edge with 1:50 cross fall and stiff broom concrete finish reinforced with 10mm bars at 250mm centres longitudinally and 10mm bars at 250mm centres transversely placed 80mm below the upper surface. Expansion and contraction joins shall be detailed on site plans. Expansion joints shall be filled with hot bitumen & sand (2:1) sealant. Below the slab shall be a layer of polythene 0.5mm thick laid over one layer of 1st class bricks laid on edge in herringbone fashion in and on cement mortar (mortar designation iv) laid over one layer of 1st class bricks laid flat in and on a layer of sand laid on insitu soil which shall be compacted as agreed with the Engineer. If the soil is clay a 75mm drainage layer of broken bricks shall additionally be placed over the soil.

The radius of the road edge at corners shall not be less than 3 metres and 1.2 metres either side of the road shall be kept clear of obstacles. Bollards or raised kerbs shall be provided where required to protect items alongside a road from vehicles. Ducts shall be provided below roads for all services in this Contract and for all future services.

Where mortar designations are referred to see BS 5628 Mortar designation iv is 1 cement: 2 Lime: 8 to 9 sand.

At each new substation site a two bay hard standing car port, complete with sun shades, is to be provided adjacent to the control building.

12B.3.9 Water Supply

The Bidder shall be responsible for providing a water supply both for construction and for operation of the completed sites. If a town's water supply is not available, the Bidder shall install

a deep tubewell of 40mm minimum diameter and 100m minimum depth with necessary pumps including all fittings, pipes etc. as required. But in that case guideline specified by WHO for drinking water is required to be satisfied. The Bidder shall supply and commission power supplies and all pumps required by tube wells.

If a town's water supply is available, the Bidder shall be responsible for making all necessary arrangements with WASA to connect a supply. If the pressure in the supply is inadequate to supply the roof tank continuously, the Bidder shall install a 1800 litre low level tank and pumps. This tank shall be below ground with a 200mm minimum air void around the tank to protect it from contamination. The pump control panel shall be located in the building. Water levels shall be controlled by float switches but the panel shall provide also for manual operation.

The supply shall be connected to a 2000 litre food graded plastic tank. This tank shall be raised 400mm clear of the line terracing on four brick piers of minimum 350mm square. All supplies in buildings shall be fed from the roof tank. The supply to the tank shall have a valve at waist height. The tank shall have an overflow returning to the location of this valve. No pipes shall pass through the roof directly over any room. Pipework shall be routed up the outside of the building and return pipes shall return down the outside of the building before entering through the wall. Pipework shall be galvanised steel secured by clamps at 1-5 metre intervals and painted with alkyd paint to match walls. All pipes should be concealed by brickworks on vertical walls.

12B.3.10 Plumbing and Sanitary Fittings

The Bidder shall prepare a drawing of all plumbing and building drainage for each building. Sanitary fittings and plumbing materials shall generally be of approved local manufacture.

In main control building each toilet shall have a single western WC. Each toilet outlet shall be vented by a 100mm diameter uPVC vent pipe passing up the outside of the building to 300mm above roof level. Beside each toilet shall be placed a low level tap. Main control Building toilets shall also have a wash basin and cold and hot water shower with 10 gallon capacity geyser for each toilet. Toilets and showers shall have all walls tiled upto the bottom of false celling.

Every tap and cistern shall have stop cocks in the supply pipe. One external tap shall be provided on each building. Battery rooms shall be provided with a stainless steel sink of approximate dimensions 900 x 600 x 200mm with a draining board to one side. The battery room floor drain shall be connected to the foul drainage. All floor drains shall have P traps.

Mirrors shall be installed over toilet wash basins. Care shall be taken in orientation of toilets to avoid offending religious sensitivities. Toilets shall generally be orientated North South where possible. Each shower shall have a wall on two sides and a porcelain shower tray sunk into the floor. Soap dishes shall be provided beside each shower.

Only foul water from WC pans shall be connected to septic tanks. All other water shall flow to surface water drains.

12B.3.11 Substation Building Floors

All topsoil containing roots shall be removed and the insitu soil compacted before placing backfill. All backfill, including the backfill to column footings, below the floor shall be sandThe floor and all cable trenches shall be made of Class A concrete. The ground floor slab shall have a minimum 125mm thick reinforced Class A concrete furnished with floor tiles and shall rest on the compacted fill. Below the slab shall be placed a layer of polythene 0.5mm and a layer of sand khoa (2:3) compaction of minimum 100mm thick, hand rammed to a smooth upper surface.

All cables from cable trenches shall enter the building over grade beam level, no cable trench shall be allowed into main control room building. Where power cables traverse a building to reach a switchgear room on the far side they shall generally be contained within cable tray.

All sand backfill shall be compacted to 95% optimum density and shall be tested. The fill within a building, above ground level, shall not be placed until all backfill outside the building is completed. All floor slabs shall have a damp proof membrane of 0.5mm thickness.

Each control building shall have a ramp at a slope of approximately 1 in 7.5, of 1.5m minimum width with a Concrete Class A slab of min depth 125mm with a stiff brush concrete surface finish, or other agreed non slip surface.

All floors (including verandahs) except for GIS room and battery room shall have 25mm homogeneous floor tiles topping. All external steps where public access is given to buildings shall have marble tiles toppings. Elsewhere, concrete surfaces shall be used for all external floors/steps. Verandahs shall have a minimum 1:50 slope to shed rainwater away from buildings. Concrete floors and steps shall also be treated with 3coats of Lithurin or other approved concrete dust proofer.

Verandahs shall have a minimum shed of 1:50 slope to rainwater away from buildings.

If floor tiles are not adequately durable to withstand switchgear movement when rolled out to the maintenance position, then galvanized steel chequered plates shall be inserted in the floor to resist the abrasion from switchgear wheels.

12B.3.12 Cable Basement and GIS Room Floors

No cable basement shall be used. Cables shall enter into the building through ground floor. GIS room shall have a concrete floor finished by 25mm cement screed in composite method of construction. To avoid cracks, joint of adequate size are to be made at suitable points. Screed shall correspond with expansion joints in floor slab. Additional screed joints like sawn joints, additional expansion joint etc. shall be avoided. To improve the resistance to abrasion and to reduce dust accumulation, the screed shall be coated with synthetic resin based paint unless specified otherwise.

12B.3.13 Control Room Floor

No raised floor shall be used.

12B.3.14 Battery Room Floors

Battery rooms shall have a concrete floor sloping to a cast iron floor drain. The concrete surface shall be treated with Nitocote epoxy resin coating (Nitoflor primer plus two coats of Nitocote in accordance with manufacturer's instructions), or similar approved material, to ensure resistance to battery electrolyte. There shall be no cable trenches in battery rooms. Cable entrances through the floor shall be protected by a raised plinth 50mm high around the opening with the annulus around the cable sealed after installation.

12B.3.15 Site Clearance, Obstructions and Adjacent Structures

The Contractor shall be responsible for clearance of:-

(1) Trees, shrubs and any vegetation including the extraction of all roots and compaction of backfill where roots have been extracted.

(2) The removal of all buildings, sheds or any other structures above or below ground including the removal of any septic tanks, drains or other underground services.

(3) The removal of any existing surfacing, roads, foundations or any other obstruction.

All material cleared away by the Contractor shall be the property of the Employer and shall be removed by the Contractor to a site in the Dhaka area upon instructions of the Employer. The Employer may remove any buildings or structures himself from sites before the site is handed over to the Contractor.

Where an existing service, existing equipment or adjacent building is to be retained, the Contractor shall take all necessary measures to protect the item concerned from damage and shall be responsible for ensuring that no movement of foundations occurs during or after completion of construction.

Any existing electrical equipment/cables which have to be modified or repositioned shall be included in the works at no extra cost. Any buried gas or water main services which require to be diverted shall be deviated by the Employer at his cost. However, where it is possible to retain these existing services and build new structures around them, the Contractor shall take all necessary measures to build in the service at no extra cost.

12B.3.16 Guard Houses, Boundary Walls, Fences and Entrance Gates

The guard house serves for control of entrance. The gatekeeper shall be able to watch the area before and behind the guard house. The guard house shall be provided with toilet, water supply facilitates. Small power and lighting facilitates are to be provided in the Guard Houses.

The Bidder shall base his design of boundary walls and gates following bid drawing and subsoil investigation report. Where sites are within existing Employer's boundary walls, the Bidder shall erect a permanent fence 2.0m high in accordance with BS 1722 part 10 or similar approved.

12B.3.17 Windows

Even natural light shall be provided by windows to illuminate all areas of buildings. Window area shall be about 6% of floor area to limit solar heat gain. Tops of windows shall generally be below 2.5 metres from floor level but toilet windows may be higher. The bottom of windows shall be generally at least 0.45 metres above floor level. Each window shall be provided with a sunshade projecting about 500mm from the wall above and at the upper sides of the window. Few windows shall be placed on south facing walls. Windows shall be spaced to give a wide view of the switchyard.

Windows shall have single glazing with 6mm thick glass, reinforced with wire mesh where windows are placed in or over doors.

Window frames shall be anodised aluminium.

Glass panels shall be placed over doors to provide natural light to internal corridors and rooms where required.

External cills shall have a sloping tile or similar detail with drip.

The Bidder shall prepare a window schedule for each building.

The schedule shall clearly indicate both fixed and opening windows.

The Control and Switchgear rooms in particular shall have opening windows to allow adequate ventilation. Approved quality of MS grill shall have to be provided to all windows. All MS grill will be painted with one coat of red oxide primer and minimum two coats of approved quality synthetic enamel paint.

12B.3.18 Doors

Internal doors and door frames shall be anodised aluminium. Main Entrance/Exit doors and door frames shall be steel.

External doors shall be of aluminium. Fire rated doors shall be in accordance with NFPA 80 and shall be of standard construction. Doors shall be dust-proofed by use of neoprene or other approved seals.

The minimum size of the structural openings for doors shall be 1550mm wide for double doors and 930mm wide for single doors. Door height shall generally be 2100mm but switchgear and control rooms shall have a removable transom and removable panel over the door or a taller door to provide a total height of about 2500mm. All door sizes and widths shall be adequate to get in and get out all equipment and future equipment.

All external doors shall have weather boards, hydraulic closers and cabin hooks to hold the door open. External doors shall open inwards, except for switchgear room doors which must open outwards and be fitted with panic release latches.

Each door leaf shall have three 150mm heavy iron hinges equally spaced. Door furniture shall be of approved local manufacture and shall generally be of brass. All corridor doors, external doors and rest room (toilet) doors shall be fitted with hydraulic closers. Door stops shall be

fitted where required. Door frames shall generally be set 200mm off a wall junction to enable the door to open fully through 90°.

All external doors shall be shaded by either the roof canopy or a separate precast concrete canopy over the top and the upper sides of a door.

The Bidder shall prepare a schedule of all doors and all door furniture for each building.

For the GIS entrance gate at GIS room, the gate shall be electrical motorized horizontal or vertical door. Before commencement of installing, the contractor shall submit a detailed drawings and specifications of motorized door for Employer's approval. This is a **Hold Point**.

12B.3.19 Brickwork

Brickwork shall be designed to BS 5628. External panels of brickwork shall be checked for wind pressure calculated in accordance with BS 6399 for a wind speed of 160 kph 3 second gust.

Bricks shall be first class bricks from approved manufacturers. 10 bricks shall be tested in accordance with BS 3921 to determine water absorption and crushing strength, which shall exceed 20N/mm^2. Mortar shall generally be mixed at a ratio of 1:1: 5 to 6. cement, lime, sand.

All brick panels shall be tied to the concrete frame with galvanised ties of approved design. Ties shall be painted with bituminous paint.

Facing bricks shall be 200 x 62 x 25 mm facing bricks from Mirpur ceramics. Facing bricks shall be tied back to the main wall. External walls shall be 230mm thick brickwork, rendered internally and clad externally with facing bricks or rendered as required by the architectural plan.

Bricks shall be compacted down onto a full bed of mortar. Vertical joints shall be completely filled with mortar. Joints shall be raked out about 10mm deep where walls are to be rendered.

Brick walls shall be constructed so that tops of all meeting walls are about the same level with maximum variation of 0.75m. Only 18 courses per day shall be laid. New work shall be protected from sunlight and drying winds for 4 days.

Lime and cement for all brickwork shall be stored in a dry building with a raised dry floor.

Reinforcement by mild steel rods shall be provided where required by the design. Additionally openings over 500mm wide shall be reinforced for 2 courses above and below the opening, two 6mm bars per course extending 900mm beyond the opening both sides where possible.

All exposed brickwork shall be rendered and painted where not faced with facing bricks.

12B.3.20 Expansion Joints, Joint Fillers and Sealants

Not used.

12B.3.21 Cable Trenches in Switchyards

Cable trench sizes shall be standardised. Layout drawings shall be submitted for each substation showing layout and size of trenches. No trench shall cross a road; power cables shall be placed in ducts of minimum 150mm diameter with bell-mouthed ends. Ducts shall extend 1500mm minimum beyond the edge of roads. Spare ducts shall be installed for likely future development.

Floors and walls of trenches shall be constructed of Class A reinforced concrete of minimum 150mm thickness, with the external surface painted with two coats of bitumastic paint. Walls and covers shall protrude at least 50mm above site finish level and the top of the wall shall be flat with no rebate. Floors shall be sloped at 1:150 minimum slope to brick soakaways placed below the trench at low points; the volume of each soakaway shall be 2.5m^3 per 150m^2 of trench.

Covers shall be of reinforced concrete Class A. Each cover weight less than 55 kg. The minimum depth shall be 70mm, with downstand ribs along each side providing a minimum overall depth of 100mm. The ends of the cover shall overhang the wall by 15mm and in the centre of each end there shall be a hand hole of minimum size 100mm by 20mm high. This hole shall allow air to ventilate the trench so that heat built up in the trench shall be reduced. No gaps larger than 5mm shall be left between adjacent covers so that the cables are always shaded. Cover slabs shall sit squarely and uniformly on the trench walls without the need for bedding or shims. Because portable fire extinguishers will be rolled over and along trenches, each cover shall be capable of resisting a 250kg point load at mid span. The Contractor shall provide ramps up to the edge of covers in several locations, as agreed on site, to enable the wheeled extinguisher to mount the covers. Longitudinal edges may be inclined at 10 to the vertical, thus creating a larger gap at the bottom of adjacent slabs, again to reduce heat build up. The upper surface of covers shall have a stiff broom non slip concrete finish. All sharp edges shall be stoned smooth. Outer edges shall be chamfered.

Longitudinal fire separation walls and transverse fire separation walls as required by the cable section, may be of brick or reinforced concrete.

12B.3.22 Rainwater Pipes

Down pipes shall be 100mm minimum diameter placed on the outside of walls but enclosed in a brick buttress of facing bricks. One downpipe shall be provided for each 100m^2 of roof area. The head of the downpipe shall be enlarged to 200mm diameter and a purpose made cast iron grill provided over the head. This grill shall be sited in a recess in the roof slab projection.

The foot of the pipe shall have a 90° bend and water shall be discharged into either:

i) a small open channel conveying the water to the boundary channel

ii) a pipeline conveying the water off the site. Rainwater shall not be connected to the septic tank or allowed to discharge directly onto switchyard paving.

12B.3.23 Switchyard Foundations

The tops of all foundations shall be set at the same level, which shall be raised above the Finished Switchyard Level (FSL) for the purpose of preventing surface water coming into contact with the equipment structures and holding-down bolts. The distance between the Finished Switchyard Level (FSL) and the top of foundations shall be at least 200mm. All exposed concrete surfaces shall be painted with an acrylic weatherproofer or bituminous paint, and flat areas shall be sloped to shed water. No base shall permit ponding of water in any way, and free drainage shall also be possible from all areas inside any grouting.

Bases shall generally be of Class A reinforced concrete.

Bases shall have all recesses for cables and earthing detailed on drawings. The drawings shall clearly show the orientation of each base and the location of all recesses. Where new foundations are adjacent to existing foundations; the Bidder shall be responsible for verifying the extent of the existing foundation and ensuring its stability.

For anchorage design of switchyard foundations shear force, vertical accelerations, overturning moments and torsion due to mass eccentricities of the equipment for the earthquake load of 0.1G are required to be considered. Mild steel ductile bolts and headed studs cast-in-place anchor bolts shall be used. Thick plate washer is required to be welded to the equipment base plate. Normal washers shall be used under a nut in all cases.

12B.3.24 Transformer Bases

The transformer base, together with its surrounding bund shall form a raft to distribute the load from the transformer over the entire area within the bund wall. The bund shall extend at least 700mm beyond any part of the transformer and its radiators. The level of the top of the bund and the skids shall be 200mm above general switchyard level. Skids shall extend to the edge of the bund. Where separate transformer cooler banks are provided, the cooler banks shall also be protected by the bund.

50mm below the top of the wall shall be placed a layer of stone 225mm deep set on a galvanised grill painted with two coats of bitumastic paint. The effective volume of the bund below the stone shall equal 125% of the total volume of oil in the transformer and its radiators.

Rainwater will tend to collect in the bund. To evacuate rainwater a fixed submersible pump controlled by sensors and switches (Aqua Sentry or equal) shall be provided at each bund with power supplies and drainage manhole conveniently located. The bund water control system shall differentiate between water and oil to ensure that the pump will not be activated while oil is present in the bund.

The transformer base and the bund shall be founded a minimum 1.0 metres below Finished Ground Level (FGL).

The skid walls shall be at least 600mm wide. RCC piles shall be provided below each jacking point to lift the transformer. Top level of jacking pad should be at the same level of skid wall. Steel plates shall be inserted at the top of jacking pad.

The entire concrete surface of the bund and the transformer base which is not buried shall receive two coats of bitumastic paint. Skids shall receive 3 coats of bitumastic paint before being cast in.

Carriage way is required to be provided with rail connected to all transformer bases. Transformer shall be anchored in such a manner so that it can prevent the movement of transformer for 0.2G ground acceleration.

12B.3.25 Blast Walls

The Bidder shall construct blast walls to reduce the risk of fire spreading from each three phase transformer unit to an adjacent transformer unit or control building. Blast walls shall also be constructed to resist impact forces causing from a transformer explosion damaging adjacent equipment.

The height of the blast walls for transformers shall be 500mm higher than the tops of transformer or same height of the tops of the HV bushing (whichever is higher) and 300mm wider at both sides than the width of transformer. The minimum thickness of blast walls shall be 200mm.

The blast wall will be constructed with Class A reinforced concrete with all exposed edges chamfered, Surface of wall will fare faced concrete and painted as the colour of transformer body.

12B.3.26 Paints and Painting

All paints shall be of approved makes and colours and proven suitability for the prevailing climate and shall be approved by the Engineer. All surfaces for painting shall be cleaned down prior to being painted and rubbed down to a smooth finish.

All externally exposed concrete and render of the buildings, boundary walls and guard posts shall be painted with a fungicide, Snowcem primer and two coats of Snowcem. All exposed facing bricks and Snowcem painted surfaces shall be treated with one coat of clear silicone (5%) water proofing solution.

All exposed parts of foundations, the outer faces of cable trenches and cable tunnels shall be painted with two coats of bitumastic paint.

All ungalvanized metalwork shall receive two coats of red oxide paint at least 4 days before installation and shall receive two finishing coats of paint after installation, each coat being of different colour. Surface preparation before painting shall be SA 2.5 or an agreed rust convertor acid shall be used. All galvanized steel, including all brick ties, boundary wall wire supports, crane beams, baseplates and holding down bolts and concrete plinths shall receive two coats of bitumastic paint. Galvanized steel shall not be painted until the surface has weathered.

Internal walls when fully dry shall have the surface rubbed down with sandpaper and be painted with a sealer and 2 finishing coats of plastic emulsion paint before equipment is installed. A further finishing coat shall be applied after completion of installation.

One day shall be allowed for drying of each coat before the next coat is applied.

The interior of all septic tanks and manholes carrying foul sewage shall receive two coats of bitumastic paint.

12B.3.27 Furniture

The Contractor shall supply a complete set of tables, chairs, stools, desks, benches, storage shelves and drawing cabinets as described in the Project Requirements with layout top, for drawing examination, lockable cabinets for spares and test equipment and key boxes in each building. These shall generally be of steel of local manufacture and shall be of robust durable construction. In each rest room (toilet) two couches, approximately 900mm wide by 1900mm long with back rests against the wall, shall be provided.

The full details and specification of these materials shall be agreed before purchase. The Contractor shall arrange for a list of items to be handed over to the Employer, who will sign for receipt of a complete set as stated on the list.

12B.3.28 Concrete

Only two grades of concrete shall be used. Class A shall be used for all structural work, piling and for all foundations. Class B concrete shall be used for blinding, pipe surround and unreinforced or nominally reinforced concrete. Road slabs and floor slabs shall all be Class A reinforced concrete.

	Class A	Class B
Min Cement Content	360kg/m^3	170kg/m^3
Max Water Cement ratio	0.55	-
Coarse Aggregate type	Broken stone	Jhama brick
Max Coarse aggregate size	20mm (40mm piling)	25mm
Method of Batching	Volume batching	Volume batching
Min Characteristic of Trial Mix at 28 days	30N/mm2	-
Min characteristic strength of trial mix at 7 days	14N/mm2	-
Min characteristic strength of works cubes at 28 days	20N/mm2	-
Slump Range	30mm min-100mm max	50mm min

Slump for concrete placed below water in piling	150mm min

It should be noted that minimum specified cement content will produce significantly stronger concrete. The Contractor's design shall be based on a 28 day crushing strength of 20N/mm^2. Design shall be in accordance with this Contract and BS 8110 or other agreed standard.

For all types of foundation work high tensile steel shall be used (minimum characteristic strength 415 N/mm^2) and minimum reinforcement required for pedestals and foundation bases shall be 0.5% and 0.13% of gross cross sectional area respectively.

Minimum cover to rebars shall be 60mm where concrete is in contact with backfilled soil against a shuttered face, 100mm where concrete is cast against soil, and 30mm for all above ground concrete. In detailing bars which traverse a member, a reduction of 5mm shall be made for a bent bar and 10mm for a straight bar to ensure adequate cover. Exposed ends of sunshades and roof projection shall have 70mm minimum cover.

All concrete design shall ensure easy access for vibrators of 50mm minimum diameter. Because of the slowness of concreting using local methods of transport, congested reinforcement details and shapes which are difficult to concrete should not be used. The location of all cold joints shall be agreed in writing with the Engineer and all joint surfaces shall be scrabbled. All joints shall be horizontal or formed against vertical stop ends. All cold joints shall be indicated on drawings. Roof slabs shall generally be cast in one continuous operation. Where curing compounds are used to protect exposed surfaces from solar radiation and improve moisture retention, they shall be subject to the approval of the Employer. This is a **Hold Point**.

12B.3.29 Concrete Reinforcement

The Contractor may use locally available mild steel bars from approved sources or import steel bars to any agreed standard. No bar or stirrup shall be smaller than 6mm diameter to ensure adequate rigidity during concreting.

If locally purchased bars are used, bending tests and tensile tests shall be carried out to ensure the bars meet the design standard adopted and weight per unit length shall be tested regularly.

Bar bending lists shall generally be shown on drawings, where possible with a diagrammatic representation of each bar to ensure clarity and ease site communication. The Engineer will not systematically check the accuracy of every bar on bar lists when approving drawings. The Contractor shall therefore arrange to check all bar lists. Drawings shall detail all chairs and ties and include these on bar lists.

Bars shall be tied at every intersection and the ends of tie wire bent away from concrete surfaces.

Anti crack bars shall be provided at changes in slab or wall thickness and at the corners of every rectangular opening.

12B.3.30 External Render

All brickwork which is not faced with facing bricks shall be rendered. Concrete columns and walls shall be rendered and painted in accordance with BS 5262 with a 3mm spatterdash coat a 12mm undercoat followed by a 9mm finishing coat. Surface preparation shall be as described in BS 5262. Joints shall be provided in all render where brickwork panels abut concrete columns and grade beams, as required by BS 5262.

A mix type II or III shall generally be used. The finishing coat shall be weaker than the undercoat.

The tops of all foundation blocks and all protruding concrete foundations shall also be rendered where required by the Engineer.

