

POWER GRID COMPANY OF BANGLADESH LIMITED



**Tender Documents
for
Procurement of**

**Design, Supply, Installation, Testing &
Commissioning of 400kV AIS Bay extension at
Kaliakoir 400/230kV Substation (Package-2, Lot-1)**

Volume 3 of 3

Invitation for Bids No. :27.21.0000.101.07.413.21.5568, December 22, 2021
ICB No. : PGCB/EXIM BANK/LOC-2/400kV/SS-KAL
Country : Peoples Republic of Bangladesh

Employer:



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OVERALL DESCRIPTION OF THE WORKS

1.1 Description of Overall Project

The Government of Peoples Republic of Bangladesh has prioritized the power sector development and has taken massive initiatives to build a country wide power network (transmission & distribution). As per our Power System Master Plan (PSMP, 2016), a transmission system capable of supplying 40000 MW electricity throughout the country is necessary by 2030. With the aim of realizing Government's vision, Power Grid Company of Bangladesh Ltd. (PGCB) has undertaken numerous projects to strengthen the National Grid in order to meet the proliferating demand of electricity of the country.

At present, we have natural gas, oil, coal-based power plants. In our country, reserve of natural gas and coal is limited. The remaining natural gas and other sources will take less time to get depleted as consumption rate is getting high. Moreover, because of utilization of natural gas in electricity generation, production in other economic sectors are being hampered. On the other hand, availability of fossil oil is completely dependent on import. Import of fossil oil and coal also involves huge expense in foreign currency. The Government has planned to install nuclear power plant (NPP) at Rooppur. The 2x1200 MW Nuclear Power Plant will be built at Rooppur in two stages about 200 km north-west of Dhaka with the assistance of Russia. First & second units of nuclear power generators are expected to come in operation by 2022 & 2023 respectively.

This project about the power evacuation infrastructure development consisting of 01 no. of 400 kV double circuit transmission line including river crossing (using river bed towers) lines from Bogura 400kV SS to Kaliakoir 400kV SS, 01 no. of 230kV double circuit line from Bogura to Barapukuria, 2 nos. 400 kV bay extensions at kaliakoir 400kV SS, 2 nos. 230 kV bay extensions at Barapukuria 230kV SS and implementation of Frequency Control and Frequency drop protection, power system protection, emergency control system and other associated task for qualitative upgradation of Bangladesh power system.

These infrastructures will help PGCB to connect Rooppur Nuclear Power Plant to national grid of Bangladesh and is also about recommended qualitative upgradation of Bangladesh power system which is the mandatory for the integration and the safe operation of Rooppur Nuclear Power Plant.

1.2 Description of this Package

The scope of works under this turnkey contract is: design, supply, manufacture, quality assurance, inspection and testing, delivery, new packing for export, insurance, shipment & transport to the site, complete construction and installation, jointing, terminating, bonding, earthing, painting, setting to work, site testing and commissioning, defect liability for all equipment, including all civil works for extension of existing 400kV AIS, 230kV AIS.

All necessary works have to including in the contract price, including all kinds of dismantling works, if any.

The civil design has to incorporate countermeasures against flooding so as not to affect any substation equipment during the wet season. Given the recorded past maximum flood water level in the project area, sufficient ground level height for land formation is required at the Contractor's responsibility.

The Bidders are advised to conduct site visits, to inform themselves and to carry out their own assessment on all concern sites according to their needs before the submission of their bids. The Employer may arrange necessary permission, if required by the Bidders.

The geotechnical studies and soil investigations are in the Contractor's scope of work.



The Civil Design and backfilling have to consider and incorporate protection measures against flooding. The sufficient ground level height for land formation is required at the Contractor's responsibility and will be subject of the Employer's approval. Finishing Ground Level (FGL) shall be at least 500 mm above the Highest Flooding Level (HFL). The Bidders has to inform themselves about the HFL.

Generally, **land development of new substation** shall be made for the **total substation area** and **boundary wall** shall be made for the **total substation area**.

Generally, **land development** of the **substation** which has to be **extended/renovated** shall be made only for the **required substation area** and **extension** of the **boundary wall** shall be made only if it is required.

The Contractor's responsibility is to provide that all parts of the works be completed in every respect for commercial operation, to the requirements of the Engineer.

The drawings provided in the bidding documents are indicative only and hence do not reflect the entire scope of works. The Bidder has to consider all Tender drawings as preliminary and for Tender purpose only. The drawings may be changed at the time of execution. All dimensions are preliminary and general. Not all equipment is shown on the drawings. Details are not shown at all. The Contractor has to make Engineering and to provide detail calculation, detail design and detail drawings of the complete facilities, which will be subject of the Employer's approval.

The Bidder is deemed to have visited site, inspected, gathered data and verified details of the as-built system in order to design, supply and interface their new equipment. All necessary materials, adjustments, dismantling, remedial and tiding-up work in order to complete the work specified shall be included in the contract price.

The other ends of Transmission Lines have to be covered from the tele-communication point of view under the scope of this contract. All equipment and services have to be provided. All necessary materials, adjustments, dismantling, remedial and tiding-up work in order to complete the work specified shall be included in the contract price. The bid price shall include supply and delivery of mandatory spare parts, maintenance tools and test equipment.