PVA Bonding agents shall not be used because of the risk of early drying in the tropics. All concrete surfaces to be rendered shall have the entire surface scabbled and brushed with a stiff brush to remove all loose material. The surface of the undercoat shall be roughened to ensure bonding of the finishing coat.

All render once completed shall be kept continuously damp for 10 days, after which if shall be treated with a fungicide. Any existing backgrounds shall be treated with a fungicide and all growth cleaned after 5 days of contact with the fungicide.

12B.3.31 Lifting Beams

In substation buildings a galvanised steel lifting beam shall be provided for hoisting equipment to all upper floors. The beam shall be fixed permanently in place and shall project the required distance from the building to lift the largest equipment from road transport. Beams shall be designed in accordance with BS 2853 and deflection shall be limited to 1/900th of span. An approved (Morris of Loughborough 190 Series with Morris 164 travelling trolley or similar approved) hand chain hoist with hand geared travel and travelling trolley of capacity to suit the heaviest equipment or future equipment shall be provided on each beam. The chains shall reach to lorry level and provision shall be made to hang up the chains to one side when not in use.

Inward opening doors shall close around the beam and be shaped to a close fit.

12B.3.32 Stairs

Except where indicated otherwise in the schedules, all single/multi storey buildings shall have an internal/external staircase up to the roof; the minimum staircase clear width shall be 2.2 metre and the maximum slope about 33˚, all detail being designed in accordance with BS

5395. These staircases shall be enclosed. The design shall allow free circulation of air over the treads and through the risers. Non slip nosings shall be provided.

GIS building shall have one internal and one external staircase for fire escape, which shall have a minimum clear width of 2.5 metre with a maximum slope of 30˚, all detailed in accordance with BS 5395. External/fire staircases shall be enclosed and shall be completely protected against rain by roof projections; steps shall be open with non slip nosings. All staircases shall have homogeneous floor tiles with non-slip nosings. All staircases shall be provided with stainless steel railings (38mm dia. for vertical railing & 50mm dia for horizontal railing). In GIS building, provision for a lift of capacity of 6 persons should be provided.

All roofs which are not accessible by stairs shall be provided with a galvanised steel fixed ladder.

12B.4 CONCRETE WORKMANSHIP

12B.4.1 General

At all stages in the production, mixing, placing and curing of concrete, the work will be inspected by the Engineer's representative. If any material, dimension or practice is not at least equal to the standards set out herein, it shall be rejected and alternatives compliant with the said standards, and in addition to the satisfaction of the Engineer, shall be implemented.

12B.4.2 Aggregates

Coarse aggregate shall be capable of passing through a 20mm sieve and be retained on a 5mm sieve. Fine aggregate shall be not larger than 5mm and not smaller than 0.06mm and shall be sharp in texture.

All aggregates shall be free of harmful quantities of organic impurities, clay, silt, salt or unsound particles. The amount of clay, silt and fine dust present in aggregate, whether as coatings or separate particles, may not be more than:

15% by weight in crushed sand
3% by weight in natural or crushed gravel sand
1% by weight in coarse aggregate.

If the Engineer considers that any aggregate which the Contractor proposes to use contains an excess of fine particles or any harmful substances, the Contractor shall either replace the aggregate or, at his option and entirely at his expense, institute a series of approved tests at an approved laboratory to determine the nature and extent of the fine particles and harmful substances. Following receipt by the Engineer of the results of the analysis and tests, he will advise the Contractor in writing whether the proposed aggregate may or may not be used. The Engineer's decision in this respect shall be final.

Tests to determine the extent of impurities or fine particles shall include (but shall not be restricted to) the relevant tests specified in BS 882:1992, ASTM. C40-79 (Colormetric test) and ASTM. C33-82.

12B.4.3 Sampling

At least four weeks before he envisages first receiving aggregate from any source the Contractor, in the presence of the Engineer, shall obtain samples for testing. Samples shall be taken in accordance with the procedure quantities laid down in BS 812 and shall be subjected to those tests which the Engineer considers necessary to demonstrate the soundness of the material.

Such tests shall be carried out in an approved manner at the Contractor's expense and may include the manufacture, both in the laboratory and at site, of test cubes or cylinders to determine crushing strength.

12B.4.4 Grading

The Contractor shall ensure that his offer includes the full cost of obtaining and transporting suitably graded stone aggregates to site.

Grading of aggregates should, together with the required minimum cement content and water cement ratio, ensure adequate durability, density and characteristic strength of the finished concrete. The Contractor shall submit in writing to the Engineer the make up of the mix he proposes to use, together with the grading analysis for the particular material and any details concerning his or others' experience with the use of aggregate obtained from the same source.

12B.4.5 Cement

Portland Composite Cement shall comply with BS 12. The Contractor may obtain cement, bagged or in bulk, from any approved source in Bangladesh but shall always submit sufficient samples from each delivery, as required by the Engineer, to ensure that all cement complies with the minimum requirements of BS 12. All cement shall be stored in a weathertight shed at least 300mm off the floor. Regular checks shall be made on the weight of cement in each bag.

12B.4.6 Water

All water used in the preparation of concrete for foundations shall be clean, fit for drinking and free from all earth, vegetable matter and alkaline substances, whether in solution or in suspension, and shall comply with BS 3148.

12B.4.7 Reinforcing

Where reinforcing is specified in any foundation design, it shall comply with BS 4449 or an approved similar standard. Before any reinforcing is used, the Contractor shall provide the Engineer with a certified mill certificate, verifying its grade and quality, and proof test such samples as the Engineer considers necessary. All reinforcement shall be clean and free from loose mill scale, dust, loose rust and paint, oil or any other coating which in the opinion of the Engineer may destroy or reduce bond.

12B.4.8 Storage

The Contractor shall ensure that all the materials he provides for the preparation of concrete shall be stored in a manner which prevents contamination by dust, clay, water or any other harmful material.

Heaps of coarse and fine aggregate shall be separated by at least one metre.

Where aggregate is tipped directly onto the ground, the bottom 20cm of the heaps shall not be used. Bagged cement shall be protected from rain, mixing water or damp soil during storage/transport. Cement from accidentally split or damaged bags shall not be used.

Where the Engineer considers it necessary, special precautions shall be taken to ensure that aggregate stored on site shall remain dust free. Such precautions may include the bagging of aggregate at the pit if sites are adjacent to dusty roads or if heavy rain is liable to wash out fine material or saturate the aggregate to an extent which might influence the water content of a mix.

Where the Contractor establishes central depots for receiving cement prior to dispatch to individual sites, he shall ensure that the cement storage areas are sufficiently raised above the surrounding ground to prevent contamination of the cement by surface water. The material from which storage plinths are made shall be approved by the Engineer.

12B.4.9 Design Mix

Prior to ordering any aggregate the Contractor shall inform the Engineer of the source(s) of his aggregates and deliver samples to the Engineer. The Contractor will authorise at an approved laboratory tests to show the sieve analyses, relative densities, moisture content of the samples of aggregate from each source. At least four test specimens of concrete shall be mixed at an approved laboratory and tested after 7 and 28 days. The contractor shall be entirely responsible for the control of the quality of concrete mixed and placed. Before the commencement of any concrete design mix, the Contractor shall submit to the Engineer the details of the material used, source of the supply, storage and quality control requirements, including preliminary trail mixes and works' tests. This is a **Hold Point**.

Depending on the moisture content of the samples of aggregate the Contractor will report to the Engineer on the expected water/cement ratio and the aggregate/cement ratio of concrete to be produced on site.

Following the successful testing of the laboratory samples the Contractor shall make trial mixes at site (from which he will take at least 4 test specimens) using the proportions advised to the Engineer (and in the presence of the Engineer) and using the equipment he intends to use in the normal day to day manufacturing of concrete. This is a **Hold Point**. The minimum 28 day crushing strength of any such test specimen shall be not less than 20N/mm2.

After successful testing of the test specimens made at site, the Engineer may then approve the source(s) of aggregate and the mix design.

No changes to the approved mix design will be permitted unless the type or source of aggregate differs from those already tested, in which case further tests at both the laboratory and at site will be made.

Any concrete placed which does not conform to the approved mix designs, shall be removed and replaced by the Contractor at his own cost.

12B.4.10 Mixing and Placing of Concrete

Proportions of aggregates and cement and the quantity of water for each batch of concrete shall be closely monitored by an experienced mixer operator. Aggregate shall preferably be weight batched but, where this is not possible, volume batching shall be permitted, provided that the net volumes of the loading equipment are approved by the Engineer. Containers for measuring quantities of water shall be clearly marked and only approved quantities of water shall be used in the manufacture of concrete.

Mechanical mixers shall be in good condition and well maintained. After loading, the constituent parts of the concrete shall be mixed together for a period of not less than two minutes or 30 revolutions of the barrel, whichever is the greater. For mixers with a capacity greater than 1.5m3 these periods may be increased if the Engineer so requires.

When the constituents are adequately mixed, the fresh concrete shall be discharged from the mixer and placed in the foundation with the minimum of delay. Chutes shall be used to ensure that fresh concrete is not dropped by more than 1.5 metres.

No concrete shall be placed until all form work, installation of parts to be embedded, and preparation of surfaces involved in the placing have been approved. No concrete shall be placed in or through water, except with the written permission of the Engineer, and the method of depositing such concrete shall be approved by the Engineer. Concrete shall not be placed in running water and shall not be subjected to the action of running water until after the concrete has hardened for seven days. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed, mud or other foreign material, shall be cleaned of all such refuse before the surrounding or adjacent concrete is placed. Immediately before placing concrete, all surfaces of foundations upon or against which the concrete is to be placed shall be free from standing water, mud and other foreign matter. The surfaces of concrete which have set, and against which new concrete is to be poured, shall be thoroughly cleaned to remove all foreign material and laitance, and be saturated with water immediately before placing concrete. Concrete shall be deposited continuously and as rapidly as possible until the unit being poured is complete. If for any reason the work is stopped before completing the unit of operation, a construction joint shall be installed in accordance with the instructions of the Engineer. Concrete shall be so deposited as to maintain, until the completion of a unit, a plastic surface approximately horizontal.

The method and equipment used for transporting concrete shall be such that concrete having the required composition and consistency will be delivered as near as practical to its final

position without segregation or loss of slump. All concrete mixing and placing equipment and methods shall be subject to approval by the Engineer. Concrete placement will not be permitted when, in the opinion of the Engineer, weather conditions or other pertinent factors prevent proper placement and consolidation.

Bidders are reminded that, as a minimum standard, the following series of inspections should be carried out by the Contractor before concreting can begin:

1 Formwork coated with mould oil and correct in type, quantity and condition

2 Centre lines of template to coincide at the centre peg

3 Formwork to be well strutted and correctly located

4 Vibrator to be in working order

5 Mixer to be in working order

6 There is provision to maintain continuous mixing and pouring, by hand if necessary, in the event of a mixer breaking down

7 Where necessary, re-bar is on site ready bent and complete with tie wire, stirrups and concrete or plastic preformed spacer packs

8 A reliable level is at hand

9 There is sufficient aggregate, cement and water to complete the pour

10 Excavations are safe and not cluttered around the top edges

11 The mixer barrel is clean, and the paddles are complete and in place and the barrel will rotate at the speed specified by the Manufacturer

12 A suitable chute is in place

13 Both an air thermometer and concrete thermometer are on site

14 There is a large quantity of hessian sacking at hand

Where any of the above items are not complied with, the Engineer may suspend concreting pending their implementation.

12B.4.11 Testing of Concrete

Samples shall be taken and tested in accordance with BS 1881. Testing shall be carried out by an approved laboratory, who shall arrange to immediately notify the Contractor and the Employer in writing of any cube failure. Failed cubes shall be kept for reference.

Concrete for the test specimens shall be taken at the point of deposit. To ensure that the specimens are representative of the concrete, a number of samples shall be taken from different points. Each sample shall be large enough to make one test specimen and shall be taken from one point in the work.

The tests specimens shall be stored at the site at a place free from vibration, under damp sacks for 24 hours + 1/2 hour, after which time they shall be removed from the moulds, marked and stored in water at a temperature of 10 to 21°C until the test date. Specimens which are to be sent to a laboratory for testing shall be packed for transit in damp sand or other suitable damp material, and shall reach the laboratory at least 24 hours before test. On arrival at the laboratory, they shall be similarly stored in water until the date of the test.

One compression plate of the testing machine shall be provided with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central point of the face of the plate. Test specimens shall be placed in the machine in such a manner that the load is applied to the sides of the specimen as cast.

Cube strengths for concrete are to be not less than 14N/mm2 within seven days after mixing and 20N/mm2 within 28 days after mixing.

One cube shall be tested at 7 days to obtain an indication of the concrete strength. The remaining three cubes shall be tested at 28 days and the average of their strengths shall be calculated. Should the average of the cube strengths fall below the specified 28 days cube strength, the Engineer may order the affected concrete to be removed and replaced at the Contractor's expense, or the Engineer may allow the Contractor to take a cylinder for further testing in accordance with BS 1881, if Schmidt Hammer readings indicate below strength concrete.

The diameter of the cylinder shall be not less than three times the size of the maximum aggregate and its length will be at least double the diameter, after allowing for preparation and facing prior to the test. Both a report and compression test will be completed for the sample in accordance with BS 1881. Only one such test will be permitted from any one sample and if the crushing strength of the sample is in excess of that required by the design the Engineer may, after the Contractor has made suitable repairs to the part disturbed by taking the sample, accept the concrete.

In addition to cube sampling, 30% of concrete pours shall be tested by Schmidt Hammer. The Contractor is to pay for all remedial work and testing. Readings shall be taken at locations agreed with the Engineer and shall be witnessed by the Engineer. At least 15 readings shall be taken such that, after discarding the highest and lowest, some 12 readings remain from which the mean shall be calculated. Readings shall be restricted to the middle third of a beam, slab or column and shall not be closer than 50mm to an edge or closer than 50mm to any other readings. Immediately on completion of hammer testing, the concrete surface shall be painted to seal it with two coats of snowcem primer.

12B.4.12 Formwork

Formwork shall conform to the shape, lines and dimensions of the concrete as called for on the Plans and shall be sufficiently strong to carry the dead weight of the concrete without undue deflection or bulging, and sufficiently tight to prevent leakage of mortar. It shall be properly braced and tied together so as to maintain position and shape. Members used in forms at exposed surfaces shall be dressed to uniform thickness and shall be free from loose knots or other defects. Joints in forms shall be horizontal or vertical. At all unexposed surfaces and rough work, undressed timber may be used. Timber reused in shutters shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned before being reused. Formwork shall not be disturbed until a minimum of 48 hours has passed from time of placement and concrete has hardened sufficiently to support any construction loads that may be imposed. When stripping forms, metal wedges or tools shall not be used to pry panels loose. If wedging is necessary, it shall be done with wood wedges lightly tapped to break adhesion. All columns and beams will have exposed edges chamfered 20 mm x 20mm.

12B.4.13 Reinforcing Steel

Steel reinforcing bars shall be positioned in the concrete at the places shown on the drawings, or where reasonably directed by the Engineer.

Before reinforcing bars are placed in position, surfaces shall be cleaned of heavy flaky rust, loose mill scale, dirt, grease and all foreign matter. Once in position, reinforcing bars shall be maintained in a clean condition until they are completely embedded in concrete. Reinforcing bars shall have at least the minimum concrete cover shown on the drawings. Reinforcing bars shall be accurately placed and secured in position, such that they will not move during placing of concrete. Precast concrete block spacers may be used for supporting reinforcing bars.

12B.4.14 Consolidation of Concrete

Concrete shall be consolidated to maximum practical density, without segregation, by vibration so that it is free from pockets of coarse aggregate and closes against all surfaces and embedded materials. Vibration of concrete in structures shall be by electric or pneumatic-driven immersion type vibrators of 50mm minimum diameter, operating at speeds of at least 8,000rpm when immersed in concrete. The vibrator shall be inserted vertically at close enough intervals so that the zones of influence overlap. The vibrator shall be inserted to the full depth of the layer being treated and withdrawn slowly. When concrete is being placed in layers, the tip of the vibrator shall extend approximately 100mm into the underlying layer. Vibrators shall not be used to move concrete horizontally. Care shall be exercised to avoid over-vibration of the concrete and direct contact between the vibrator and reinforcing shall be avoided.

12B.4.15 Curing of Concrete

For foundations where excavations are to be backfilled immediately following the striking of shutters, the concrete is to be thoroughly wetted before backfilling commences. Where shutters are to be struck and backfilling of the excavation is not to take place immediately, the concrete is

to be covered with wetted hessian sacking and be enclosed in polythene sheeting to avoid rapid drying of the concrete.

12B.4.16 Hot Weather Concreting

In hot weather the following additional precautions shall be taken.

(a) In hot weather suitable means shall be provided to shield the aggregate stockpiles from the direct rays of the sun or to cool the mixing water/aggregates to ensure that the temperature of the concrete when deposited shall not exceed 32°C.

(b) In hot dry weather suitable means shall be provided to avoid premature stiffening of concrete placed in contact with hot dry surfaces. Where necessary the surfaces, including reinforcement, against which the concrete is to be placed shall be shielded from the rays of the sun and shall be sprayed with water to prevent excessive absorption by the surfaces of water from the final concrete.

12B.5 WORKMANSHIP OF ALL OTHER MATERIALS

This specification only describes concrete work in detail. All other materials workmanship shall be in accordance with an agreed standard. Before starting any new item of work the Contractor shall submit samples of the materials to the Engineer for approval in writing and the method of installation shall also be approved. The first item of any type to be installed shall be inspected and checked in detail by the Engineer before other items are constructed.

The contractor shall submit to the Engineer a comprehensive method statement giving sequential details of his proposed installation method and include his intended program. The method of statement shall include the following details, but not limited;

(a) Method of excavation and dealing with water
(b) Method of pre-heating, welding and site bending of reinforcement
(c) Method of placing of concrete
(d) Method of curing and protecting the concrete
(e) Method of backfilling and compacting
(f) Method of floor finishing
(g) Method of motorized door for GIS entrance
(h) Reinstatement of working areas
(i) Quality control procedure
(j) Site safety procedure

This is a **Hold Point**.

12A.6 Land development work :

The contractor to ensure all necessary requirements to mitigate any nuisance impact and disturbance to the surrounding community during carrying of fill material and the filling work in the proposed sites.·

The contractor to ensure the preservation of topsoil of proposed substation site. In general, the topsoil is fertile and loss of topsoil has a long-term environment impact. Excavate the top soils (minimum 0.5m thick) of the proposed site and storage at suitable corner prior to start filling. After filling the site, the topsoil should be re-spread for using on the open surface, site boundary/road side slopes and in areas to be landscaped.

· Prior to the commencement of construction, the contractor along with the PGCB officials will conduct the joint survey in the proposed substation site to confirm the layout plan and ensure required land area for installation of equipment and construction of civil work (transformers, buildings, access road, transmission structures etc) with necessary clearances for electrical safety**.**

12A.6.1 Land development work shall be carried out by dredged filling material or by carriedearth/viti sand using the following methods:

(c) Land development by dredge filling material:

Land development by dredge filling materials means dredging by cutter suction dredger for collection and direct pumping of dredged fill materials by 18" dia. or more cutter suction dredgers from the pre-selected river bed through pipe line to the proposed fill site in wet and liquefied condition. The dredged material will be placed at site directly and excess water will be removed out of the site. Spreading and compaction of fill material will be carried out in layers. The layer thickness shall be determined on the quality of dredged fill material. Each layer should be compacted to a minimum of 95% optimum density as defined by the Proctor Test.

(d) Land development by carried earth/viti sand:

The responsibility of selecting proper location of collection of fill materials (such as earth/viti sand) will rest on the contractor, subject to the approval of the employer. The contractor shall obtain prior necessary permission from the concerned owner/authority paying royalties, all taxes, duties etc. as per prevailing Govt. / semi Govt. / Autonomous organization rule with the intimation to employer for collecting the required fill material. In this case mini suction dredger can be used to collect fill material from nearby river. The crops compensation resulting from the damage of crops during pipe line installation and any other activities shall be paid by the contractor and the cost deem to be included in the price. All fill shall be compacted in layers not exceeding 150mm deep to a minimum of 95% optimum density as defined by the Proctor Test.

12A.6.2 The quoted rates are inclusive of all the costs for supply of materials and hire charges for equipment and accessories etc. required to execute the works by the Contractor.

12A.6.3 Before land filling, The Contractor has to construct necessary dyke/embankment for protection the developed land.

10.7.4 The rates are inclusive of all the royalties, taxes, VAT, octroi etc. to be paid to Govt. & semi-Govt. Organization or to any person for the earth borrowed from.

10.7.5 If the Contractor uses the land beyond the control of the Employer, the cost/hire charges, octroi etc. so required will be paid by the Contractor for carrying, laying & installation of equipment, tools & pipes etc. over that land.

10.7.6 The Contractor is responsible to obtain the permission/approval from the competent authority for the works as mentioned in clause no. 4 & 5 above.

10.7.7 The Contractor shall execute the pre-work measurements jointly with the representative of Employer for the area to be filled prior to start the land development work.

10.7.8 The Contractor, along with his bid shall furnish the detailed procedure of whole works with a list of manpower, tools & equipment required to execute the same. He shall, if the proposal is by dredged filling also show in the drawing location of the river bed to be dredged and the route of pipe lines from the dredging point to the filling area.

10.7.9 The Contractor shall clean and remove the unspecified & the unsuitable materials which do not mix with the earth at his own cost and responsibility.

The work may be increased or decreased as per site requirement and no extra price escalation by the contractor for such increase of work shall be entertained.

10.7.10 The Contractor will arrange the testing of the samples of the fill materials & compaction tests of developed areas by Laboratory approved by employer. The cost of any or all such tests shall be borne by the Contractor.

10.7.11 The Contractor shall protect & maintain all the materials, equipment etc. against any theft or damage etc. at his own cost until the final executed works are handed over to the Employer.

10.7.12 After 30 days of completion of the land development work, the contractor will arrange the joint survey (Post-work measurement) along with the employer representative. The quantity of land development shall be calculated by the contractor and checked by the employer according to this joint post-work measurement and the pre-work measurement taken prior to start the work (as mentioned in clause no.7). The rates in the schedule are inclusive of all surveys/pre & post-work measurements.

10.7.13 The security of the equipment and materials used and the safety of the personnel engaged in the work shall be at the risk and responsibility of the Contractor.

10.8 Fire Extinguisher :

10.7.1 Control Room/Communication Room/Battery Rooms :

These rooms shall be protected by portable CO_2 fire extinguisher system. The system shall consist of all equipment required for directing the CO_2 gas discharge at a fire including, but not limited to, CO_2 cylinders and necessary piping, a flexible hose along with a jet nozzle. The effective reach of CO_2 gas jet release shall be sufficient to fight small fires that could develop in a control room area. Fire extinguishers shall be placed at strategic locations as per instruction of project engineer. The quantity of extinguisher at each new/upgradation AIS and GIS substation given in Table-1.

10.7.2 Outdoor Switchyard/Cable Room :

These areas shall be protected by portable dry type ABC powder fire extinguisher system. The system shall consist of all equipment required for directing the dry ABC powder discharge at a fire including, but not limited to, a wheel carriage(only for 15kg capacity) loaded with potable cylinders and necessary piping and a flexible hose along with a jet nozzle & pressure gauge. The extinguisher material shall be non-explosive, non-hazardous, non-corrosive, non toxic. The effective reach of jet release shall be sufficient to fight small fires that could develop in an outdoor switchyard, cable room & store room area. Fire extinguishers shall be placed at strategic locations as per instruction of project engineer. In addition sand buckets also shall be provided with a metal frame for hanging buckets and shall be placed at locations directed by project engineer. The quantity of extinguisher at each new substation given in Table-1.

Table-1: The quantity of fire extinguisher shall be provided at each new substation as follows:

Sl No	Description	Quantity
1	CO_2 Type:	
	3kg	5Nos.
	5kg	5 Nos.
2	ABC dry powder type:	
	5kg	6 Nos.
	8kg	4 Nos.
	15kg(including wheel carriage)	3 Nos.
3	Sand bucket with metal frame	One(1)set with 5 buckets

	1 Lot	1 Lot 245kV Gas Insulated Line (GIL) with terminating bushings, complete with support
	1 Lot	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel as appropriate
	1 No.	Local Control Panel
1B2	Three (3) Nos. of 245kV GIS Auto Transformer Feeder Bays, each comprising:	
	1 lot	245kV, 4000A, 50kA/3s, three phase double busbar
	2 Sets.	245kV, 1600A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism
	2 Sets	245kV, 50kA/3s, three phase earth switch complete with motor operating mechanism at both sides of CB
	1 Set	245kV, 1600A, 50kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism
	3 Nos.	245kV, 1600A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 1600/1A, Class X for Busbar Differential Protection and Breaker Failure - 1600/1A, Class 5P20 for Spare - 1600/1A, Class 0.2 for Metering
	3 Nos.	245kV, 1000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 1600/1A, Class 5P20 for Main 1 Protection - 1600/1A, Class 5P20 for Main 2 Protection and Transformer Differential - 1600/1A, Class 5P20 for BCU & DFDR
	1 Sets	245kV, 1600A, 50kA/3s, three phase line disconnector complete with motor operating mechanism
	1 Lot	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements with gas-air bushing, busbar end covers or link to adjacent switchgear panel as appropriate.
	1 No.	Local Control Panel
1B3	One (1) Nos. of 245kV Bus Coupler Bays , each comprising:	
	1 lot	245kV, 4000A, 50kA/3s, three phase double busbar
	2 Sets	245kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism
	2 Sets	245kV, 50kA/3s, three phase earth switch complete with motor operating mechanism, one (1) on either side of circuit breaker.
	1 Set	245kV, 4000A, 50kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism
	3 Nos.	245kV, 4000A, 50kA/3s, single phase, 2-core, current transformer with cores as follows: - 4000/1A, Class X for Busbar Differential Protection - 4000/1A, Class 0.2 for Metering
	3 Nos.	245kV, 4000A, 50kA/3s, single phase, 2-core, current transformers with cores as follows: - 4000/1A, Class X for Busbar Differential Protection and Breaker Failure Protection - 4000/1A, Class 5P20 for BCU & DFDR
	1 Lot	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, busbar end covers or link to adjacent switchgear panel as appropriate
	1 No.	Local Control Panel

system is to be provided for:

- 87 and 21 relays for each transmission line protection (through fiber cores)
- SCADA data from switchgear and control system through SAS
- Hot-line telephone system
- Substation LAN system

Additionally, if any Optical Interfaces are required for system configuration at each remote end substation, then interface devices shall be installed in each existing system.

1M2 PABX extension:

Two sets of subscriber telephone sets with necessary wiring and connection to be installed in SPR.

1M3 Optical Fiber:

Underground optical fiber cables (48 cores for 230kV) from terminal box on gantry of 230kV double circuit transmission line termination point to ODF (Optical Distribution Frame) to be installed in existing 132kV GIS Control Building communication room. The Contract includes supply and installation of ODF and pigtail cables with adequate length.

1N SCADA system for Telecontrol and Telemetering

1N1 One (1) lot of complete set of design, supply, delivery, installation, testing & commissioning of hardware and software to extend the existing equipment (in 132kV GIS Control Building) for the telecontrol & telemetering facilities required at the existing National Load Dispatch Center (NLDC) at Rampura and backup station at Biddyut Bhaban for integration of complete new 230kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. One more Industrial Gateway shall be installed and configured as hot stand-by. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station of NLDC at Rampura & Biddyut Bhaban are to be carried out.

Section-II Mandatory Spares, Erection & Test Equipment

Supply of complete spares and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment as per quantity mentioned in Schedule B. Test equipment to be supplied under this project shall be from Europe, USA, Japan or equivalent origin. The materials shall have to be handed over to the designated store as per instruction of the Employer.

APPENDIX A9-1

Schedule of Technical Requirements for Post Insulator 230 kV

No.	Description	Minimum Requirements	
		Unit	**Data**
1	**Post Insulators - Characteristics**		
1.1	Nominal system voltage	kV_{rms}	230
1.2	Highest voltage for equipment U_n	kV_{rms}	245
1.3	Rated lightning impulse withstand voltage	kV_{peak}	1050
1.4	Rated short duration power frequency voltage	kV	460
1.5	Rated frequency f_r	Hz	50
1.6	Minimum creepage distance	mm/kV	Min. ≥ 25 mm/kV
1.7	Failing load bending (p0) (C10)	N	≥ 10000
1.8	Failing load torsion	Nm	≥ 4000
2	**Post Insulators - Design and Construction**		
2.1	Insulation material		Porcelain, brown
2.2	Material quality acc. IEC 60672		Min. C130

APPENDIX A12

Schedule of Technical Requirements for Surge Arresters

No.	Description	Minimum Requirements		
		Unit	230kV	132kV
1.	Nominal system voltage	kV_{rms}	230	132
2.	Highest voltage for equipment U_n	kV_{rms}	245	145
3.	Rated voltage of surge arrester U_r	kV_{rms}	216	120
4.	Max. continuous operating voltage U_c	kV_{rms}	210	110
5.	Rated frequency	Hz	50	50
6.	Nominal discharge current In (8/20 µs)	kA_{peak}	10	10
7.	High current impulse of an arrester (4/10 µs)	kA_{peak}	100	100
8.	Line discharge class	Class	3	3
9.	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	≥ 6.5
10.	Long duration current impulse (2000 µs)	A	≥ 850	≥ 850
11.	For switching impulse current 30/60 µs at 0,5 kA	kV_{peak}	≤ 375	≤ 235
12.	For switching impulse current 30/60 µs at 1 kA	kV_{peak}	≤ 385	≤ 240
13.	For switching impulse current 30/60 µs at 2 kA	kV_{peak}	≤ 405	≤ 255
14.	For lightning impulse current 8/20 µs at 5 kA	kV_{peak}	≤ 435	≤ 280
15.	For lightning impulse current 8/20 µs at 10 kA	kV_{peak}	≤ 465	≤ 300
16.	For lightning impulse current 8/20 µs at 20 kA	kV_{peak}	≤ 515	≤ 320
17.	Lightning impulse withstand voltage of arrester housing up (1.2/50 µs)	kV	≥ 925	≥ 550
18.	Power frequency withstand voltage of arrester housing (1 min wet)	kV	≥ 425	≥ 250
19.	Specified short-term load SSL (F_{dyn})	N	≥ 2250	≥ 3750
20.	Specified long-term load SSL (F_{stat})	N	≥ 1550	≥ 2500
21.	Minimum creepage distance	mm/kV	≥ 25 mm/kV	≥ 25 mm/kV
22.	Housing insulating material		Composite/Silicon	Composite/Silicon
23.	Insulating basement		Yes	Yes
24.	Surge arrester height	mm	Insert	Insert
25.	Surge arrester weight	kg	Insert	Insert
26.	Voltage distribution ring present / ring diameter	yes / no / mm	Insert	Insert
27.	Shape		Flat	Flat
28.	Dimension	mm x mm	Min 100 x 100	Min 100 x 100
29.	Number of holes		Min 4	Min 4

Schedules of Rates and Prices

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
1B	**230kV GIS Switchyard**								
	230kV Outdoor Type Gas Insulated Switchgear (GIS)								
1B.1	230kV GIS Double Busbar, Line Feeder Bay with Local Control Cubicle and support structure		2	bays					
i	230kV, 4000A Gas Insulated Line (GIL) for double circuit overhead line connection with gas-to-air bushing including support structures [3]		200	m					
1B.2	230kV GIS Double Busbar , Auto Transformer Bay with Local Control Cubicle and support structure		3	bays					
1B.3	230kV GIS Double Busbar , Bus Coupler Bay with Local Control Cubicle and support structure		1	bay					
1B.4	230kV GIS Double Busbar , Bus VT with Busbar ES circuit Bay with Local Control Cubicle and support structure		1	bay					
	245kV Air Insulated Switchgear (AIS)								
1B.5	196kV rated voltage, 160kV(rms) continuous operating voltage at 50^{o}C 10kA, 50Hz, Heavy duty class, metal oxide type, single phase surge arresters with surge counter and support structure		15	nos.					
1B.6	230kV post insulators to be installed between auto transformers and 230kV GIS transformer bays air terminations.		18	nos.					
1B.7	Rigid tubular bus and/or stranded conductors including all accessories for each connections for completing 230kV GIS Switchyard		1	lot					
1B.8	Insulators and fittings including all necessary clamps and connectors as required for completing 230kV GIS Switchyard		1	lot					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
1B.9	Steel gantry for two (2) circuits of 230kV Transmission Line including all necessary accessories as required for completing 230kV GIS Switchyard		1	lot					
1B.10	Steel gantry for overhead circuits between Auto Transformers and 245kV GIS including overhead lines and all necessary accessories as required for completing 230kV GIS Switchyard		1	lot					
	Sub-total 1B								
1C	**132kV Autotransformer to 132kV GIS Connections**								
1C.1	Surge arrester 120kV rated voltage, , 10kA discharge current, gapless metal oxide type, single phase		9	set					
1C.2	**132kV XLPE Power cable**		1600	m					
1C.3	132kV outdoor cable termination		9	set					
1C.4	132kV GIS cable termination		9	set					
1C.5	rigid tubular bus and/or stranded conductors including accessories for of connection of 132kV cables to autotransformers and surge arresters		1	lot					
1C.6	Steel structures for equipment supports including nuts & bolts and cable tray including all necessary fitting & fixing accessories required to complete 132kVcircuits		1	lot					
	Sub-total 1C								
1E	**Power Transformers**								
1E.1	Deleted								
1E.2	230/132/33 kV, 235/300 MVA (ONAN/ONAF), three phase outdoor type auto transformer		3	nos.					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
1E.3	Nitrogen injection Fire protection system for three (3) 230/138/33KV Auto transformers		1	lot					
	Sub-total 1E								
1F	**Control, Protection, Substation Automation and Metering**								
	230kV Circuits								
1F.1	Control, Monitoring, Protection & Substation Automation System for two (2) sets of 230kV overhead line circuits		1	lot					
1F.2	Control, Monitoring, Protection & Substation Automation System for three (3) sets of 230kV auto transformer circuits		1	lot					
1F.3	Control, Monitoring, Protection & Substation Automation System for one (1) sets of 245kV bus coupler bays		1	lot					
1F.4	Control, Monitoring, Protection & Substation Automation System for one (1) lot of 245kV busbars		1	lot					
1F.5	Tariff metering for 230kV system		1	lot					
1F.6	Digital Fault and Disturbance recorder (DFDR)		1	set					
	Sub-total 1F								
1G	**Multicore Cables**								
1G.1	Multicore low voltage power and control cables for control, protection, metering, monitoring and L/V power circuits		1	lot					
	Sub-total 1G								
1H	**Earthing and Lightning Protection**								
1H.1	Earthing and Lightning Protection		1	lot					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
1H.2	Portable(maintenance) earthing equipment device		2	sets					
	Sub-total 1H								
1I	**Batteries, chargers & DC distribution**								
1I.1	110V Ni-cad Batteries with chargers and distribution boards								
i	110V Ni-cad Batteries, 150Ah @ 5h		1	set					
ii	Battery charger 110V, 50A		1	set					
iii	DC Distribution Board		1	set					
	Sub-total 1I								
1J	**LVAC Distribution**								
1J.1	LVAC switchboard for substation services		1	lot					
	Sub-total 1J								
1K	**Civil Works, Building and Foundation**								
1K.1	Identification and relocation control and protection cables for existing 33kV feeders		1	lot					
1K.2	Dismantling and removal of the existing 132kV substation equipment		1	lot					
1K.3	Complete outdoor civil works excluding SPR Building								
i	Outdoor gantry foundation 230kV switchyard		1	lot					
ii	Outdoor equipment foundation 230kV switchyard		1	lot					
iii	Transformer foundation including oilpit & carrage way		1	lot					
iv	Blast wall		1	lot					
v	Internal road 6m wide		200	m					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
vi	Surface draining		1	lot					
vii	Cable trench		1	lot					
viii	Switchyard surface finishing, drainage system including surface drain		1	lot					
ix	Gravel laying		1	lot					
x	Septic tank, soakaway		1	lot					
1K.4	SPR Building								
i	Foundation works		1	lot					
ii	Super structures		1	lot					
iii	All finish works		1	lot					
1K.5	Fire alarm & fire fighting system		1	lot					
	Sub-total 1K								
1L	**Lighting, small power, air conditioning and Ventilation**								
1L.1	Lighting, small power, air conditioning and Ventilation and emergency DC lighting for SPR Building		1	lot					
1L.2	Lighting for ouside buildings for security, roadway, switchyard and emergency DC lighting including steel poles (H=6m)		1	lot					
	Sub-total 1L								
1M	**Fiber Optic Multiplexer Equipment for Communication and Protection**								
1M.1	Extension of existing Fibre Optic Multipexer Equipment		1	lot					
1M.2	Extension of exisiting PABX with subscriber telephone sets		1	lot					
1M.3	Fibre Optic cable and termination box		1	lot					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
	Sub-total 1M								
1N	**SCADA system for Telecontrol and Telemetering**								
1N.1	Complete SCADA hardware & software		1	lot					
	Sub-total 1N								
2	**Mandatory Spares**								
2.1	**245kV Gas Insulated Switchgear**								
2.1.1	245kV Circuit Breaker								
2.1.1.1	Operating mechanism for circuit breaker		2	nos.					
2.1.1.2	Each type of closing coils and opening coils		15	nos.					
2.1.1.3	Each type of auxiliary contacts unit		3	nos.					
2.1.2	245kV Disconnectors and Earthing Switches								
2.1.2.1	Operating mechanism for disconnector		2	nos.					
2.1.2.2	Mechnical drive for high speed earthing switch		1	no.					
2.1.3	245kV Current Transformer								
2.1.3.1	Cores of each rating and each class		1	set					
2.1.4	245kV Voltage Transformer								
2.1.4.1	Winding of each rating and each class		1	set					
2.1.5	Special tools / instruments for operation and maintenance								
2.1.5.1	Special tools / instruments for operation and maintenance (To be listed up by Bidder)		1	set					
2.2.	**245kV Outdoor equipment**								

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
2.2.1	Complete set of 196kV Surge Arrester		1	set					
2.3.	**145kV Outdoor equipment**								
2.3.1	Complete set of 120kV Surge Arrester		1	set					
2.3.2	132kV outdoor cable termination		1	set					
2.3.3	132kV GIS cable termination		1	set					
2.4	**Protection and Control**								
2.4.1	Each type of Protection relay and AVR		1	set					
2.4.2	Each type of Tripping relays		2	sets					
2.4.3	Each type of Auxiliary relays		5	sets					
2.4.4	Each type of Trip circuit supervision relays		1	set					
2.4.5	Each type of Bay Control Unit		1	set					
2.4.6	Each type of Switch (if applicable)		1	set					
2.4.7	Each type of MCB		1	set					
2.4.8	Each type of Lamps		10	sets					
2.4.9	Industrial PC		1	set					
2.4.10	Gateway Terminal		1	set					
2.4.11	Bay Ethernet Switches		2	nos.					
2.4.12	Optical connectors (one for each)		1	lot					
2.5	**DC & Charger Equipment**								
2.5.1	Each type of Printed Circuit Board		1	lot					

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
2.5.2	Circuit breaker of each type and rating (Bidder to list all types)		1	lot					
2.6	**LVAC Equipment**								
2.6.1	Circuit breaker of each type and rating (Bidder to list all types)		1	lot					
2.7	**Power, Control and Auxiliary Cables**								
2.7.1	Power Cable (132kV)		300	m					
2.7.2	Control Cables, 200m of each type		1	lot					
2.7.3	LV cables, 200m of each type		1	lot					
2.7.4	Other cables (communication, etc.), 100m of each type		1	lot					
2.8	**Transformers**								
2.8.1	Auto Transformer								
2.8.1.1	Set of gaskets		1	no.					
2.8.1.2	Set of dial type thermometer with gaskets		1	no.					
2.8.1.3	Set of thermal image type indicator with gaskets		1	no.					
2.8.1.4	Set of Silica gel breather		1	no.					
2.8.1.5	Buchholz relay		1	no.					
2.8.1.6	Set of tap changer diverter switch		1	no.					
2.8.1.7	Tap changer control mechanism motor		1	no.					
2.8.1.8	Transformer oil 200 litter barrel		10	nos.					
2.9	**Instruments for Communication & SCADA**								

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
			(1)			Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
2.9.1	Digital data (Communication) analyzer		1	lot					
2.9.2	Generator and Receiver for the following interfaces: (1) V.24/RS232 SYNC AND ASYNC (2) V.35 (3) G.703 CO-DIR AND 2048kbps and 704kbps (4) Bit Error rate measuring facility		1	lot					
2.9.3	Digital selective level meter (50Hz to 600kHz) plus level generator (50Hz to 2MHz)		1	lot					
2.9.4	Subscriber Module for DCS 255 Exchange		1	lot					
2.10	**Post Type Insulator**								
2.10.2	For 245kV		3	nos.					
2.11	**Gas Insulated Line (GIL)**								
2.11.1	245kV, 4000A, GIL		25	m					
2.12	**Disc Insulator**								
2.12.1	Each type of Disc Insulator		20	nos.					
2.13	**Conductor**								
2.13.1	Each type of Bus Conductor		25	m					
2.13.2	Each size of Rigid Tubular Conductor		10	m					
2.14	**Clamp and Fitting**								
2.14.1	Each type of Clamps and Fittings		6	nos.					
	Sub-total 2								
TOTAL OF SCHEDULE NO.1 (To be indicated in Schedule No.6 Grand Summary)					Foreign Currency				
					Local Currency (Taka)				

Schedule No. 1. Plant and Mandatory Spare Parts Supplied from Abroad

(In case of any item will be supplied from within the Employer's Country, please select these items and indicate their prices in the Schedule No.2.)

Item	Description	Code[1]	Qty.	Unit	Currency	Unit Price[2]		Total Price[2]	
						CIP		*CIP*	
						Foreign	*Local (Taka)*	Foreign	*Local (Taka)*
			(1)			*(2)*	*(3)*	*(1) x (2)*	*(1) x (3)*

[1] Bidders shall enter a code representing the country of origin of all imported plant and equipment.

[2] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

[3] Estimated length of GIL shall be specified. Actual length of GIL shall be finalized during execution stage and payment shall be based on actual one.

Schedules of Rates and Prices

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
1B	**230kV GIS Switchyard**							
	230kV Outdoor Type Gas Insulated Switchgear (GIS)							
1B.1	230kV GIS Double Busbar, Line Feeder Bay with Local Control Cubicle and support structure		2	bays				
i	230kV, 4000A Gas Insulated Line (GIL) for double circuit overhead line connection with gas-to-air bushing including support structures [3]		200	m				
1B.2	230kV GIS Double Busbar , Auto Transformer Bay with Local Control Cubicle and support structure		3	bays				
1B.3	230kV GIS Double Busbar , Bus Coupler Bay with Local Control Cubicle and support structure		1	bay				
1B.4	230kV GIS Double Busbar , Bus VT with Busbar ES circuit Bay with Local Control Cubicle and support structure		1	bay				
	245kV Air Insulated Switchgear (AIS)							
1B.5	196kV rated voltage, 160kV(rms) continuous operating voltage at 50°C 10kA, 50Hz, Heavy duty class, metal oxide type, single		15	nos.				
1B.6	230kV post insulators to be installed between auto transformers and 230kV GIS transformer bays air terminations.		18	nos.				
1B.7	Rigid tubular bus and/or stranded conductors including all accessories for each connections for completing 230kV GIS		1	lot				
1B.8	Insulators and fittings including all necessary clamps and connectors as required for completing 230kV GIS Switchyard		1	lot				
1B.9	Steel gantry for two (2) circuits of 230kV Transmission Line including all necessary accessories as required for completing 230kV GIS Switchyard		1	lot				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
1B.10	Steel gantry for overhead circuits between Auto Transformers and 245kV GIS including overhead lines and all necessary accessories as required for completing 230kV GIS Switchyard		1	lot				
	Sub-total 1B							
1C	**132kV Autotransformer to 132kV GIS Connections**							
1C.1	Surge arrester 120kV rated voltage, , 10kA discharge current, gapless metal oxide type, single phase		9	set				
1C.2	**132kV XLPE Power cable**		1600	m				
1C.3	132kV outdoor cable termination		9	set				
1C.4	132kV GIS cable termination		9	set				
1C.5	rigid tubular bus and/or stranded conductors including accessories for of connection of 132kV cables to autotransformers and surge arresters		1	lot				
1C.6	Steel structures for equipment supports including nuts & bolts and cable tray including all necessary fitting & fixing accessories required to complete 132kVcircuits		1	lot				
	Sub-total 1C							
1E	**Power Transformers**							
1E.1	Deleted							
1E.2	230/132/33 kV, 235/300 MVA (ONAN/ONAF), three phase outdoor type auto transformer		3	nos.				
1E.3	Nitrogen injection Fire protection system for three (3) 230/138/33KV Auto transformers		1	lot				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
	Sub-total 1E							
1F	**Control, Protection, Substation Automation and Metering**							
	230kV Circuits							
1F.1	Control, Monitoring, Protection & Substation Automation System for two (2) sets of 230kV overhead line circuits		1	lot				
1F.2	Control, Monitoring, Protection & Substation Automation System for three (3) sets of 230kV auto transformer circuits		1	lot				
1F.3	Control, Monitoring, Protection & Substation Automation System for one (1) sets of 245kV bus coupler bays		1	lot				
1F.4	Control, Monitoring, Protection & Substation Automation System for one (1) lot of 245kV busbars		1	lot				
1F.5	Tariff metering for 230kV system		1	lot				
1F.6	Digital Fault and Disturbance recorder (DFDR)		1	set				
	Sub-total 1F							
1G	**Multicore Cables**							
1G.1	Multicore low voltage power and control cables for control, protection, metering, monitoring and L/V power circuits		1	lot				
	Sub-total 1G							
1H	**Earthing and Lightning Protection**							

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
1H.1	Earthing and Lightning Protection		1	lot				
1H.2	Portable(maintenance) earthing equipment device		2	sets				
	Sub-total 1H							
1I	**Batteries, chargers & DC distribution**							
1I.1	110V Ni-cad Batteries with chargers and distribution boards							
i	110V Ni-cad Batteries, 150Ah @ 5h		1	set				
ii	Battery charger 110V, 50A		1	set				
iii	DC Distribution Board		1	set				
	Sub-total 1I							
1J	**LVAC Distribution**							
1J.1	LVAC switchboard for substation services		1	lot				
	Sub-total 1J							
1K	**Civil Works, Building and Foundation**							
1K.1	Identification and relocation control and protection cables for existing 33kV feeders		1	lot				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
1K.2	Dismantling and removal of the existing 132kV substation equipment		1	lot				
1K.3	Complete outdoor civil works excluding SPR Building							
i	Outdoor gantry foundation 230kV switchyard		1	lot				
ii	Outdoor equipment foundation 230kV switchyard		1	lot				
iii	Transformer foundation including oilpit & carrage way		1	lot				
iv	Blast wall		1	lot				
v	Internal road 6m wide		200	m				
vi	Surface draining		1	lot				
vii	Cable trench		1	lot				
viii	Switchyard surface finishing, drainage system including surface drain		1	lot				
ix	Gravel laying		1	lot				
x	Septic tank, soakaway		1	lot				
1K.4	SPR Building							
i	Foundation works		1	lot				
ii	Super structures		1	lot				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
iii	All finish works		1	lot				
1K.5	Fire alarm & fire fighting system		1	lot				
	Sub-total 1K							
1L	**Lighting, small power, air conditioning and Ventilation**							
1L.1	Lighting, small power, air conditioning and Ventilation and emergency DC lighting for SPR Building		1	lot				
1L.2	Lighting for ouside buildings for security, roadway, switchyard and emergency DC lighting including steel poles (H=6m)		1	lot				
	Sub-total 1L							
1M	**Fiber Optic Multiplexer Equipment for Communication and Protection**							
1M.1	Extension of existing Fibre Optic Multipexer Equipment		1	lot				
1M.2	Extension of exisiting PABX with subscriber telephone sets		1	lot				
1M.3	Fibre Optic cable and termination box		1	lot				
	Sub-total 1M							
1N	**SCADA system for Telecontrol and Telemetering**							
1N.1	Complete SCADA hardware & software		1	lot				
	Sub-total 1N							
2	**Mandatory Spares**							
2.1	**245kV Gas Insulated Switchgear**							
2.1.1	245kV Circuit Breaker							
2.1.1.1	Operating mechanism for circuit breaker		2	nos.				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
2.1.1.2	Each type of closing coils and opening coils		15	nos.				
2.1.1.3	Each type of auxiliary contacts unit		3	nos.				
2.1.2	245kV Disconnectors and Earthing Switches							
2.1.2.1	Operating mechanism for disconnector		2	nos.				
2.1.2.2	Mechnical drive for high speed earthing switch		1	no.				
2.1.3	245kV Current Transformer							
2.1.3.1	Cores of each rating and each class		1	set				
2.1.4	245kV Voltage Transformer							
2.1.4.1	Winding of each rating and each class		1	set				
2.1.5	Special tools / instruments for operation and maintenance							
2.1.5.1	Special tools / instruments for operation and maintenance (To be listed up by Bidder)		1	set				
2.2.	**245kV Outdoor equipment**							
2.2.1	Complete set of 196kV Surge Arrester		1	set				
2.3.	**145kV Outdoor equipment**							
2.3.1	Complete set of 120kV Surge Arrester		1	set				
2.3.2	132kV outdoor cable termination		1	set				
2.3.3	132kV GIS cable termination		1	set				
2.4	**Protection and Control**							
2.4.1	Each type of Protection relay and AVR		1	set				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
2.4.2	Each type of Tripping relays		2	sets				
2.4.3	Each type of Auxiliary relays		5	sets				
2.4.4	Each type of Trip circuit supervision relays		1	set				
2.4.5	Each type of Bay Control Unit		1	set				
2.4.6	Each type of Switch (if applicable)		1	set				
2.4.7	Each type of MCB		1	set				
2.4.8	Each type of Lamps		10	sets				
2.4.9	Industrial PC		1	set				
2.4.10	Gateway Terminal		1	set				
2.4.11	Bay Ethernet Switches		2	nos.				
2.4.12	Optical connectors (one for each)		1	lot				
2.5	**DC & Charger Equipment**							
2.5.1	Each type of Printed Circuit Board		1	lot				
2.5.2	Circuit breaker of each type and rating (Bidder to list all types)		1	lot				
2.6	**LVAC Equipment**							
2.6.1	Circuit breaker of each type and rating (Bidder to list all types)		1	lot				
2.7	**Power, Control and Auxiliary Cables**							
2.7.1	Power Cable (132kV)		300	m				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
2.7.2	Control Cables, 200m of each type		1	lot				
2.7.3	LV cables, 200m of each type		1	lot				
2.7.4	Other cables (communication, etc.), 100m of each type		1	lot				
2.8	**Transformers**							
2.8.1	Auto Transformer							
2.8.1.1	Set of gaskets		1	no.				
2.8.1.2	Set of dial type thermometer with gaskets		1	no.				
2.8.1.3	Set of thermal image type indicator with gaskets		1	no.				
2.8.1.4	Set of Silica gel breather		1	no.				
2.8.1.5	Buchholz relay		1	no.				
2.8.1.6	Set of tap changer diverter switch		1	no.				
2.8.1.7	Tap changer control mechanism motor		1	no.				
2.8.1.8	Transformer oil 200 litter barrel		10	nos.				
2.9	**Instruments for Communication & SCADA**							
2.9.1	Digital data (Communication) analyzer		1	lot				
2.9.2	Generator and Receiver for the following interfaces: (1) V.24/RS232 SYNC AND ASYNC (2) V.35		1	lot				

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
2.9.3	Digital selective level meter (50Hz to 600kHz) plus level generator (50Hz to 2MHz)		1	lot				
2.9.4	Subscriber Module for DCS 255 Exchange		1	lot				
2.10	**Post Type Insulator**							
2.10.2	For 245kV		3	nos.				
2.11	**Gas Insulated Line (GIL)**							
2.11.1	245kV, 4000A, GIL		25	m				
2.12	**Disc Insulator**							
2.12.1	Each type of Disc Insulator		20	nos.				
2.13	**Conductor**							
2.13.1	Each type of Bus Conductor		25	m				
2.13.2	Each size of Rigid Tubular Conductor		10	m				
2.14	**Clamp and Fitting**							
2.14.1	Each type of Clamps and Fittings		6	nos.				
	Sub-total 2							

TOTAL OF SCHEDULE NO.2 (To be indicated in Schedule No.6 Grand Summary)	Foreign Currency	
	Local Currency (Taka)	

Name of Bidder _____

Schedule No. 2. Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

(In case of any item supplied from within the Employer's Country , please select the Items and indicate the prices)

Item	Description	Code	Qty.	Unit	Currency	Unit Price [1]		Total Price [1]
						EXW Price	Local Transportation and insurance	
			(1)			*(2)*	*(3)*	*(1) x {(2) + (3)}*
					Signature of Bidder			

[1] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

[2] Cubic meter for land development and Length for security boundary wall & chain link fencing shall be finalized during execution stage and payment shall be based on actual one.

[3] Estimated length of GIL shall be specified. Actual length of GIL shall be finalized during execution stage and payment shall be based on actual one.

Schedule No. 3. Design Services

(Special Notes)
1) The Design Services, shall include Project managing/ engineering fees such as, Liaison, overall substation design, project schedule & control , drawings/ documentation handling, contract issues, cash flows, periodical reporting, Project progress meeting and etc., which are not including in equipment, installation, site testing and civil works for the Package SS-2 Contract.

2) The design fees for plant and mandatory spare parts shall be included in Schedule No .1 or 2.

3) The design fees for erection/Installation, commissioning and Civil works shall be including in related items of Schedule No.4.

Item	Description	Qty. *(1)*	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign Currency Portion *(2)*	Local Currency Portion *(3)*	Foreign *(1) x (2)*	*Local (1) x (3)*
3.1	Project Managing/Engineering Fees	1	lot					
TOTAL OF SCHEDULE NO.3 (To be indicated in Schedule No.6 Grand Summary)				Foreign Currency				
				Local Currency (Taka)				

Name of Bidder _____

Signature of Bidder _____

[1] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

Schedules of Rates and Prices

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
1B	**230kV GIS Switchyard**							
	230kV Outdoor Type Gas Insulated Switchgear (GIS)							
1B.1	230kV GIS Double Busbar, Line Feeder Bay with Local Control Cubicle and support structure	2	bays					
i	230kV, 4000A Gas Insulated Line (GIL) for double circuit overhead line connection with gas-to-air bushing including support structures [3]		200	m				
1B.2	230kV GIS Double Busbar , Auto Transformer Bay with Local Control Cubicle and support structure	3	bays					
1B.3	230kV GIS Double Busbar , Bus Coupler Bay with Local Control Cubicle and support structure	1	bay					
1B.4	230kV GIS Double Busbar , Bus VT with Busbar ES circuit Bay with Local Control Cubicle and support structure	1	bay					
	245kV Air Insulated Switchgear (AIS)							
1B.5	196kV rated voltage, 160kV(rms) continuous operating voltage at 50°C 10kA, 50Hz, Heavy duty class, metal oxide type, single phase	15	nos.					
1B.6	230kV post insulators to be installed between auto transformers and 230kV GIS transformer bays air terminations.	18	nos.					
1B.7	Rigid tubular bus and/or stranded conductors including all accessories for each connections for completing 230kV GIS Switchyard	1	lot					
1B.8	Insulators and fittings including all necessary clamps and connectors as required for completing 230kV GIS Switchyard	1	lot					
1B.9	Steel gantry for two (2) circuits of 230kV Transmission Line including all necessary accessories as required for completing 230kV GIS Switchyard	1	lot					

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
1B.10	Steel gantry for overhead circuits between Auto Transformers and 245kV GIS including overhead lines and all necessary accessories as required for completing 230kV GIS Switchyard	1	lot					
	Sub-total 1B							
1C	**132kV Autotransformer to 132kV GIS Connections**							
1C.1	Surge arrester 120kV rated voltage, , 10kA discharge current, gapless metal oxide type, single phase	9	set					
1C.2	**132kV XLPE Power cable**	1600	m					
1C.3	132kV outdoor cable termination	9	set					
1C.4	132kV GIS cable termination	9	set					
1C.5	rigid tubular bus and/or stranded conductors including accessories for of connection of 132kV cables to autotransformers and surge arresters	1	lot					
1C.6	Steel structures for equipment supports including nuts & bolts and cable tray including all necessary fitting & fixing accessories required to complete 132kVcircuits	1	lot					
	Sub-total 1C							
1E	**Power Transformers**							
1E.1	Deleted							
1E.2	230/132/33 kV, 235/300 MVA (ONAN/ONAF), three phase outdoor type auto transformer	3	nos.					
1E.3	Nitrogen injection Fire protection system for three (3) 230/138/33KV Auto transformers	1	lot					

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. *(1)*	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
	Sub-total 1E							
1F	**Control, Protection, Substation Automation and Metering**							
	230kV Circuits							
1F.1	Control, Monitoring, Protection & Substation Automation System for two (2) sets of 230kV overhead line circuits	1	lot					
1F.2	Control, Monitoring, Protection & Substation Automation System for three (3) sets of 230kV auto transformer circuits	1	lot					
1F.3	Control, Monitoring, Protection & Substation Automation System for one (1) sets of 245kV bus coupler bays	1	lot					
1F.4	Control, Monitoring, Protection & Substation Automation System for one (1) lot of 245kV busbars	1	lot					
1F.5	Tariff metering for 230kV system	1	lot					
1F.6	Digital Fault and Disturbance recorder (DFDR)	1	set					
	Sub-total 1F							
1G	**Multicore Cables**							
1G.1	Multicore low voltage power and control cables for control, protection, metering, monitoring and L/V power circuits	1	lot					
	Sub-total 1G							
1H	**Earthing and Lightning Protection**							

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
1H.1	Earthing and Lightning Protection	1	lot					
1H.2	Portable(maintenance) earthing equipment device	2	sets					
	Sub-total 1H							
1I	**Batteries, chargers & DC distribution**							
1I.1	110V Ni-cad Batteries with chargers and distribution boards							
i	110V Ni-cad Batteries, 150Ah @ 5h	1	set					
ii	Battery charger 110V, 50A	1	set					
iii	DC Distribution Board	1	set					
	Sub-total 1I							
1J	**LVAC Distribution**							
1J.1	LVAC switchboard for substation services	1	lot					
	Sub-total 1J							
1K	**Civil Works, Building and Foundation**							
1K.1	Identification and relocation control and protection cables for existing 33kV feeders	1	lot					

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
1K.2	Dismantling and removal of the existing 132kV substation equipment	1	lot					
1K.3	Complete outdoor civil works excluding SPR Building							
i	Outdoor gantry foundation 230kV switchyard	1	lot					
ii	Outdoor equipment foundation 230kV switchyard	1	lot					
iii	Transformer foundation including oilpit & carrage way	1	lot					
iv	Blast wall	1	lot					
v	Internal road 6m wide	200	m					
vi	Surface draining	1	lot					
vii	Cable trench	1	lot					
viii	Switchyard surface finishing, drainage system including surface drain	1	lot					
ix	Gravel laying	1	lot					
x	Septic tank, soakaway	1	lot					
1K.4	SPR Building							
i	Foundation works	1	lot					

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
ii	Super structures	1	lot					
iii	All finish works	1	lot					
1K.5	Fire alarm & fire fighting system	1	lot					
	Sub-total 1K							
1L	**Lighting, small power, air conditioning and Ventilation**							
1L.1	Lighting, small power, air conditioning and Ventilation and emergency DC lighting for SPR Building	1	lot					
1L.2	Lighting for ouside buildings for security, roadway, switchyard and emergency DC lighting including steel poles (H=6m)	1	lot					
	Sub-total 1L							
1M	**Fiber Optic Multiplexer Equipment for Communication and Protection**							
1M.1	Extension of existing Fibre Optic Multipexer Equipment	1	lot					
1M.2	Extension of exisiting PABX with subscriber telephone sets	1	lot					
1M.3	Fibre Optic cable and termination box	1	lot					
	Sub-total 1M							
1N	**SCADA system for Telecontrol and Telemetering**							
1N.1	Complete SCADA hardware & software	1	lot					
	Sub-total 1N							

Schedule No. 4. Installation and Other Services

Schedule No. 4.1 Civil Works, Installation and Site tests / Commissioning of Equipment

Item	Description	Qty. (1)	Unit	Currency	Unit Price[1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
TOTAL OF SCHEDULE NO. 4.1 (To be indicated in Schedule No.6 Grand Summary)				Foreign Currency				
				Local Currency (Taka)				

Name of Bidder _____

Signature of Bidder _____

[1] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

[2] Cubic meter for land development and Length for security boundary wall & chain link fencing shall be finalized during execution stage and payment shall be based on actual one.

[3] Estimated length of GIL shall be specified. Actual length of GIL shall be finalized during execution stage and payment shall be based on actual one.

Schedules of Rates and Prices

Schedule No. 4. Installation and Other Services

Schedule No. 4.2 –Other Services

Item	Description	Qty. (1)	Unit	Currency	*Unit Price* [1]		Total Price[1]	
					Foreign *(2)*	*Local (Taka) (3)*	Foreign *(1) x (2)*	*Local (Taka) (1) x (3)*
4.2.1	**International Training**							
(a)	Fianancial Management Four (4) officials, Two (2) weeks	1	lot					
(b)	Project Management Four (4) Engineers, Two (2) weeks	1	lot					
(c)	Procurement Management Four (4) Engineers, Two (2) weeks	1	lot					
	Sub-total 4.2.1							
4.2.2	**Witness of Factory Acceptance Tests of Equipment**							
(a)	230/132/33kV, Three (3) Phase, 300MVA Auto Transformers Two (2) Engineers with one (1) Consultant, Twelve (12) days	1	lot					
(d)	245kV GIS: Two (2) Engineers with one (1) Consultant, Twelve (12) days	1	lot					
	Sub-total 4.2.2							
4.2.3	**O & M Training at Site**							
(a)	Substation facilities including HV GIS & Transformers Fifteen (15) Engineers, 2 Weeks	1	lot					

Schedule No. 4. Installation and Other Services

Schedule No. 4.2 –Other Services

Item	Description	Qty. (1)	Unit	Currency	*Unit Price* [1]		Total Price[1]	
					Foreign (2)	*Local (Taka)* (3)	Foreign (1) x (2)	*Local (Taka)* (1) x (3)
(b)	Protection and Substation Automation System (SAS) Fifteen (15) Engineers, 2 Weeks	1	lot					
(c)	Fibre Optic Multiplexer & digital PABX Fifteen (15) Engineers, 2 Weeks	1	lot					
	Sub-total 4.2.3							
4.2.4	**Employer's Engineer's Office Accomodation at Site**	1	lot					
(a)	Office accommodation with specified facilities and services during construction period	1	lot					
(b)	Security guard services for Engineer's Office at Site	1	lot					
	Sub-total 4.2.4							
TOTAL OF SCHEDULE NO.4.2 (To be indicated in Schedule No.6 Grand Summary)				Foreign Currency				
				Local Currency (Taka)				

Name of Bidder _____

Signature of Bidder _____

[1] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

Schedules of Rates and Prices

Schedule of No.5 Grand Summary

Item	Description		Total Price[1]	
			Foreign	*Local (Taka)*
5.1	**Total Schedule No.1 (Plant and Equipment, Mandatory Spare Parts and Instrument supplied fromAbroad)**			
5.2	**Total Schedule No.2 (Plant and Equipment, Mandatory Spare Parts and Instrument supplied from Within the Employer's Country)**			
5.3	**Total Schedule No.3 (Design Services)**			
5.4	**Total Schedule No.4 (Installation and Other Services)**	**Sub-total Schedule No.4.1 (Civil Works, Installation, Site Tests and Commissioning of Plant)**		
		Sub-total Schedule No.4.2 (Other Services)		
		Total (4.1 + 4.2)		
5.5	**Total Schedule No.5 (Provisional Sums))**	**Sub-total Schedule No.5.1**	*Not Applicable*	
		Sub-total Schedule No.5.2		
5.6	**Recommended Spare Parts**			
5.7	GRAND TOTAL (Schedule No.1 to Schedule No.4 & Schedule No.6 (to Letter of Price Bid)			

Name of Bidder

Signature of Bidder

[1] Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

Schedules of Rates and Prices

Schedule No. 6. Recommended Spare Parts

Item	Description	Code [1] (Country)	Qty. (1)	Unit	Currency	Unit Price[2] FOB Price (2)	Unit Price[2] CIP Price Foreign Currency (3)	Unit Price[2] CIP Price Local Currency (4)	Total Price[2] CIP Price Foreign Currency (1) x (3)	Total Price[2] CIP Price Local Currency (1) x (4)
	TOTAL SCHEDULE NO.6 Recommended Spare Parts				Currency 1					
					Currency 2					
					Local Currency (Taka)					

Name of Bidder _____

Signature of Bidder _____

1 Bidder shall enter a code representing the country of origin of all imported plant and equipment.

2 Specify currency in accordance with specifications in Bid Data Sheet under ITB 19.1 in Single-Stage Bid. Create and use as many columns for Unit Price and Total Price as there are currencies.

Schedules of Rates and Prices

SCHEDULE No. 7 - DAY WORKS

1)

No works whatsoever may be executed as day works, nor will payment be made for any Day works except in accordance with provisions of the Conditions of Contract, and with prior written authorization of the Engineer/ Employer.

LABOUR

2) The Contractor shall be entitled to the following payments in respect of labour employed on Day works:

The aggregate amount of wages for such labour calculated on the actual hours worked at the wage rate set out in this schedule up to the grade of charge hand or overseer working with the men.

3) The wages given in this schedule shall cover Contractor's profit, on cost, superintendence, insurance and all allowances to labour, time keeping and all clerical and office work as well as the use of tools, timber, light equipment and non-mechanical equipment and all incidental charges whatever.

4) The "Normal working Day" as hereinafter referred to shall be taken to be of eight hours excluding meal breakers and rest periods.

5) Including the sums due to the Contractor for the execution of Day works, the hours for which payment shall be made for all personnel and the hire of all equipment shall be reckoned from the time of starting the particular item of day work, either at the beginning of or during the course of a normal working day to the end of the normal working day or the time of completion of the particular item of Day work, whichever maybe sooner. No payment shall be made for personnel or plant for hours outside the normal working day unless the said personnel and plant are employed on Day works outside the Normal Working Day on the written instruction of the Employer's Representative, The same Day work rate shall apply for works done both during and outside the Normal Working Day.

6) On completion of any authorized Day works, a written statement shall be issued by the Employer's Representative who shall sign it together with the Contractor and which shall state the number of workmen and their grades involved in the Day work, the number of hours worked and a detailed description of the Material used and the work carried out. A copy of this signed statement shall be retained by the Employer's Representative and the Contractor and shall be the sole basis upon which payment for Day Works will be made.

7) Day Work Rate for Labour

Class of Labour	Normal Working Day of 8 Hours Local Taka/Day
Local Labour	
Unskilled Labourer	
Skilled Labourer	
Driver	
Steel Erector	
Surveyor (on survey work only)	
Mason/ concrete work	
Carpenter	
Bar-bender/ Steel fixer	
Welder	
Welder's assistant	
Painter	
Crane operator	
Bulldozer/ grader operator	

Expatriate Labour	Normal Working Day of 8 Hours Foreign Currency - Per Day
Junior Engineer	
Senior Engineer	

8) Any other class of labour envisaged by Contractors for the execution of any Day works, except that covered by Paragraph 3 above, i.e. superintendent, etc., shall be entered above together with the appropriate labour rates, and such rates shall be the only rates considered in any Day works claim.

9) The labour rates to be entered above shall include all other benefits or contributions made by the employer such as contributions to Social Insurance Schemes, Annual leave, Termination of Employment and Redundancy Law, Provident fund, Health Schemes, etc.; which are imposed either by Law or by agreement with Trade Unions.

EQUIPMENT AND TRANSPORT

10) The rates for hire of equipment and transport shall apply only to equipment, which the Contractor has on site, and are to apply for the actual running for which the equipment is employed on work.

11) The rates shall include service, operators and necessary attendants, fuel, lubricants and other consumable.

12) The Contractor may insert additional items.

MATERIALS

13) The rates for materials shall apply to the net amount of materials actually provided, erected and foaming part of the works and shall include for delivery to the site of operations.

14) The Contractor may insert additional items.

Item	Description	Unit	Rate	
			Foreign	Local
1	**Equipment (with operator)**			
a.	Mobile Welding set	hr.		
b.	Acetylene cutting equipment	hr.		
c.	Air compressor (180m3/hr. atmosphere) complete with hoses and tools	hr.		
d.	Dump truck 6 Cu.m capacity	hr.		
e.	Crane up to 6 Tonnes lift	hr.		
f.	Drilling equipment	hr.		
g.	Compactor Machine	hr.		
h.	Water Pump	hr.		
i.	Vibrator Machine with porker	hr.		
j.	Small Generator and mobile Lighting Facility	hr.		
k.	Excarator	hr.		
l.	Vibrator Roller	hr.		
m.	Scaffoliding Sets	hr.		
n.	Tractor without winch	hr.		
o.	5- tonne lorry	hr.		
p.	2 - tonne lorry	hr.		
q.	5- seater saloon car (or similar)	hr.		
r.	Bulldozer (D6 or similar)	hr.		

s.	Pick-up Truck	hr.		

2	**Material**			
a.	Cement	ton		
b.	Sand	m3		
c.	Crushed Stone	m3		
d.	Reinforcing Steel	ton		
e.	Imported material for backfilling	m3		
f.	Timber shoring	m2		
g.	Sheet piling	m2		
h.	Gabion walls with mesh	m3		
i.	Turfing of slopes	m2		
j.	150mm-100mm Base course for roads	m3		
k.	50mm-20mm Base for roads	m3		
l.	150mm thick premix-Asphalt layer	m3		
m.	Rubble stones for foundation work (150-300mm dia.)	m3		

SUPERVISORY STAFF RATES

The following rates shall apply where, by agreement with Employer's Representative, supervisory staff are employed on Day works in a direct capacity, i.e. other in their normal supervisory capacity.

The rates also be used as a basis for assessing any legitimate claims for extra costs in accordance with the provision of the Conditions of Contract, where these have not been claimed as Day works.

No payment shall be made without the prior written authority of the Engineer, and the provisions of the Conditions of Contract shall apply to any claim for payment.

The Contractor shall insert in the following schedule descriptions and rates for any class of supervisory staff envisaged which are not already included.

Class of supervisory staff	**Normal working Day of 8 Hours**
Expatriate	Foreign Currency/ Day
Senior Engineer	
Junior Engineer	
Local	Local Currency/Taka./ Day
Senior Engineer - Civil /Structural	
Junior Engineer - Civil / Structural	
Architect	
Surveyor	
Supervisor	
Foreman	

Schedules of Rates and Prices

Country of Origin Declaration Form

Sl. No	Description	Country Code[1]	Name of Country

PART 13
Post Insulators

No.	Description	Unit	Guaranteed
1.	**Post Insulators - General**		
1.1	Manufacturer		
1.2	Type		
1.3	Model designation		
1.4	Country of origin		
1.5	Standards		
1.6	Quality control		
1.7	Design		
2	Post Insulators - Characteristics		
2.1	Nominal system voltage	kV_{rms}	
2.2	Highest voltage for equipment U_n	kV_{rms}	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	
2.4	Rated short duration power frequency voltage	kV	
2.5	Rated frequency f_r	Hz	
2.6	Minimum creepage distance	mm/kV	
2.7	Failing load bending (p0) (C10)	N	
2.8	Failing load torsion	Nm	
3	Post Insulators - Design and Construction		
3.1	Insulation material		
3.2	Material quality acc. IEC 60672		
3.3	Insulator height	mm	
3.4	Max. diameter of insulating part	mm	
3.5	Diameter of upper base	mm	
3.6	Number of holes on upper base		
3.7	Diameter distance between holes on upper base	mm	
3.8	Hole type on upper base		
3.9	Diameter on lower base	mm	
3.10	Number of holes on lower base		
3.11	Diameter distance between holes on lower base	mm	
3.12	Hole type on lower base		
3.13	Insulator weight	kg	
	Overall compliance with the requirements (yes/no)		

PART 14
Insulator Strings

No.	Description	Unit	Guaranteed
1.	Manufacturer		
2.	Insulator type and manufacturer's reference		
3.	Insulation/Dielectric material		
4.	Number of units per string		
5.	Outside diameter	mm	
6.	Distance between centers	mm	
7.	Length of string overall	mm	
8.	Maximum working load	kN	
9.	Minimum failing load per unit	kN	
10.	Mechanical routine load test	kN	
11.	Electro-mechanical failing load	kN	
12.	Mechanical failing load	kN	
13.	Electrostatic capacity per unit	pF	
14.	Weight of complete string	Kg	
15.	50Hz 1 minute withstand voltage of unit (dry)	kV	
16.	50Hz 1 minute withstand voltage of unit (wet)	kV	
17.	Minimum 50Hz puncture voltage	kV	
18.	Dry lightning impulse withstand voltage of string 1.2/50 micro sec wave	kV	
19.	Minimum creepage distance per unit:		
	a) Specified, subject to acceptable sheed profile.	mm	
	b) Guaranteed	mm	
20.	Protected creepage distance per unit	mm	
21.	Radio influence voltage measured at um/3 at 1 MHz	µV	
	Overall compliance with the requirements (yes/no)		

d) After Final Acceptance:

- Complete sets of bound prints of As-built documents : 4 copies.
- CD ROM containing as-built documents : 4 sets as PDF.

1.2 Corresponding Letters

The corresponding letter shall have series letter number, with the date of submission, address, project name, substation name, subject etc.
The project letter numbering system may be instructed by the Employer after the Contract.

2. Drawings and Documents to be submitted with the Bid;

The following drawings/documents shall be submitted with the Bid:

2.1 Typical single line, layout & sectional drawings of substation showing details of construction and dimensions.

2.2 Outline drawings of all switchgear equipment:-

(a) Showing installed dimensions and weights;
(b) Showing transport dimensions and weights;

2.3 Outline drawings of all power transformers and auxiliary transformers:-

(a) Showing installed dimensions and weights;
(b) Showing transport dimensions and weights;

2.4 Typical drawing of transformer remote control panel.

2.5 Following type test certificates of the equipment of similar or higher specifications (higher voltage & higher capacity) as per relevant IEC with the Bid.

Following type test certificates of the equipment having similar or higher specifications (voltage & capacity) required by the bid shall be submitted as per relevant IEC and shall be issued from any independent testing laboratory except for Power transformer, GIS and Lightning Arrester.

Type test certificates of Power Transformer, GIS and Lightning Arrester shall be issued by STL member testing laboratories listed below or from manufacturer's own testing laboratory. Test carried out at manufacturer's own testing laboratory must have been witnessed and certified by a representative from the STL member testing laboratories.

(i) Power Transformer (230kV)

(a) Temperature rise test.
(b) Dielectric tests (Induced over voltage test, Lightning impulse voltage withstand test, Separate source voltage withstand test).
(c) Short circuit withstand test (special test) *.

* short circuit test certificates/reports for 230kV transformer shall be of minimum 220kV, 225MVA three phase inter bus Power Transformer.

(ii) GIS Switchgear

(a) On one Complete Switchgear (for 230 kV)

Sl No	IEC 62271-203 Clause	Test Name
i.	6.2	Dielectric tests:
		- Lightning impulse voltage tests
		- Power-frequency voltage tests
ii.	6.4	Measurement of the resistance of circuits
iii.	6.5	Temperature-rise tests
iv.	6.6	Short-time and peak withstand current tests
v.	6.104	Pressure test on partitions
vi.	6.105	Test under conditions of arcing due to an internal fault
vii.	6.106	Insulator tests

(b) Circuit Breaker (for 230 kV)

Sl No	IEC 62271-203 Clause	Test Name
ii.	6.101	Mechanical and environment al tests
iii.	6.103	Test circuits for short circuit making and breaking tests
iv.	6.108	Single-phase and double-earth fault tests
v.	6.109	Short-line fault tests
vi.	6.110	Out-of-phase making and breaking tests

(c) Disconnector & Earthing Switch (for 230 kV & 132kV)

Sl No	IEC 62271-203 Clause	Test Name
ii.	6.101	Tests to prove the short-circuit making performance of earthing switches
iii.	6.102	Operating and mechanical endurance tests
iv.	6.106	Bus-transfer current switching tests
v.	6.107	Induced current switching tests

(d) Gas leakage rate (Per year) (for 230 kV)

(iii)Lightning arrester (AIS)

(a) Power frequency voltage withstands and lightning impulse voltage withstand tests on complete arrester housing.
(b) Operating duty test.
(c) Long duration current impulse withstands test.
(d) Residual voltage test.
(e) Pressure relief test.
(f) Artificial pollution test.

(iv)XLPE Power Cable

(a) Bending test followed by partial discharge test
(b) Tan Delta measurement
(c) Heating cycle voltage test
(d) Partial discharge tests: At ambient temperature, and At high temperature.
(e) Switching impulse voltage test
(f) Lightning impulse voltage test
(g) Short Circuit Capability Test

(v) Insulator

(a) Post Insulator
(i) Dry lightning-impulse withstand voltage test
(ii) Dry or wet switching-impulse withstand voltage tests
(iii)Dry power-frequency withstand voltage test (Indoor PI)
(iv)Wet power-frequency withstand voltage test (Outdoor PI)

(b) Disk/String Insulator(On insulator unit)
(i) Dry lightning impulse voltage withstand test;
(ii) Wet power frequency voltage withstand test;
(iii)Electro-mechanical failing load test;
(iv)Thermal mechanical performance test;

(v) Impulse voltage puncture test;
(vi) Power arc test.

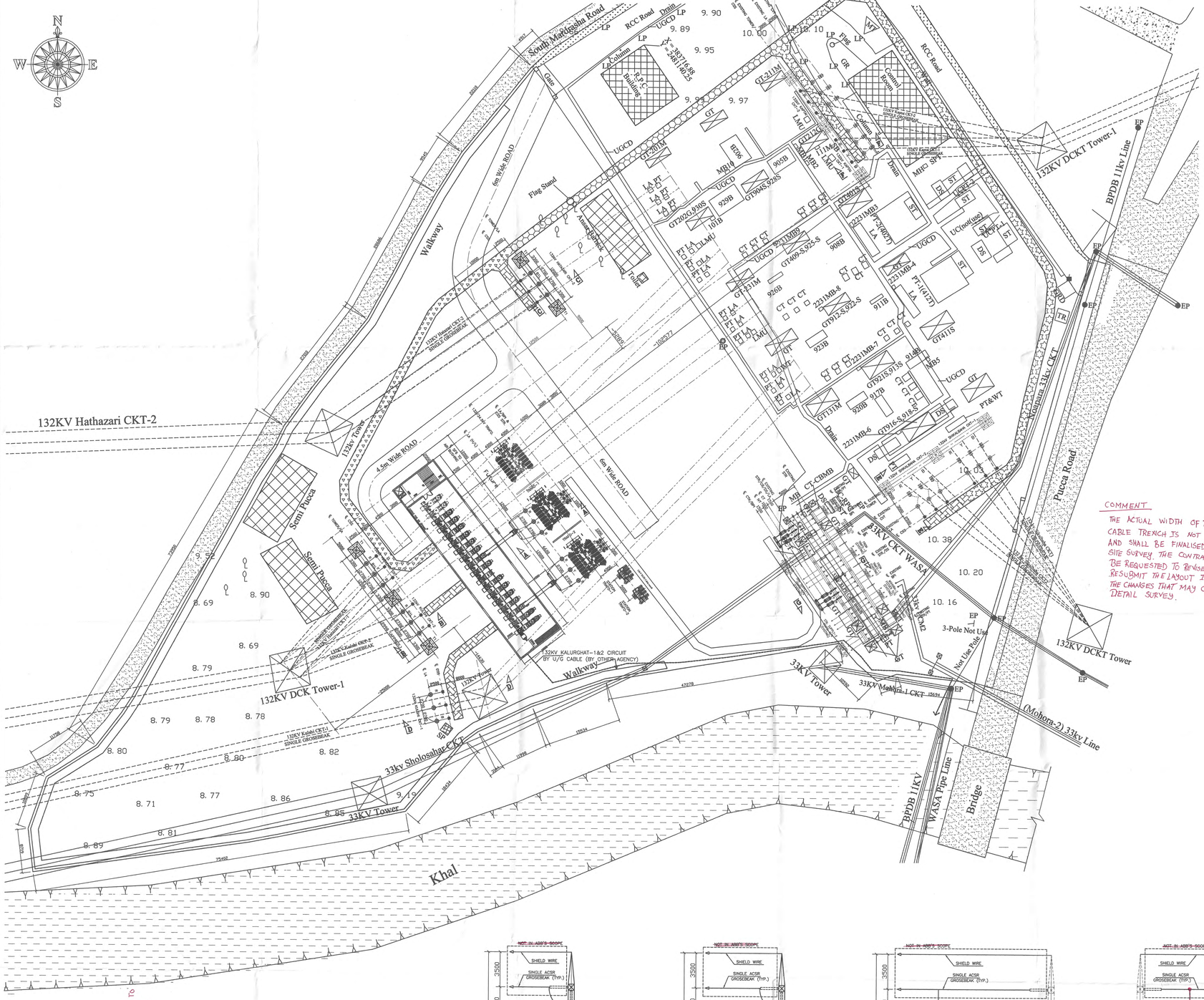
POWER GRID COMPANY OF BANGLADESH
APPROVED WITH COMMENT AND CORRECTION
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specifications and Standards for Design, Workmanship and performance as stipulated in the contract

(Engr. Hurfiqyun Rashid)
Sub-Divisional Engineer
Design & Quality Control
PGCB Ltd.

(Noor Jamal)
Executive Engineer
Substation Design & QC
PGCB Ltd.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 JUL 2017



NOTES:–

1– ALL DIMENSIONS ARE IN mm., CO–ORDINATES & LEVEL ARE IN MTR. UNLESS OTHERWISE SPECIFIED

2– MINIMUM CLEARANCE ARE AS PER SPECIFICATION:

	132KV	33KV
a) BETWEEN PHASES	1500MM	430MM
b) BETWEEN PHASE TO EARTH	1300MM	380MM
c) SECTIONAL CLEARANCE	3500MM	2740MM
d) VERTICAL DISTANCE BETWEEN LOWEST PART OF THE INSULATOR AND GROUND LEVEL	2500MM	2500MM

3– THE PARAMETERS FOR WHICH THE SYSTEM IS DESIGNED ARE:

	132KV	33KV
a) SYSTEM OPERATING VOLTAGE	132KV	33KV
b) MAX. SYSTEM VOLTAGE (RMS)	145KV	36KV
c) SYSTEM FREQUENCY	50Hz	50Hz
d) LIGHTNING IMPULSE WITHSTAND VOLTAGE : (DRY & WET)	±650kVP	±170kVP
e) ONE MIN. POWER FREQUENCY WITHSTAND VOLTAGE : (DRY & WET)	275kV(rms)	70kV(rms)
f) NOMINAL CREEPAGE DISTANCE :	3625MM	900MM (25mm/KV)
g) MAXIMUM FAULT LEVEL :	50kA/3 Sec.	31.5kA/3 Sec.

4– PLINTH HEIGHT OF FOUNDATION WILL BE +200MM FROM THE FINISHED SWITCHYARD LEVEL (F.S.L.)

5– GIS/EQUIPMENT DRAWING SHOWN ARE TENTATIVE WHICH SHALL BE AS PER ACTUAL APPROVED DRAWING OF RESPECTIVE EQUIPMENT.

6– 132kV KALURGHAT U/G CKT.–1 & CKT.–2 CABLE ALONG WITH CABLE TERMINATION KIT SET LAYING UP TO CABLE CELLAR TO BE DONE BY OTHER AGENCY. HOWEVER CONNECTION WITH GIS SHALL BE DONE BY ABB.

7– NECESSARY POWER SHUT DOWN TO BE PROVIDED BY PGCB TO CARRY OUT THE JOB SAFELY AS PER ABB REQUEST FOR SITE EXECUTION.

8– TRANSMISSION LINE DIVERSION AND OTHER NECESSARY WORK REQUIRED FOR POWER EVACUATION DURING CONSTRUCTION WORK, SHALL BE ARRANGED BY PGCB.

9– EXISTING LA FOUNDATION AND STRUCTURE SHALL BE USED FOR NEW LA AND REQUIRED STRUCTURE MODIFICATION SHALL BE DONE AT SITE.

10– ALL 132kv & 33KV INSULATOR STRINGS ARE SINGLE TENSION/SINGLE SUSPENSION TYPE WITH 120KN ELECTROMECHANICAL STRENGTH, 430MM CREEPAGE DISTANCE OF INDIVIDUAL INSULATOR, ANTI FOG TYPE DISC INSULATOR. DISCS PER STRING ARE AS BELOW :

	SINGLE TENSION/SUSPENSION
132kV	9 ⟶ considering 430 MM Creepage
33kV	3

11– SUB CONDUCTOR DETAILS:

	132KV	33KV
a) SUB CONDUCTOR SPACING	250MM	250MM

12– NOMINAL CURRENT RATING OF CONDUCTOR :

SINGLE ACSR GROSBEAK	SINGLE HI–TACSR (680sqmm.)
600 AMP	1600 AMP

13– REFER SEPARATE DETAIL DRAWING OF 33kV SWITCHYARD WHICH SHALL BE SUBMITTED SEPARATELY.

COMMENT

THE ACTUAL WIDTH OF THE CABLE TRENCH IS NOT SHOWN AND SHALL BE FINALISED AFTER SITE SURVEY. THE CONTRACTOR MAY BE REQUESTED TO REVISE AND RESUBMIT THE LAYOUT INCORPORATING THE CHANGES THAT MAY OCCUR AFTER DETAIL SURVEY.

LEGENDS:–

– 1CKT CABLE TRENCH.

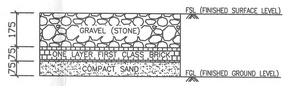
– 2CKT CABLE TRENCH.

– 4CKT CABLE TRENCH.

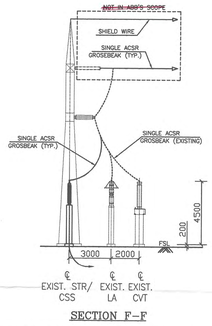
– 5/6CKT CABLE TRENCH.

REFERENCE DRAWINGS :–

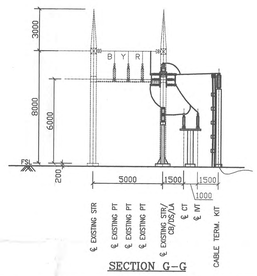
1– SINGLE LINE DIAGRAM FOR 132/33kV MADUNAGHAT (GIS) SUBSTATION, DRAWING NO.– 3VIN170633X1003.
2– SINGLE LINE DIAGRAM OF MADUNAGHAT GIS S/S., DRAWING NO.–PGCB/ADB/TRANCHE–03/PSEEIP/PCK–03/E03 (rev–01).
3– LAYOUT OF MADUNAGHAT S/S, DRAWING NO.–PGCB/ADB/TRANCHE–03/PSEEIP/PCK–03/E07.



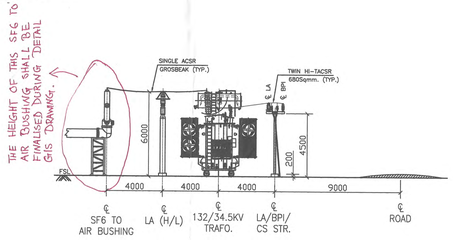
TYPICAL SWITCHYARD LEVEL



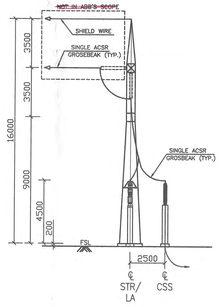
SECTION F–F



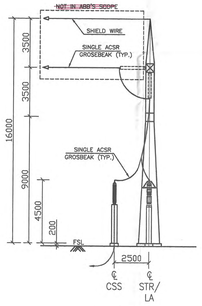
SECTION G–G



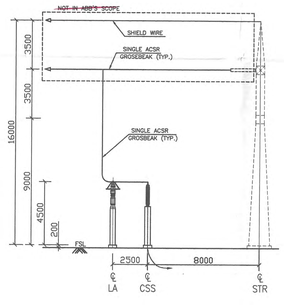
SECTION A–A



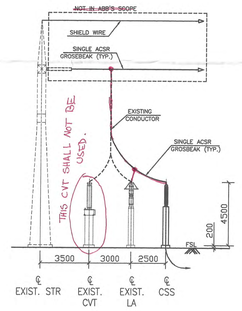
SECTION B–B



SECTION C–C



SECTION D–D



SECTION E–E

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
A	2017-07-19	REVISED AS PER DISCUSSION WITH PGCB ON 18.07.2017	✓	✓	✓	✓	✓
NIL	2017-06-07	FIRST SUBMISSION	✓	✓	✓	✓	✓
			REVIEWED BY				

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

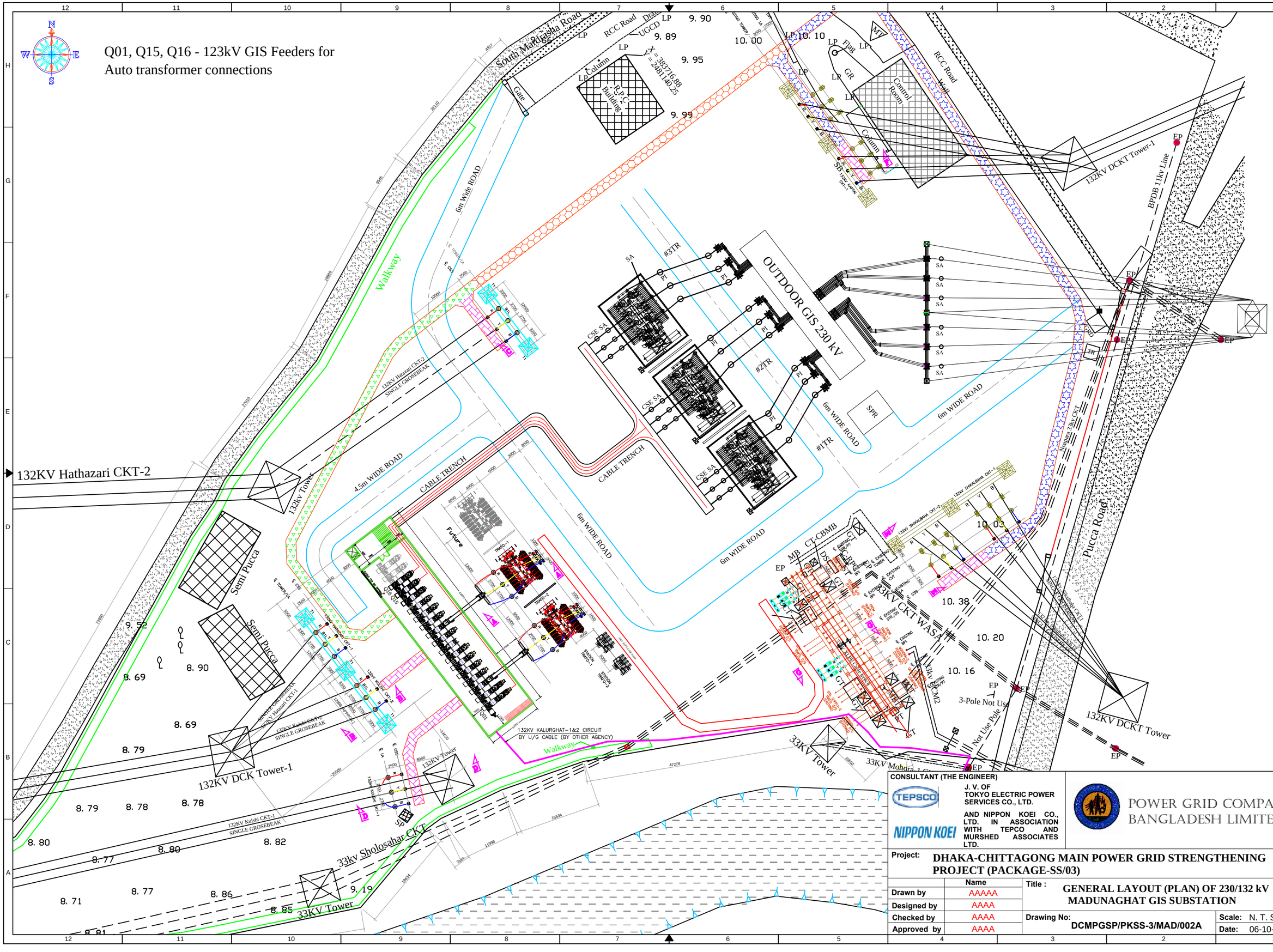
Contract No. PSEEIP (TRANCHE–3)/ADB/PGCB/P03/SS

Prepared 2017-06-07 IC	Document kind: FOR APPROVAL	Project: CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size: A1
Checked 2017-06-07 SD			Scale: NTS
Approved 2017-06-07 PKD		Title: ELECTRICAL LAYOUT PLAN & SECTION FOR 132/33kV MADUNAGHAT (GIS) SUBSTATION	
Resp. (div./dept) IN PGGI–SI(2882)		Document id. 3VIN170633X1007 / Page 01/01 / Date 2017-07-19	Rev. A / Lang. EN

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ATTACHMENT-10

Q01, Q15, Q16 - 123kV GIS Feeders for
Auto transformer connections



CONSULTANT (THE ENGINEER)

J. V. OF
TOKYO ELECTRIC POWER SERVICES CO., LTD.
AND NIPPON KOEI CO., LTD. IN ASSOCIATION WITH TEPCO AND MURSHED ASSOCIATES LTD.

POWER GRID COMPANY OF BANGLADESH LIMITED.

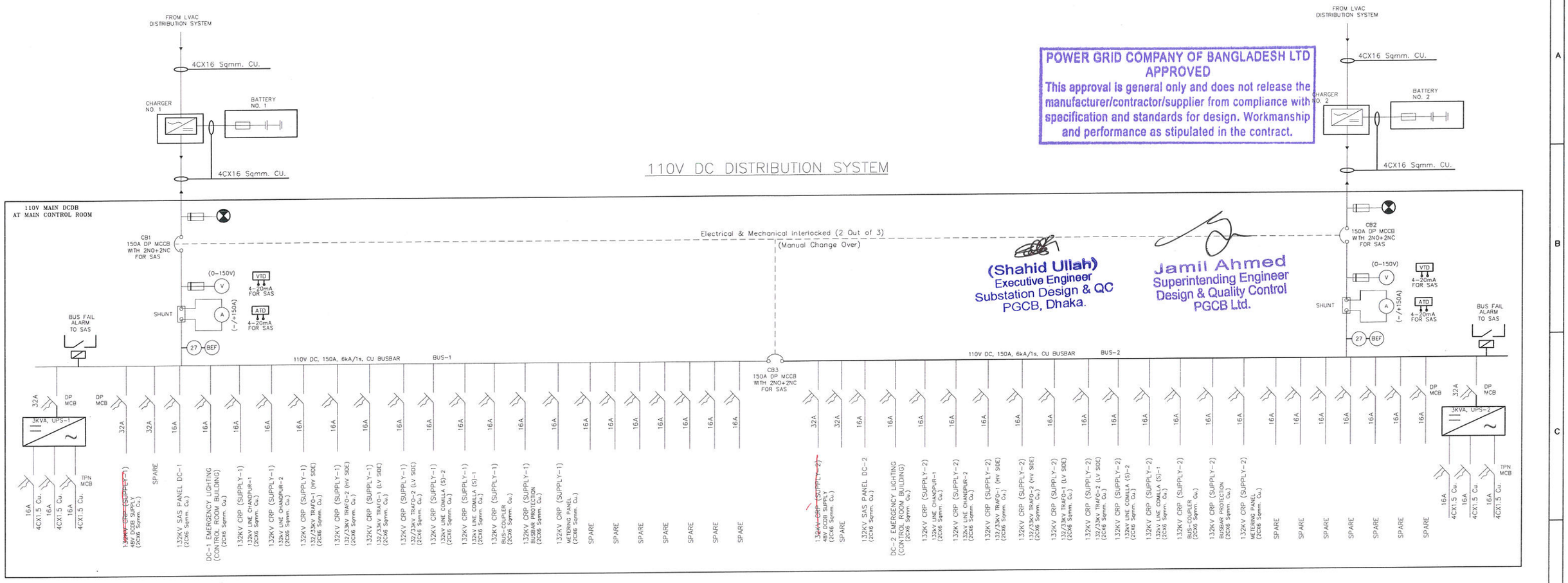
Project: DHAKA-CHITTAGONG MAIN POWER GRID STRENGTHENING PROJECT (PACKAGE-SS/03)

	Name
Drawn by	AAAAA
Designed by	AAAA
Checked by	AAAA
Approved by	AAAA

Title : GENERAL LAYOUT (PLAN) OF 230/132 kV MADUNAGHAT GIS SUBSTATION

Size: A3
Sheet Of 1/1
Drawing No: DCMPGSP/PKSS-3/MAD/002A
Scale: N. T. S.
Date: 06-10-2019

Attachment-11



POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specification and standards for design. Workmanship and performance as stipulated in the contract.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

NOTES :

1. 2 NOS. 3KVA UPS FOR SAS PANELS SHALL BE MOUNTED ON 110V DCDB.
2. CHARGER INCLUDES DIODE VOLTAGE REGULATORS (DVR).

LEGEND

- DC INCOMER ON/OFF INDICATION
- (V) DC VOLTMETER
- (A) DC CENTRE ZERO AMMETER
- (27) U/V PROTECTION
- (BEF) BATTERY E/F PROTECTION

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-14	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS		Paper size A3
Checked 2017-10-30 SD	ABB			Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM 110V DC DISTRIBUTION PANEL AT 132/33kV KACHUA (AIS) SUBSTATION		
Resp. (div./dept) IN PGGI-SI(2882)		Document id. 3VIN170633X3061	Page 01/01	Date 2018-02-14 / Rev. A / Lang. EN

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Attachment-11

POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
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LVAC DISTRIBUTION SYSTEM

INCOMER–I
FROM 200 kVA
33/0.415kV AUX. TRAFO.

4CX120 Sqmm. CU.

V S/S (0–500V) V
R Y B
VTD 4–20mA FOR SAS

CB1
400A 4P ACB
(WITH U/V,O/C & E/F IN BUILT)
WITH 2NO+2NC
FOR SAS

Electrical & Mechanical Interlocked (2 out of 3)
(Auto Change Over)

VT
415V/√3 / 110V/√3
10VA, CL.–1

CT: 400/1A
10VA, CL.–1

A S/S
EM–1 MAIN
EM–2 CHECK
A (0–400A)
ATD 4–20mA FOR SAS

BUS FAIL ALARM TO SAS

CB3
400A 4P ACB
(WITH U/V,O/C & E/F IN BUILT)
WITH 2NO+2NC
FOR SAS

415V, 3 PH 4W, 50 Hz, 400A. CU. BASBAR, 15KA FOR 3 Sec, BUS–1

INCOMER–II
FROM 200 kVA
33/0.415kV AUX. TRAFO.

4CX120 Sqmm. CU.

V S/S (0–500V) V
R Y B
VTD 4–20mA FOR SAS

CB2
400A 4P ACB
(WITH U/V,O/C & E/F IN BUILT)
WITH 2NO+2NC
FOR SAS

VT
415V/√3 / 110V/√3
10VA, CL.–1

CT: 400/1A
10VA, CL.–1

A S/S
EM–1 MAIN
EM–2 CHECK
A (0–400A)
ATD 4–20mA FOR SAS

BUS FAIL ALARM TO SAS

BUS–2

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd

TPN MCB		
125A	OUTDOOR SWITCH SOCKET OUTLET	(2RX4CX16 Sqmm. Cu.)
63A	132KV SWYD. BMK (SUPPLY–1)	(4CX16 Sqmm. Cu.)
63A	33KV SWYD. BMK (SUPPLY–1)	(4CX16 Sqmm. Cu.)
63A	AIR CONDITIONING–CRB (SUPPLY–1)	(4CX16 Sqmm. Cu.)
63A	MLDB (CONTROL ROOM BUILDING) (SUPPLY–1)	(4CX16 Sqmm. Cu.)
63A	110V. BATTERY CHARGER NO.1	(4CX16 Sqmm. Cu.)
63A	TRAFO.–1 MARSHALLING BOX	(4CX16 Sqmm. Cu.)
63A	SPARE	
32A	SPARE	
32A	SPARE	
32A	CRP PANEL (SUPPLY–1)	(4CX1.5 Sqmm. Cu.)
	SAS PANEL	(4CX1.5 Sqmm. Cu.)
	SPARE	
63A	OUTDOOR LIGHTING PANEL	(4CX16 Sqmm. Cu.)
63A	132KV SWYD. BMK (SUPPLY–2)	(4CX16 Sqmm. Cu.)
63A	33KV SWYD. BMK (SUPPLY–2)	(4CX16 Sqmm. Cu.)
63A	110V. BATTERY CHARGER NO.2	(4CX16 Sqmm. Cu.)
63A	AIR CONDITIONING–CRB (SUPPLY–2)	(4CX16 Sqmm. Cu.)
63A	MLDB (CONTROL ROOM BUILDING) (SUPPLY–2)	(4CX16 Sqmm. Cu.)
63A	TRAFO.–2 MARSHALLING BOX	(4CX16 Sqmm. Cu.)
63A	SPARE	
63A	SPARE	
63A	SPARE	
63A	SPARE	
32A	COMMUNICATION PANEL	(4CX1.5 Sqmm. Cu.)
32A	CRP PANEL (SUPPLY–2)	(4CX1.5 Sqmm. Cu.)
32A	SAS PANEL	(4CX1.5 Sqmm. Cu.)
32A	SPARE	
32A	SPARE	

19 FEB 2018

NOTES:

1) 51/51N/27 SHALL BE PROVIDED IN BOTH INCOMER 1 AND 2. THIS MAY BE INBUILT FEATURE OF INCOMER ACB.

2) TARIFF METERS (MAIN & CHECK) SHALL BE OF ACCURACY CLASS – 0.2. TARIFF METERS SHALL BE SUPPLIED LOOSE SEPARATELY AND SHALL BE MOUNTED ON LVAC BOARD AT SITE.

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-14	REVISED AS PER PGCB COMMENTS, DATED–02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

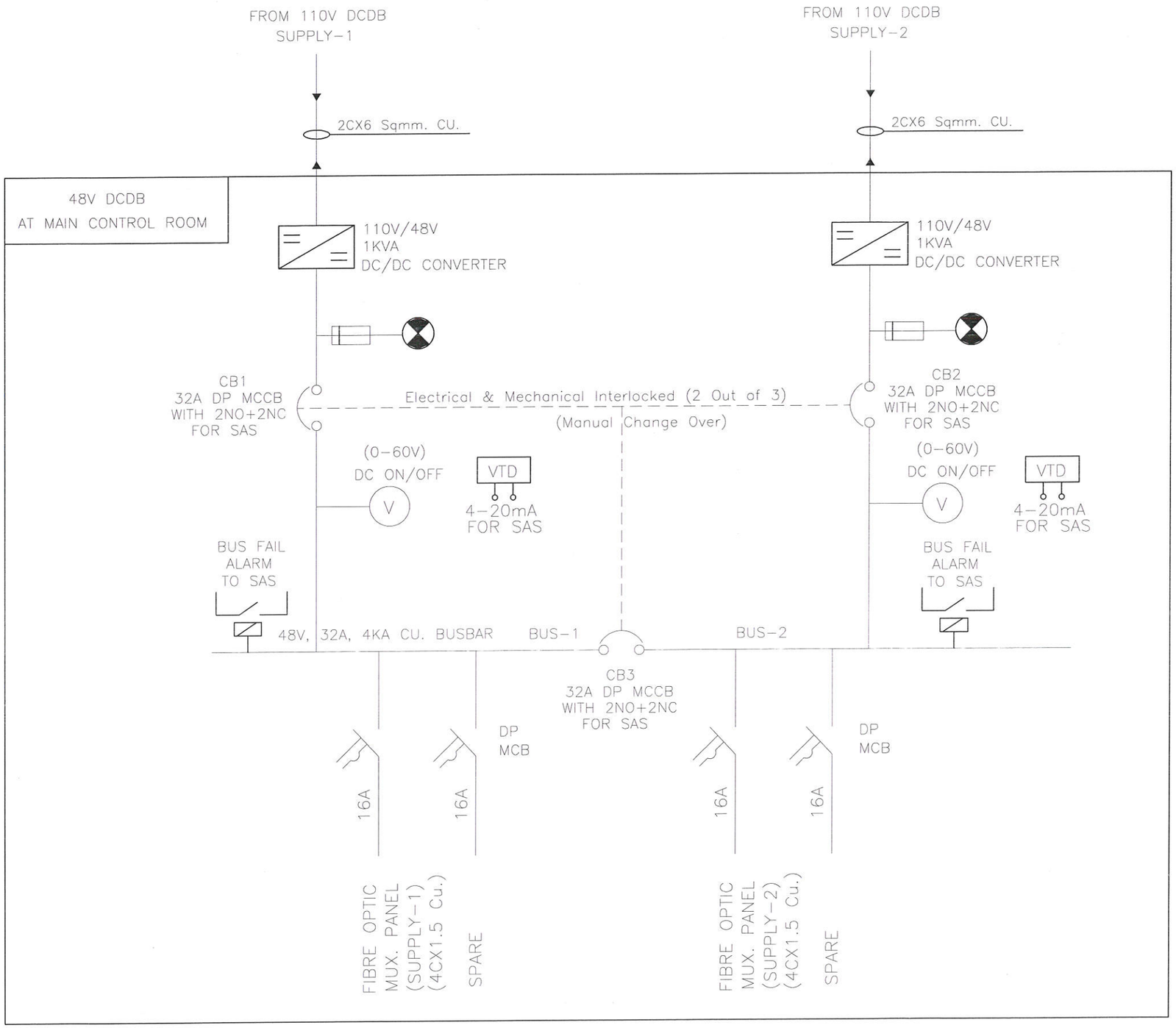
Contract No. PSEEIP (TRANCHE–3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD	ABB		Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM OF LVAC DISTRIBUTION PANEL FOR 132/33kV KACHUA (AIS) SUBSTATION	
Resp. (div./dept) IN PGGI–SI(2882)		Document id. 3VIN170633X3057 / Page 01/01 / Date 2018-02-14	Rev. A / Lang. EN

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Attachment-11

48V DC DISTRIBUTION SYSTEM



LEGEND

DC INCOMER ON/OFF INDICATION

POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specification and standards for design. Workmanship and performance as stipulated in the contract.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-14	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer

POWER GRID COMPANY OF BANGLADESH LTD.

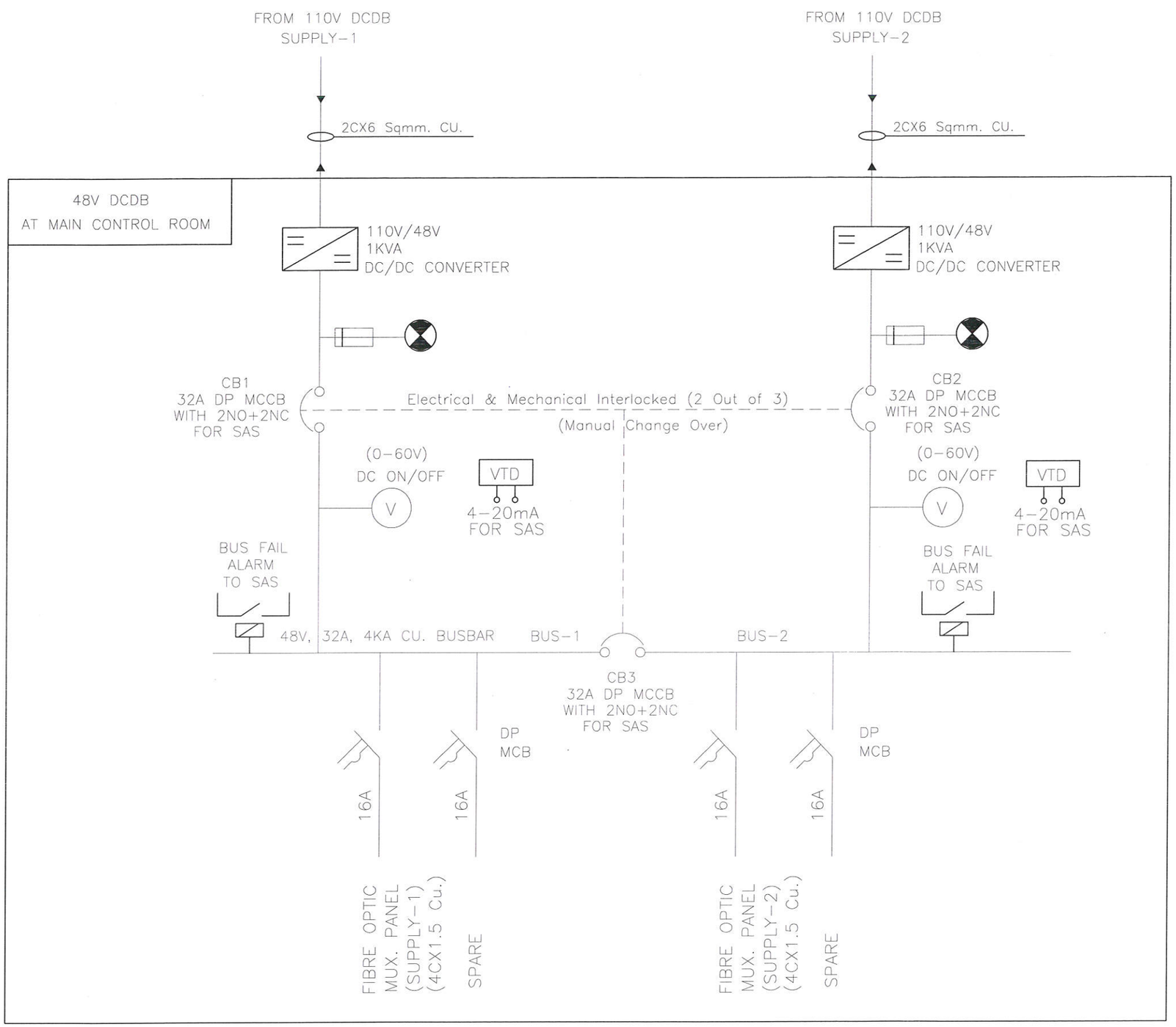
Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS			Paper size A3
Checked 2017-10-30 SD	ABB				
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 48V DC DISTRIBUTION PANEL AT 132/33kV KACHUA (AIS) SUBSTATION			Scale NTS
Resp. (div./dept) IN PGGI-SI(2882)		Document id. 3VIN170633X3065	Page 01/01	Date 2018-02-14	Rev. A / Lang. EN

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Attachment-11

48V DC DISTRIBUTION SYSTEM



POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specification and standards for design. Workmanship and performance as stipulated in the contract.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

LEGEND

DC INCOMER ON/OFF INDICATION

19 FEB 2018

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A	2018-02-15	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

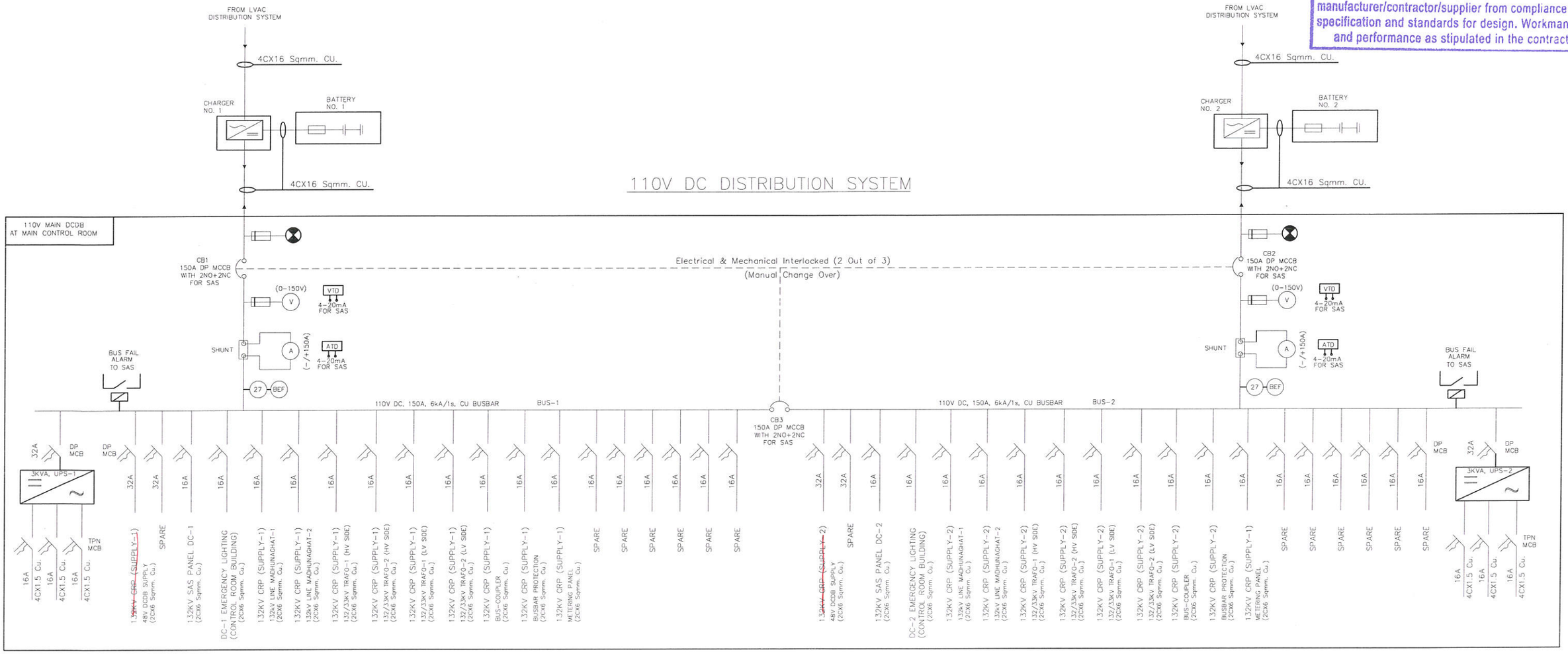
Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD			Scale NTS
Approved 2017-10-30 PKD	ABB	Title SINGLE LINE DIAGRAM FOR 48V DC DISTRIBUTION PANEL AT 132/33kV KALURGHAT (GIS) SUBSTATION	
Resp. (div./dept) IN PGGI-SI(2882)		Document id. 3VIN170633X3066 / Page 01/01 / Date 2018-02-15 / Rev. A / Lang. EN	

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POWER GRID COMPANY OF BANGLADESH LTD
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110V DC DISTRIBUTION SYSTEM



NOTES :

1. 2 NOS. 3KVA UPS FOR SAS PANELS SHALL BE MOUNTED ON 110V DCDB.
2. CHARGER INCLUDES DIODE VOLTAGE REGULATORS (DVR).

LEGEND

- DC INCOMER ON/OFF INDICATION
- (V) DC VOLTMETER
- (A) DC CENTRE ZERO AMMETER
- (27) U/V PROTECTION
- (BEF) BATTERY E/F PROTECTION

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
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Design & Quality Control
PGCB Ltd.

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Customer: POWER GRID COMPANY OF BANGLADESH LTD.

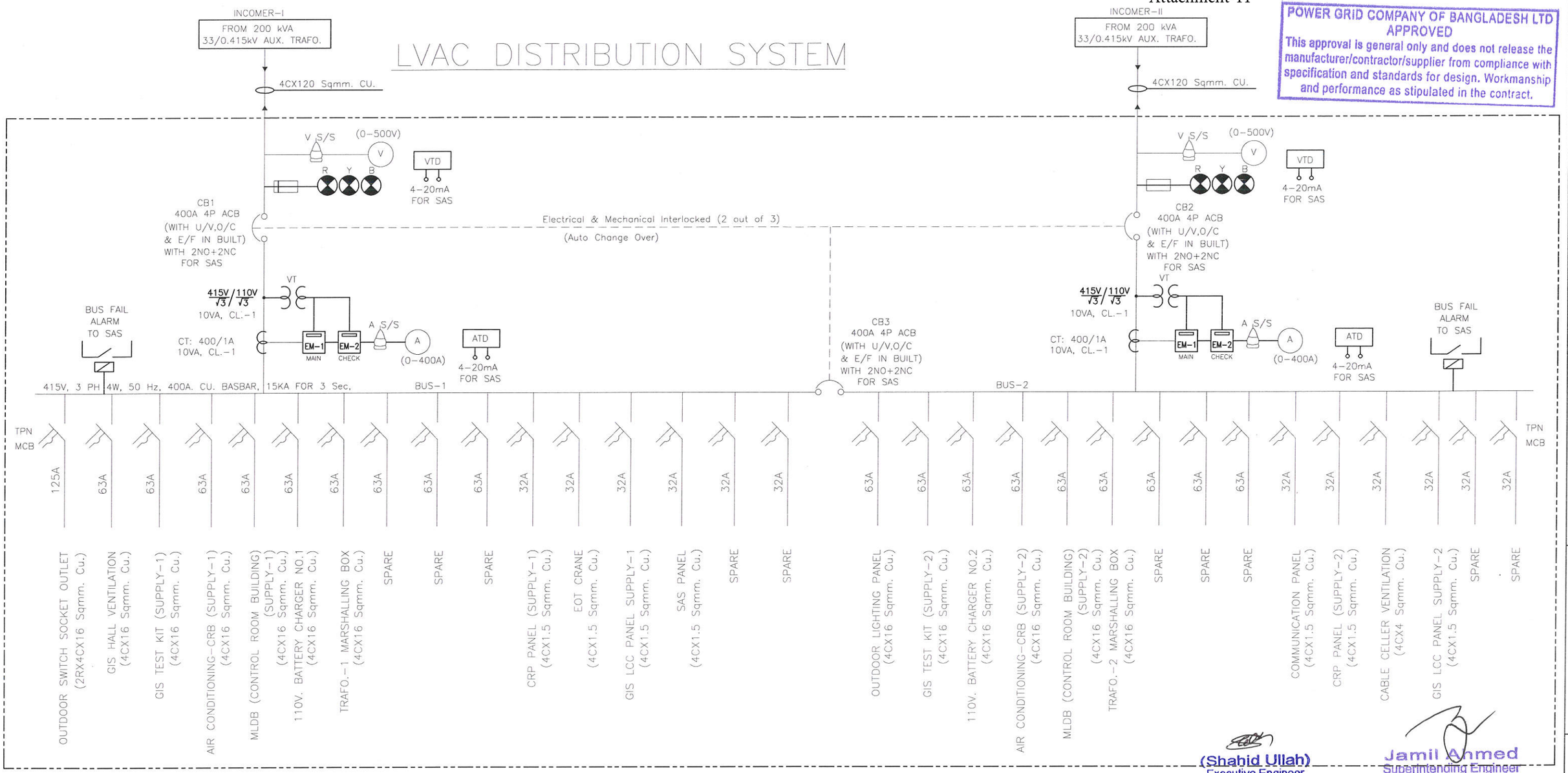
Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD	ABB		
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 110V DC DISTRIBUTION PANEL AT 132/33kV KALURGHAT (GIS) SUBSTATION	Scale NTS
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LVAC DISTRIBUTION SYSTEM



(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

NOTES:

1) 51/51N/27 SHALL BE PROVIDED IN BOTH INCOMER 1 AND 2. THIS MAY BE INBUILT FEATURE OF INCOMER ACB.

2) TARIFF METERS (MAIN & CHECK) SHALL BE OF ACCURACY CLASS – 0.2. TARIFF METERS SHALL BE SUPPLIED LOOSE SEPARATELY AND SHALL BE MOUNTED ON LVAC BOARD AT SITE.

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
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Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No. PSEEIP (TRANCHE–3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD			
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM OF LVAC DISTRIBUTION PANEL FOR 132/33kV KALURGHAT (GIS) SUBSTATION	Scale NTS
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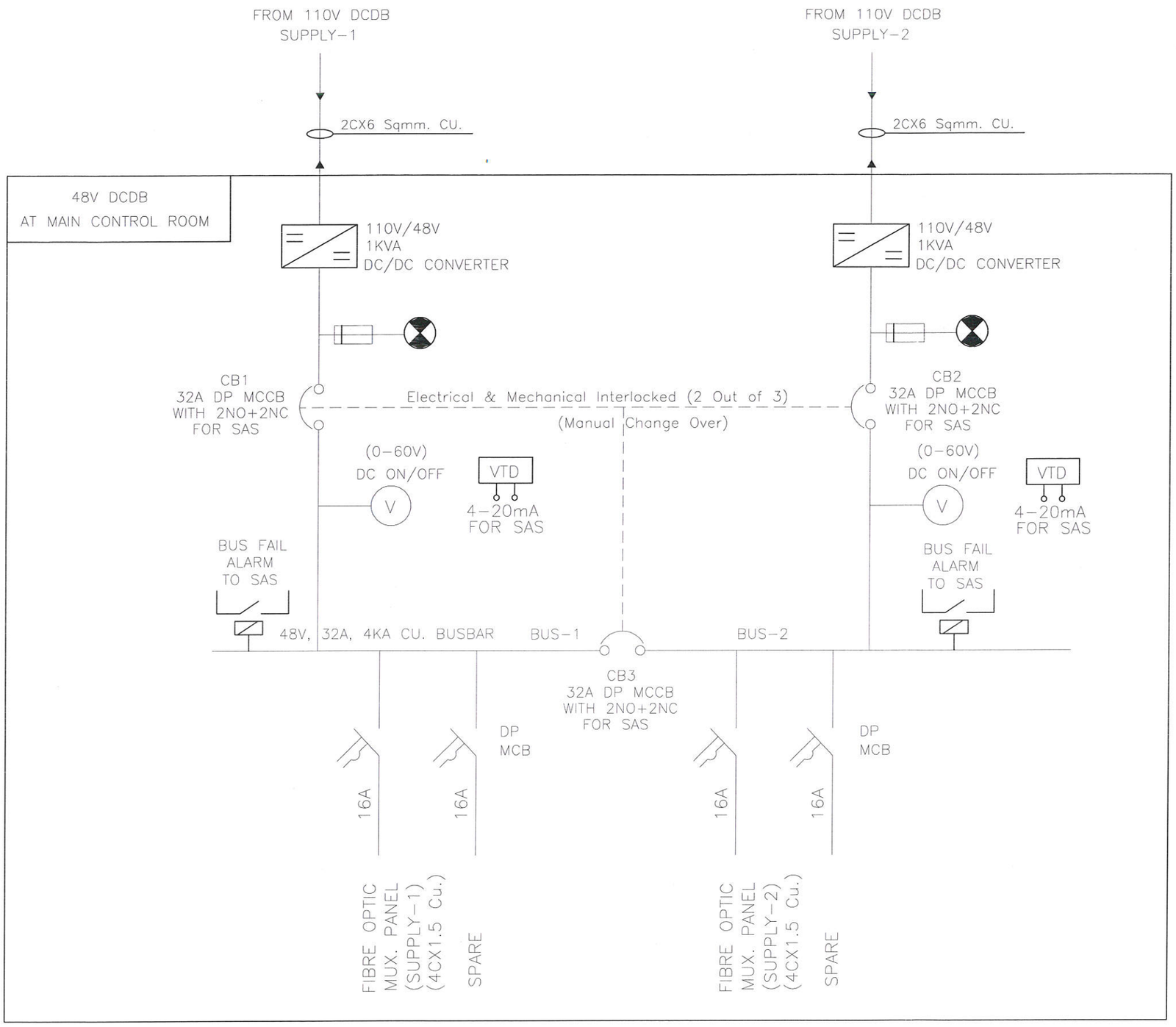
48V DC DISTRIBUTION SYSTEM

POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
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(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018



LEGEND

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A	2018-02-13	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS			Paper size A3
Checked 2017-10-30 SD	ABB				Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 48V DC DISTRIBUTION PANEL AT 132/33kV COMILLA(S) (GIS) SUBSTATION			
Resp. (div./dept) IN PGGI-SI(2882)		Document id. 3VIN170633X3068	Page 01/01	Date 2018-02-13	Rev. A / Lang. EN

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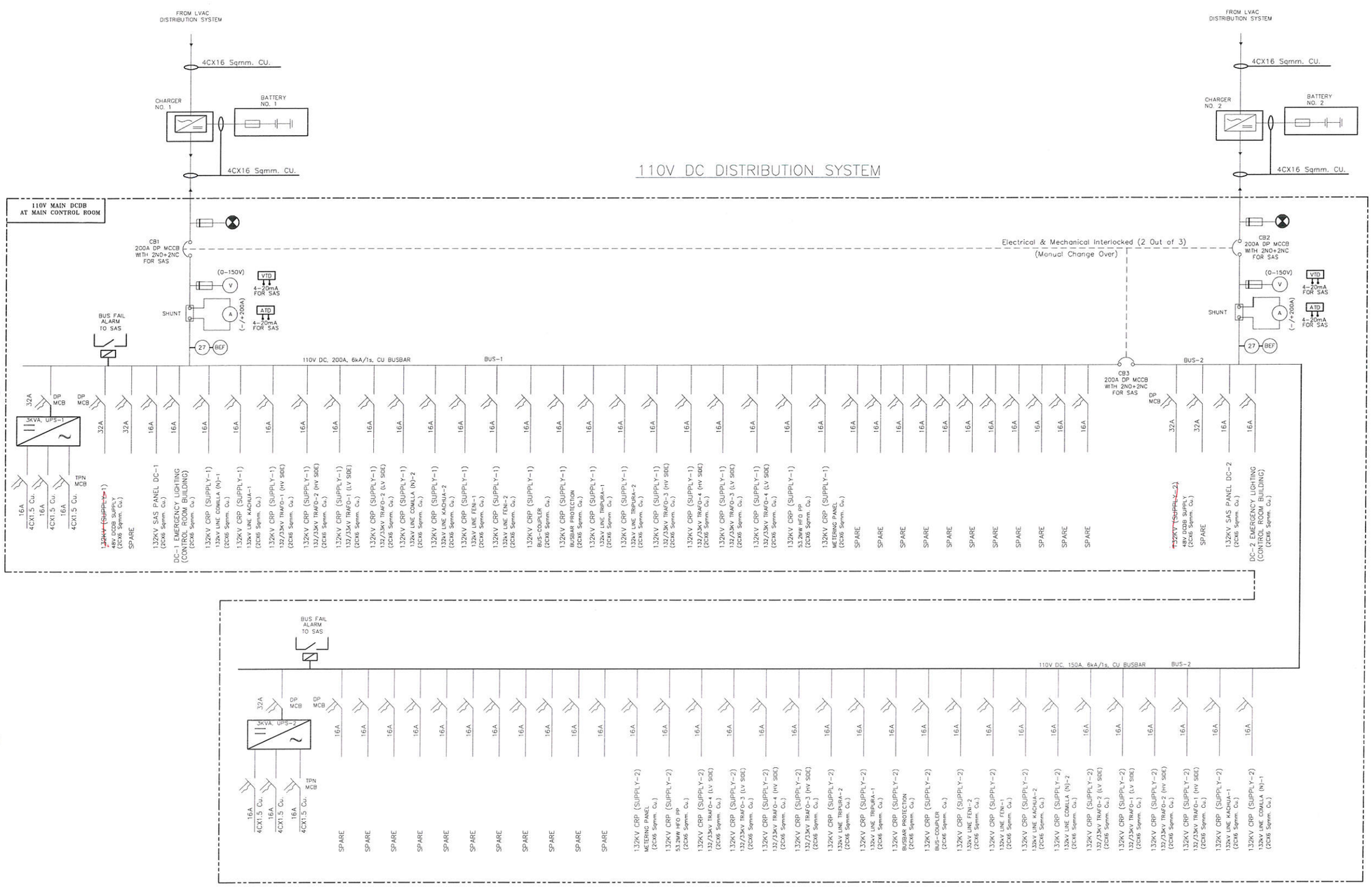
POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specification and standards for design, Workmanship and performance as stipulated in the contract.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

110V DC DISTRIBUTION SYSTEM



NOTES :

1. 2 NOS. 3KVA UPS FOR SAS PANELS SHALL BE MOUNTED ON 110V DCDB.
2. CHARGER INCLUDES DIODE VOLTAGE REGULATORS (DVR).

LEGEND

- DC INCOMER ON/OFF INDICATION
- (V) DC VOLTMETER
- (A) DC CENTRE ZERO AMMETER
- (27) U/V PROTECTION
- (BEF) BATTERY E/F PROTECTION

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-13	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

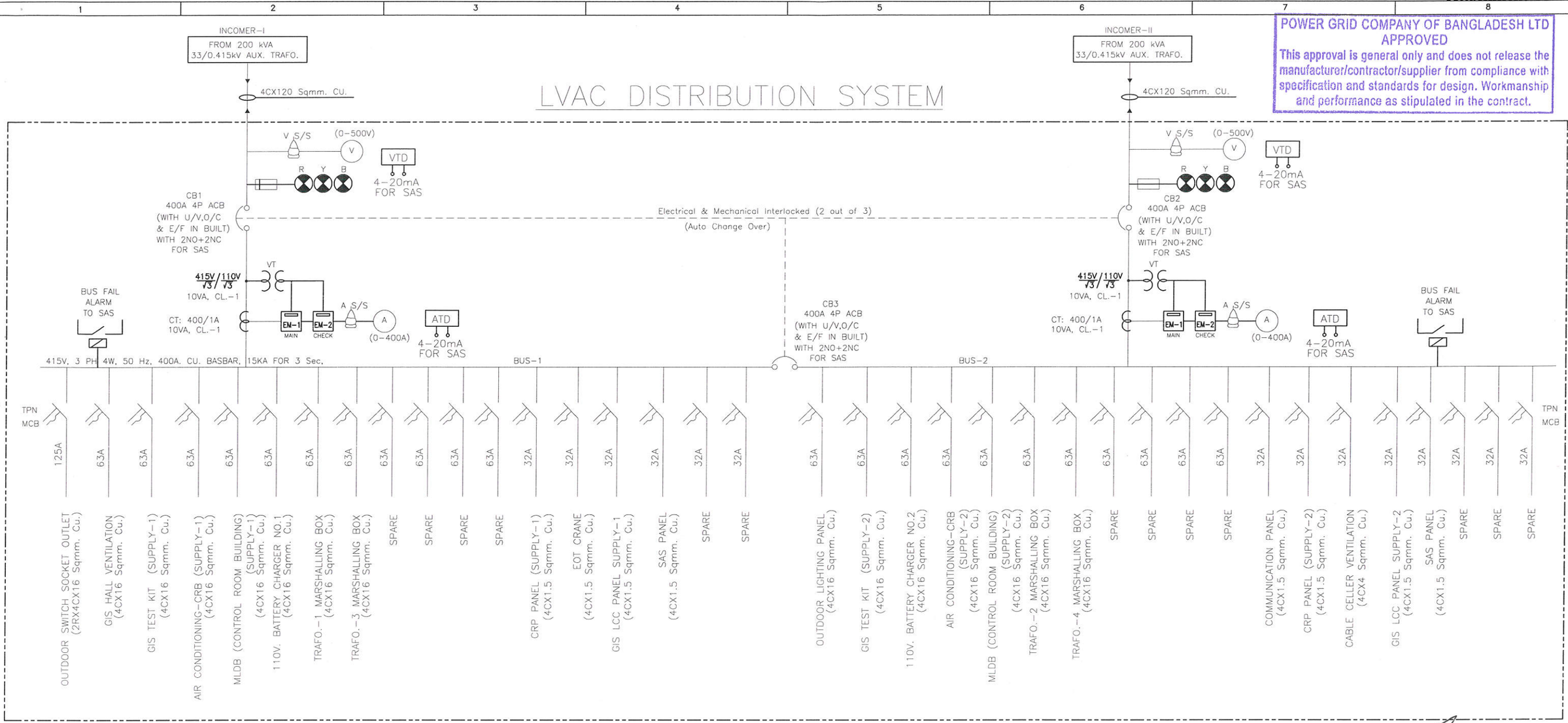
Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD			Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 110V DC DISTRIBUTION PANEL AT 132/33kV COMILLA(S) (GIS) SUBSTATION	
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LVAC DISTRIBUTION SYSTEM



NOTES:

1) 51/51N/27 SHALL BE PROVIDED IN BOTH INCOMER 1 AND 2. THIS MAY BE INBUILT FEATURE OF INCOMER ACB.

2) TARIFF METERS (MAIN & CHECK) SHALL BE OF ACCURACY CLASS – 0.2. TARIFF METERS SHALL BE SUPPLIED LOOSE SEPARATELY AND SHALL BE MOUNTED ON LVAC BOARD AT SITE.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
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A	2018-02-13	REVISED AS PER PGCB COMMENTS, DATED–02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

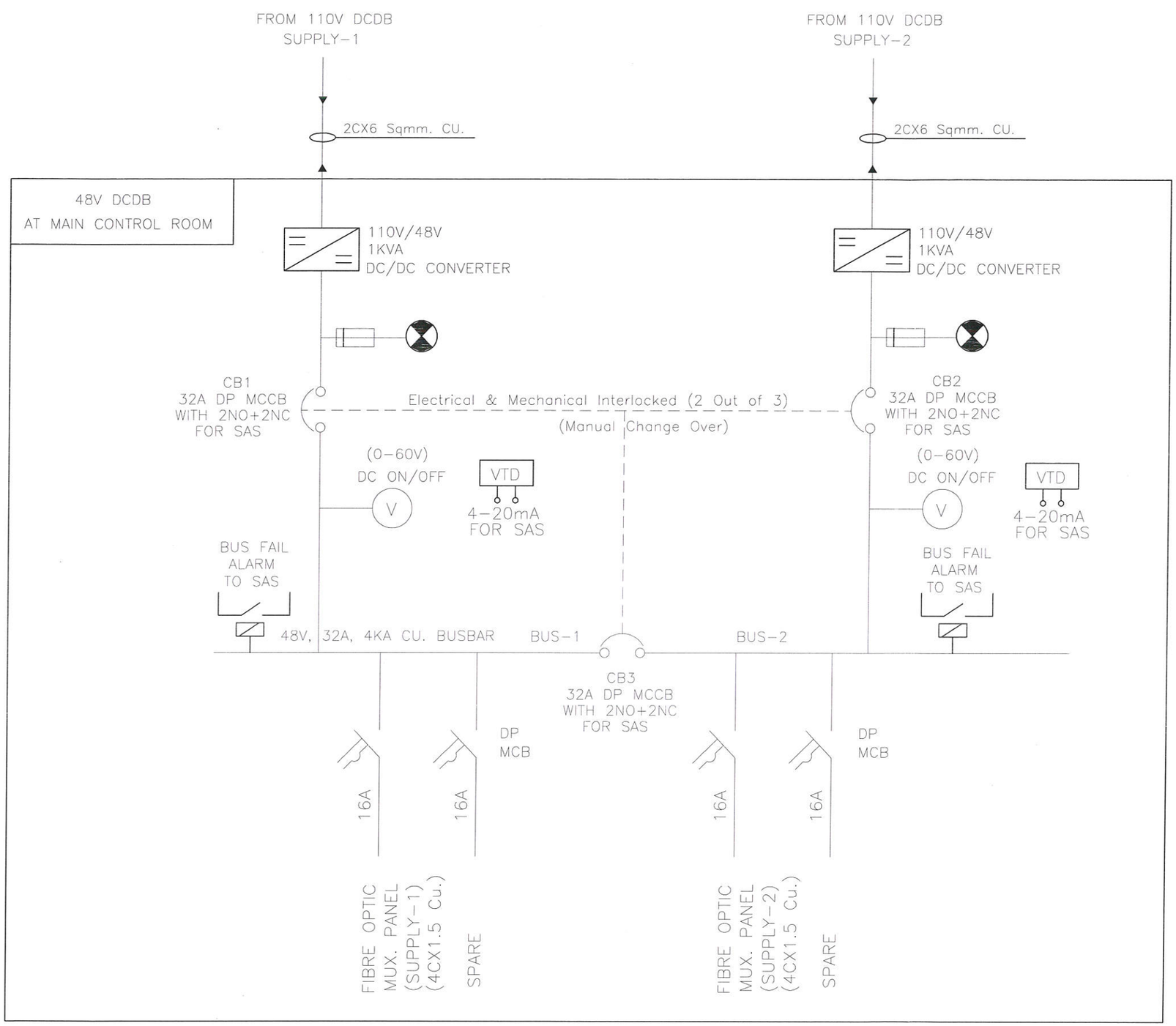
Contract No. PSEEIP (TRANCHE–3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD	ABB		Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM OF LVAC DISTRIBUTION PANEL FOR 132/33kV COMILLA(S) (GIS) SUBSTATION	
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48V DC DISTRIBUTION SYSTEM



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(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

LEGEND

DC INCOMER ON/OFF INDICATION

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
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A	2018-02-15	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

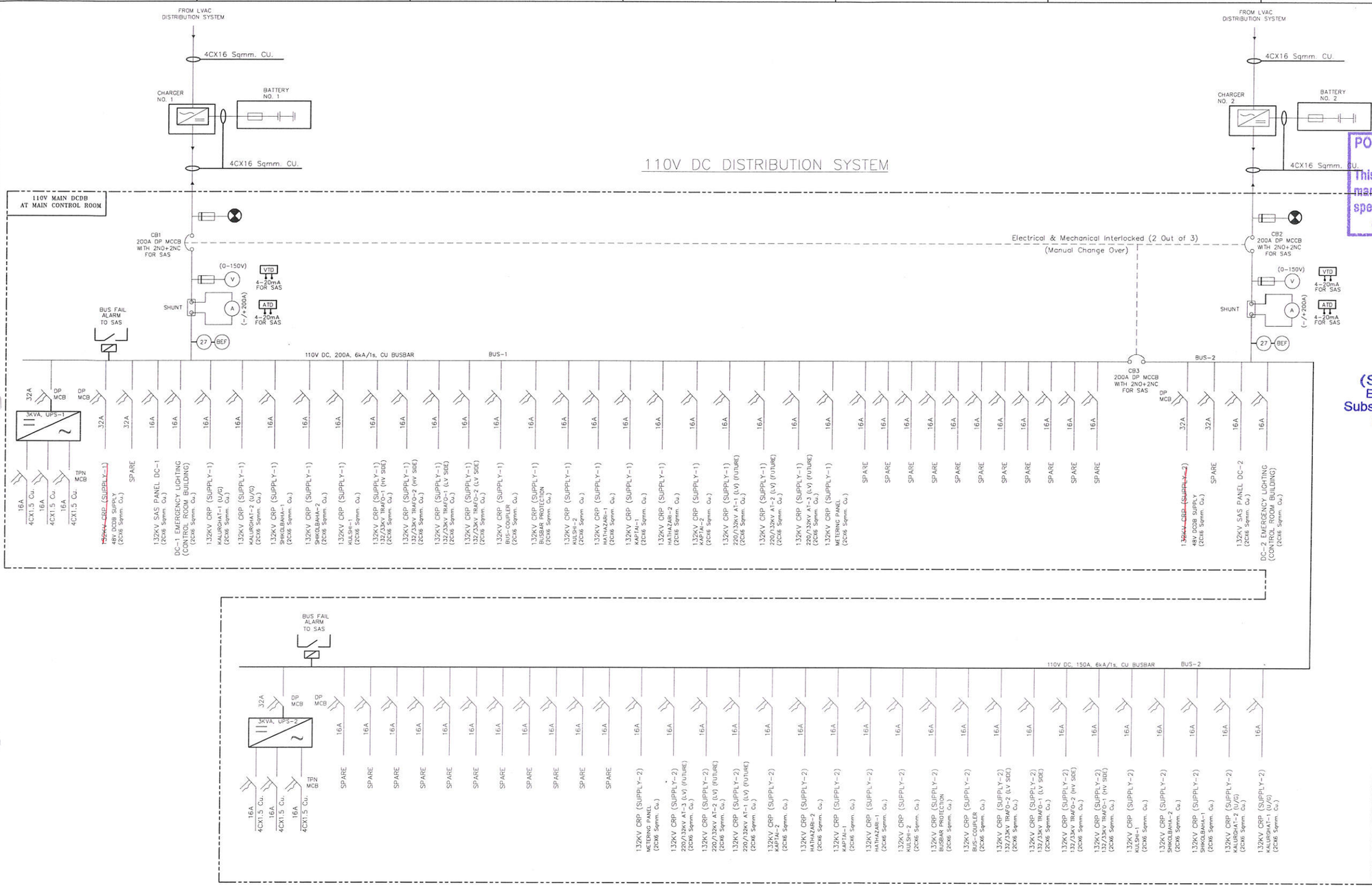
Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD			Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 48V DC DISTRIBUTION PANEL AT 132/33kV MADUNAGHAT (GIS) SUBSTATION	
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110V DC DISTRIBUTION SYSTEM



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(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

NOTES :

1. 2 NOS. 3KVA UPS FOR SAS PANELS SHALL BE MOUNTED ON 110V DCDB.
2. CHARGER INCLUDES DIODE VOLTAGE REGULATORS (DVR).

LEGEND

- (X) DC INCOMER ON/OFF INDICATION
- (V) DC VOLTMETER
- (A) DC CENTRE ZERO AMMETER
- (27) U/V PROTECTION
- (BEF) BATTERY E/F PROTECTION

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-15	REVISED AS PER PGCB COMMENTS, DATED-02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

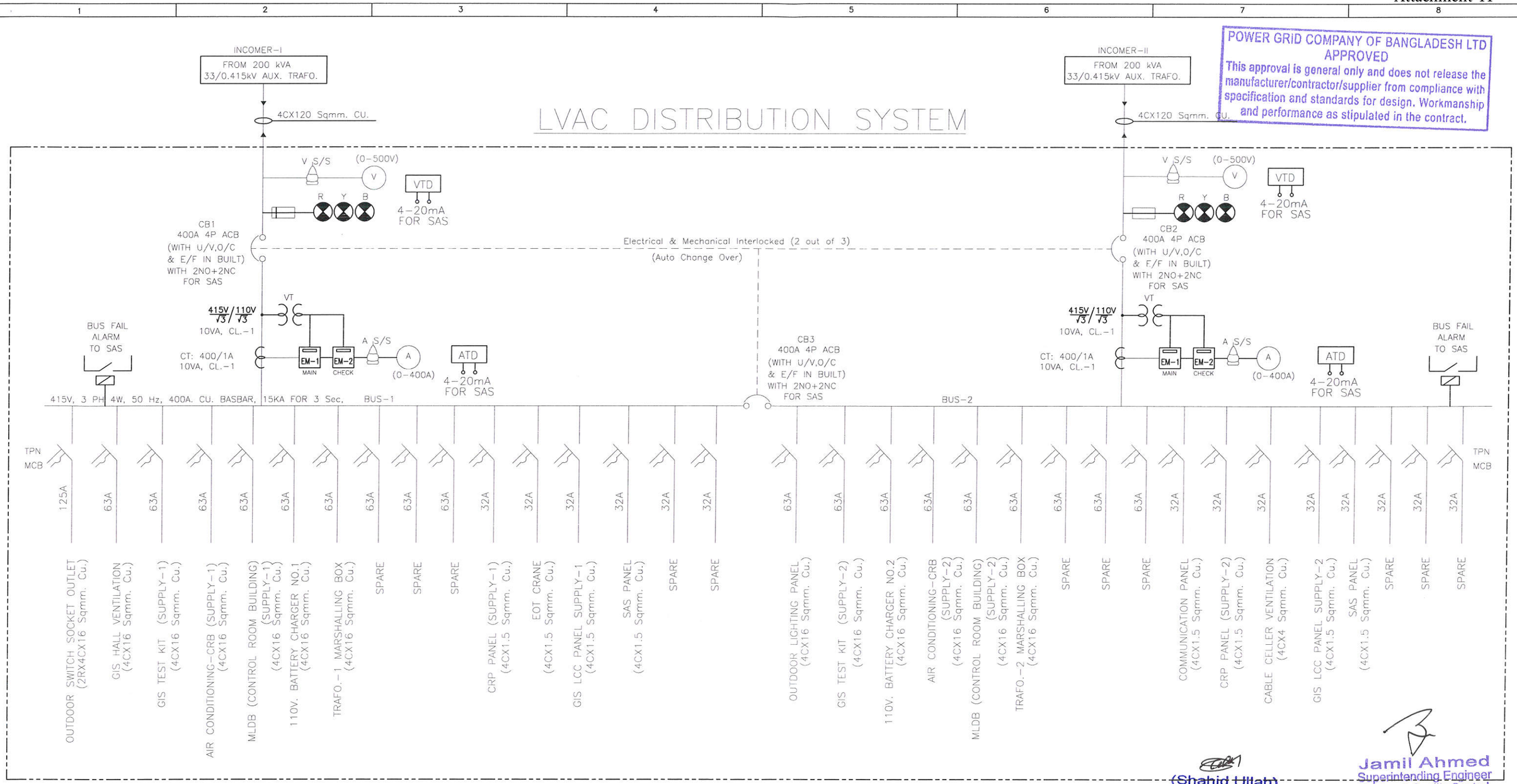
Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A3
Checked 2017-10-30 SD	ABB		Scale NTS
Approved 2017-10-30 PKD		Title SINGLE LINE DIAGRAM FOR 110V DC DISTRIBUTION PANEL AT 132/33kV MADUNAGHAT (GIS) SUBSTATION	
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LVAC DISTRIBUTION SYSTEM



(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

19 FEB 2018

NOTES:

1) 51/51N/27 SHALL BE PROVIDED IN BOTH INCOMER 1 AND 2. THIS MAY BE INBUILT FEATURE OF INCOMER ACB.

2) TARIFF METERS (MAIN & CHECK) SHALL BE OF ACCURACY CLASS – 0.2. TARIFF METERS SHALL BE SUPPLIED LOOSE SEPARATELY AND SHALL BE MOUNTED ON LVAC BOARD AT SITE.

REV	DATE	DESCRIPTION	ELE.	CIV.	STR.	C.M.	P.M
			REVIEWED BY				
A	2018-02-15	REVISED AS PER PGCB COMMENTS, DATED–02.01.2018	✓			✓	✓
NIL	2017-10-30	FIRST SUBMISSION	✓			✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No.: PSEEIP (TRANCHE–3)/ADB/PGCB/P03/SS

Prepared 2017-10-30 IC	Document kind: FOR APPROVAL	Project: CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size: A3
Checked 2017-10-30 SD			
Approved 2017-10-30 PKD	ABB	Title: SINGLE LINE DIAGRAM OF LVAC DISTRIBUTION PANEL FOR 132/33kV MADUNAGHAT (GIS) SUBSTATION	Scale: NTS
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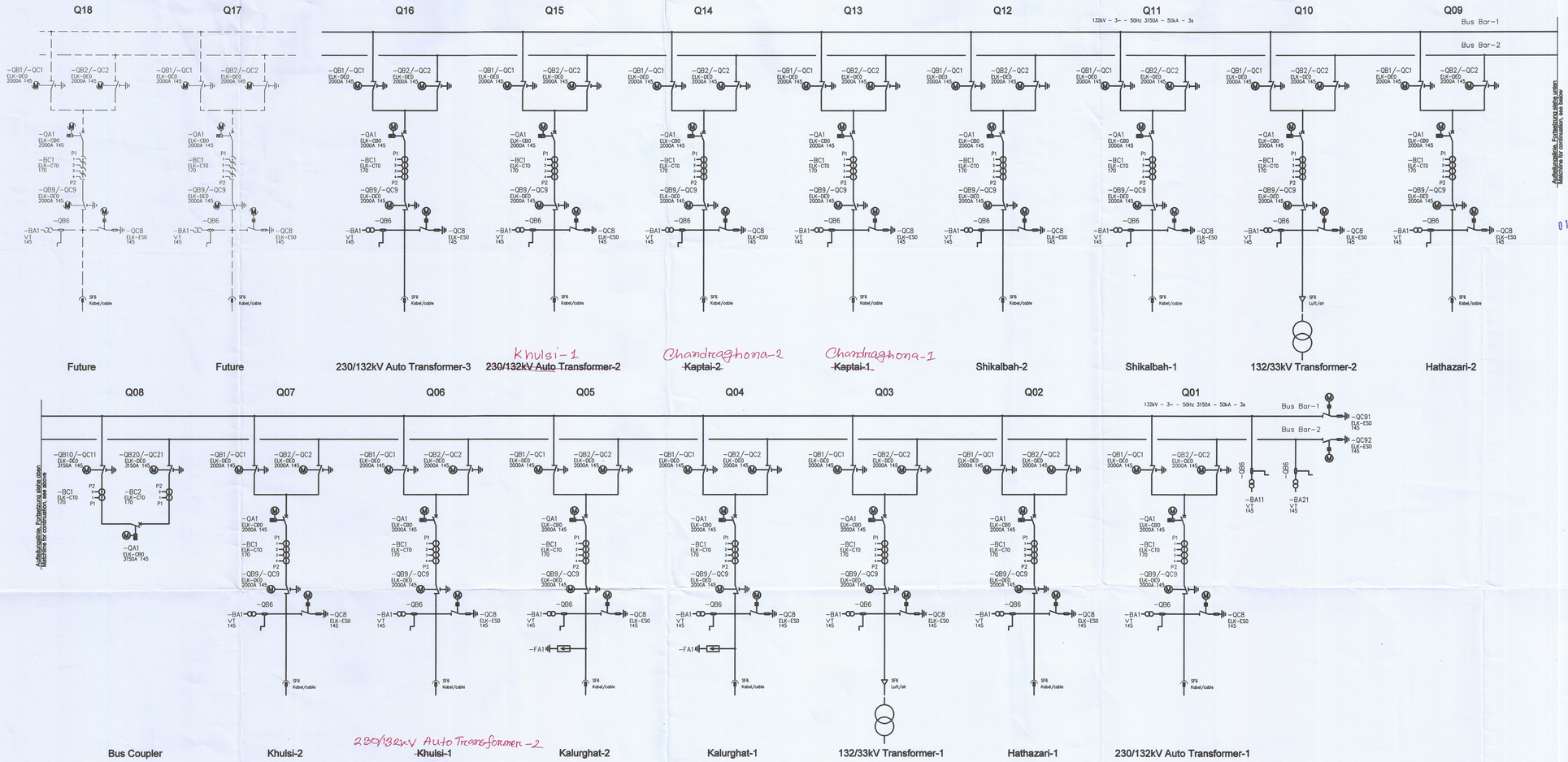
ATTACHMENT-12

POWER GRID COMPANY OF BANGLADESH LTD
APPROVED with correction
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Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

01 MAR 2018



Legende
Legend

	Leistungsschalter Circuit breaker
	Trennschalter mit Arbeitserdungsschalter (Motor) Disconnector with maintenance earthing switch (motor)
	Stromwandler Current transformer
	Spannungswandler mit integrierter Abtrennvorrichtung (manuell) Voltage transformer with integrated isolating device (manual)
	Einschaltfester Erdungsschalter Earthing switch with short-circuit making capacity
	Steckbarer Kabelendverschluss Plug-in cable termination
	Überspannungsableiter Surge arrester
	SF_6 - Luft - Durchführung SF^6 / air bushing
	Leistungstransformator Power transformer

Bemessungswerte
Rated values

Betriebsspannung [kV] Operating voltage [kV]	132
Bemessungsspannung [kV] Rated voltage [kV]	145
Stehwechselspannung: Power frequency withstand voltage:	
- gegen Erde [kV] - to earth [kV]	275
- über Trennstrecke [kV] - across isolating distance [kV]	315
Frequenz [Hz] Rated frequency [Hz]	50
Stehblitzstoßspannung: Lightning withstand voltage:	
- gegen Erde [kV] - to earth [kV]	650
- über Trennstrecke [kV] - across isolating distance [kV]	750
Kurzzeitstrom [kA] Rated short-time withstand current [kA]	50
Dauer [s] Duration [s]	3
Stoßstrom [kA] Rated peak withstand current [kA]	135
Bemessungs-Strom Sammelschiene [A] bei 40°C Rated normal current bus-bar [A] at 40°C	3150

Spannungswandler
Voltage transformer

Feld Feeder	Wicklungen Windings	Übersetzung Ratio	Klasse Class	Wicklungstyp Type of winding	Bürden Burden
Q01 - Q07, Q09 - Q16	Primär Primary	132 kV / √3			
-BA1 -BA11 -BA21	Sekundär 1 Secondary 1	110 V / √3	0.2	Messung Metering	50VA
	Sekundär 2 Secondary 2	110 V / √3	3P	Schutz Protection	50VA

Überspannungsableiter
Surge arrester

Feld Feeder	Q04,Q05
Dauerbetriebsspannung Continuous operating voltage	Uc = 96 kV rms
Bemessungsspannung Rated voltage	Ur = 132 kV rms
Leitungsentladungsklasse Line discharge class	3

Stromwandler
Current transformer

Feld Feeder	Kern-Nr. Core-No.	Übersetzung Ratio	Klasse Class	Kerntyp Type of core	Bürden Burden
Q01,Q02 Q04-Q07,Q09 Q11-Q16 -BC1	1	*800/*1600/1 A	5 P 20	Schutz Protection	40
	2	*800/*1600/1 A	5 P 20	Schutz Protection	30
	3	*800/*1600/1 A	0,2 FS 5	Messung Metering	15
	4	3000/1 A	5 P 20	Schutz Protection	10
Q03,Q10 -BC1	1	400-800/1 A	5 P 20	Schutz Protection	30
	2	400-800/1 A	5 P 20	Schutz Protection	30
	3	400-800/1 A	0,2 FS 5	Messung Metering	15
	4	3000/1 A	5 P 20	Schutz Protection	10
Q08 -BC1,-BC2	1	3000/1 A	5 P 20	Schutz Protection	10
	2	3000/1 A	5 P 20	Schutz Protection	10

Zugehörige Zeichnung
Reference Drawing:

1HDZ605219 - Grundriss GIS-Layout

Rev.	Modification	Modified by	Mod. Date
A	Bay rearranged, 3 bays added and CT Table updated	Praveen	2018-02-02
-	Base Design	Hari	2017-12-15

Customer: PG Company of Bangladesh / Bangladesh
Project name: 132 kV SF6 GIS Madunaghat

Project ID: 2410008710	Replacing: -	Based on:	Size: A1	Scale: %	
Responsible department: PGHV-GP4	Technical reference: -	Document kind:		Object designation: -E1AL1	DCC: &EFH
ABB AG Germany	Created by: Hari Approved by: Bayer	Title: Übersichtsschaltplan Single Line Diagram		Document ID: 1HDZ605221	
				Rev.: A	Rel. Date: 2018-02-02
				Lang.: EN	Page: 1 / 1

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RAHMEN-A1

CAD-Zeichnung

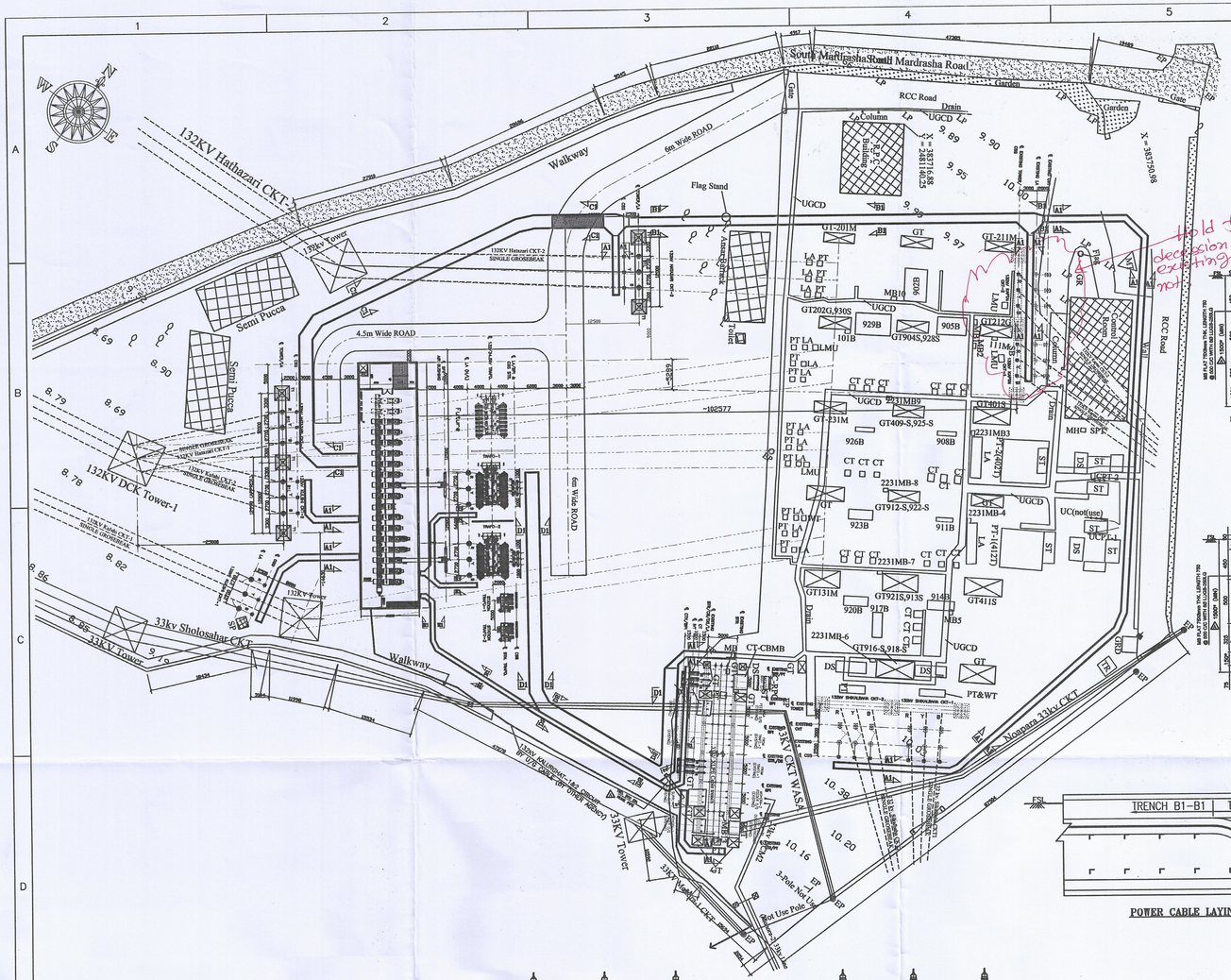
POWER GRID COMPANY OF BANGLADESH LTD
APPROVED
This approval is general only and does not release the manufacturer/contractor/supplier from compliance with specification and standards for design, Workmanship and performance as stipulated in the contract.

ATTACHMENT-13

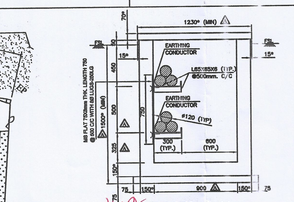
(Shahid Ullah)
Executive Engineer
Substation Design & QC
PGCB, Dhaka.

Jamil Ahmed
Superintending Engineer
Design & Quality Control
PGCB Ltd.

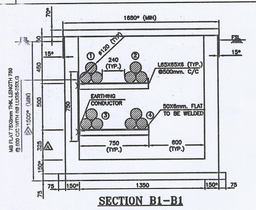
19 FEB 2018



hold for pending decision issues of existing not working on Sunday

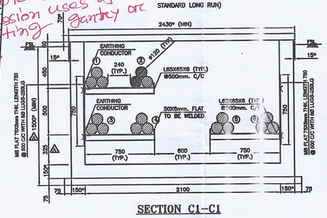


SECTION A1-A1
(FOR 2 CIRCUITS, 6 Nos., 132kV POWER CABLE IN STANDARD LONG RUN)



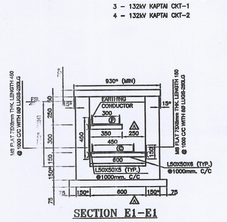
SECTION B1-B1

1 – 132kV SHIKALBAHA CKT-1
2 – 132kV SHIKALBAHA CKT-2
3 – 132kV KAPTAI CKT-1
4 – 132kV KAPTAI CKT-2

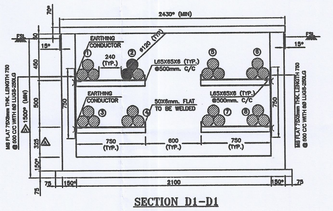


SECTION C1-C1

1 – 132kV SHIKALBAHA CKT-1
2 – 132kV SHIKALBAHA CKT-2
3 – 132kV KAPTAI CKT-1
4 – 132kV KAPTAI CKT-2
5 – 132kV HATAZARI CKT-1
6 – 132kV HATAZARI CKT-2

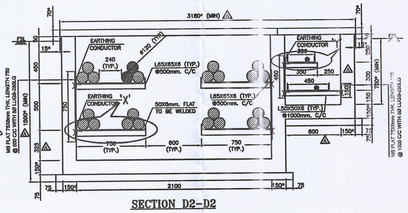


SECTION E1-E1

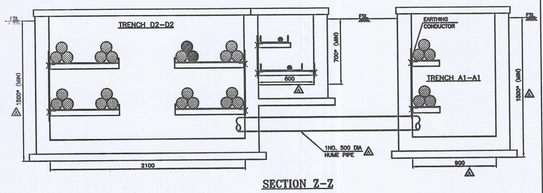


SECTION D1-D1

1 – STATION TRANSFORMER-1
2 – STATION TRANSFORMER-2
3 – 132/33kV TRANSFORMER-1 (R-Ph.)
4 – 132/33kV TRANSFORMER-1 (Y-Ph.)
5 – 132/33kV TRANSFORMER-2 (R-Ph.)
6 – 132/33kV TRANSFORMER-2 (Y-Ph.)
7 – 132/33kV TRANSFORMER-1 (B-Ph.)
8 – 132/33kV TRANSFORMER-2 (B-Ph.)

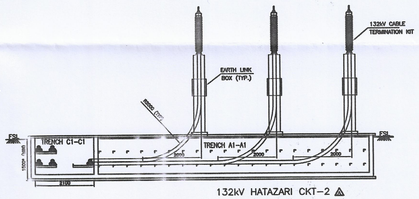


SECTION D2-D2

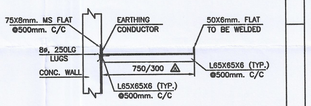


SECTION Z-Z

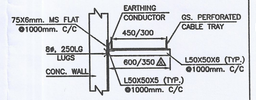
POWER CABLE LAYING ARRANGEMENT



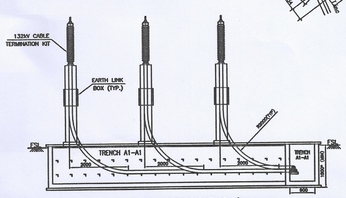
132kV HATAZARI CKT-2



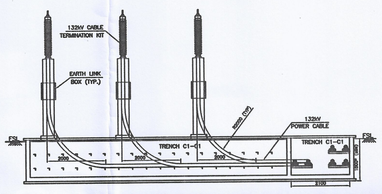
DETAIL-X



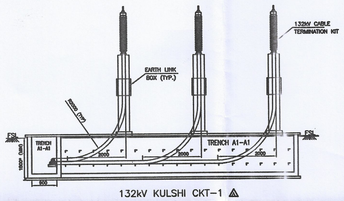
DETAIL-Y



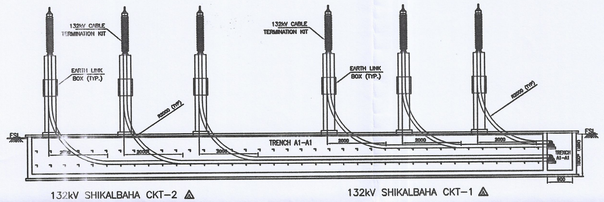
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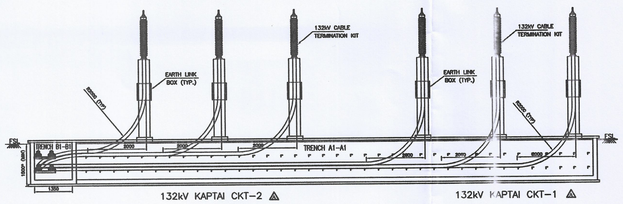
132kV HATAZARI CKT-1



132kV KULSHI CKT-1



132kV SHIKALBAHA CKT-2 | 132kV SHIKALBAHA CKT-1



132kV KAPTAI CKT-2 | 132kV KAPTAI CKT-1

NOTES:

1. ALL DIMENSIONS/LEVELS ARE IN MM. UNLESS OTHERWISE SPECIFIED. "FSL" DENOTES SWITCHYARD SURFACE FINISHING LEVEL.
2. ALL DEPTHS/DIMENSIONS SPECIFIED WITH "*" ARE MINIMUM SLOPE ON TRENCH BED AND DEWATERING ARRANGEMENT SHALL BE AS PER SPEC.
3. FIXING ARRANGEMENT OF CABLE RACKS SHALL BE KEPT ON THE INSIDE FACE OF THE TRENCH.
4. LIFTING HOOKS TO BE PROVIDED ON EVERY 10 TH. OF COVER SLAB.
5. WHEREVER FUTURE EXPANSION POSSIBILITIES ARE THERE IN THE TRENCH, END WALL WILL BE OF 250 THK. BRICK WORK (1:6) WITH PLASTER FINISH.
6. ILLUMINATION CABLE, FFPH CABLE TO BE LAID IN TRENCH AND WHEREVER TRENCHES ARE NOT AVAILABLE IT WILL RUN IN DIRECTLY BURIED TRENCH.
7. POWER AND CONTROL CABLE WILL BE LAID IN TWO LAYERS.
8. CABLE TRENCH IN THIS DRAWING IS TO INDICATE THE BASIC ROUTING AND VARIOUS SECTIONS ACCORDING TO ELECTRICAL REQUIREMENT. IF ANY PART OF THE CABLE TRENCH FOULS WITH ANY FOUNDATION, THE TRENCH MAY BE RE-ROUTED TO SUIT AT SITE.
9. EARTH FLAT IN CABLE TRENCH WILL RUN ALONG THE TOP TIER OF EACH CABLE TRENCH SECTION.
10. THIS DRAWINGS SHALL BE REFERRED FOR BASIC ELECTRICAL REQUIREMENT CABLE TRENCH & FOR OTHER DETAILS RELATED TO CIVIL WORK REFER RELEVANT CIVIL DRAWINGS.

REFERENCE DRAWINGS :-

1- ELECTRICAL LAYOUT PLAN & SECTION FOR 132/33kV MADUNAGHAT (GIS) SUBSTATION, DRAWING NO.- 3VIN170633X1007.

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REV	DATE	DESCRIPTION	REVIEWED BY ELE.	CIV.	STR.	C.M.	P.M
A	2018-02-09	REVISED AS PER PGCB COMMENTS, DATED-04.02.2018	✓	✓	✓	✓	✓
NIL	2017-09-18	FIRST SUBMISSION	✓	✓	✓	✓	✓

Customer: POWER GRID COMPANY OF BANGLADESH LTD.

Contract No. PSEEIP (TRANCHE-3)/ADB/PGCB/P03/SS

Prepared 2017-09-18 IC	Document kind FOR APPROVAL	Project CONSTRUCTION AND COMPLETION OF 132/33kV AIS SUBSTATION AT KACHUA, 132/33kV GIS SUBSTATION AT KALURGHAT AND UPGRADATION OF EXISTING 132/33kV MADHUNAGHAT & COMILLA(S) AIS SUBSTATION TO GIS SUBSTATIONS ON TURNKEY BASIS	Paper size A0
Checked 2017-09-18 SD			Scale NTS
Approved 2017-09-18 PKD		Title OUTDOOR CABLE TRENCH LAYOUT FOR 132/33kV MADUNAGHAT (GIS) SUBSTATION	
Resp. (div./dept) IN PGGI-SI(2882)		Document id. 3VIN170633X0043 / Page 01/01 / Date 2018-02-09	Rev. A / Lang. EN