The works under this turnkey contract include the following:

- Extension of 02 (two) nos. 400kV AIS Bays at existing 400kV **Kaliakoir Substation**

Detail scope of work is described in schedule-A.

1.3 Detailed Description of the Scope of Supply for Tele-communication System

The communication part of the project shall provide the interconnection between all substations involved in the Project:

- Extension of 02 (two) nos. 400kV AIS Bays at existing 400kV **Kaliakoir Substation**

The purpose of the telecommunication system is to provide all the necessary telecommunication channels for the following sub-systems:

- SCADA for data exchange between the substations and the National Load Despatch Centre (NLDC) by two communication technologies i.e. LAN & WAN
- Tele-protection to enable the communication between line differential protection relays and between distance protection relays,
- Telephone to enable telephone communication between the substations and NLDC,



- Metering: Data transfer between meters and the entity in charge of collecting and processing metering data,
- Any other telecommunication channels.

Digital PLC System shall be provided for each 420 kV Transmission Line. The characteristics shall be defined during the Design stage and there will be subject of the Employer's approval.

1.3.1 Recommendation of Communication system

Telecom equipment (Optical Transmission and ADD/DROP MUX)

- STM-16/64 / 10G or 100G / DWDM
 - MPLS (Layer-3)
- ADD/DROP Multiplexer (PDH)

Services:

- LAN Service (IP Phone, RTU/SAS, Office LAN etc)
- WAN Services (RTU, CC camera, DFDR, etc)
- E1/TDM/Tributary Services (PABX, etc)

NMS:

- End-to-End Trail management
- Protection management (I+I MPS, MSSP RING, SNCP, SNCMP)
- Clock management
- DCN Channel management

Existing equipment and facilities in PGCB Telecommunication Network

- STM-1/4
 - FOX-515/615
 - MSE-5010 (OSN-1500B)
 - MSE-5001 (Metro)
- ADD/DROP Multiplexer (PDH)
 - DXC-5000
 - FOX-515/615

Services:

- LAN Service (IP Phone, RTU/SAS etc)
- WAN Services (RTU, CC camera, DFDR, etc)
- TDM/Tributary Services (PABX, etc)

NMS :

- FOXMAN-UN/U-2000
 - End-to-End Trail management
 - Protection management (I+I MPS, MSSP RING, SNCP, SNCMP)
 - Clock management
 - DCN Channel management
 - License of all communication equipment for NMS Integration

1.3.2 Architecture of the Overall Telecommunication System

- Two (2) new SDH & PDH multiplexers (and with two (2) optical boosters only if it is required) and one (1) 48 cores Optical Distribution Frames (ODF).
- Two (2) digital PLC and two (2) Line Matching Units (LMU).

The length of the communication links is indicated in the provided drawing:

- **Map of Bangladesh Tele-communication system:**

A scheme of the overall telecommunication system is attached at following drawings:



- **SDH Telecommunication System and**
- **Digital PLC System**

1.3.3 Scope of Work and Supply

The scope of work and supply of the telecommunication system:

- One (1) optical fibre cable from the gantry for each of 400kV, 230 kV and/or 132 kV OHL to the substation communication room, including 48 cores and non-metallic (underground) but with the same optical characteristics with the OPGW (compliant to ITU-T-G 655 recommendation), shall be provided, for each of 400kV, 230 kV and/or 132 kV OHL at every involved Substation
- One (1) Optical Distribution Frames (ODF), of 48 cores capacity each, shall be provided, for each of 400kV, 230 kV and/or 132 kV OHL at every involved Substation. ODF shall be installed in the telecommunication / control room to facilitate the termination of fibres, testing and isolating of both the optical fibre cable and fibre optic terminal equipment.
- Two (2) Optical SDH / PDH multiplexers, shall be provided, for each involved Substation, including:
 - Duplicate CPU
 - Duplicate power supply
 - One optical STM-16 ports for each 400 kV transmission line
 - One optical STM-16 ports for each 230 kV transmission line
 - One optical STM-4 ports for each 132 kV transmission line
 - One 16x2 Mbps (E1) drop card
 - One 8x2 Mbps (E1) elect. Card
 - One card with four ports 10/100 Base T LAN
 - One card with four ports 10/100 Base T Router
 - One card with 10x2-w voice for FXS
 - Required no. of cards with 4x4 commands for distance protection after detail design
- The optical SDH / PDH multiplexer shall be preferably of ABB FOX 515/FOX 615 type and GE(make: UK & India) to ensure fully integration with existing FOX 515/FOX 615.
- Depending of the length of each 400 kV, 230 kV and/or 132 kV one or two optical boosters may be required.
- One (01) digital PLC with Ethernet facilities and two LMU (phase-to-earth coupling) shall be provided, for each of 400kV at every involved Substation, together with the coaxial cable for connecting PLCs to LMUs.

1.3.4 Engineering Services

General

The engineering services shall be provided by the Contractor to the necessary extent and detail of a turnkey project. They shall include drawings, instructions and all other technical documents required to allow the Contractor to build, erect, commission, operate and maintain the telecommunication system, even if these are not specifically mentioned in these Technical Requirements.

Design Services

The Contractor shall design in detail the general layout of the telecommunication system, based on the preliminary design and modifications agreed. This general layout shall be submitted to the Employer / Employer's Representative for approval and comments. It shall also include all detailed structural drawings, detailed descriptions and reports required to permit an exact understanding of the solution adopted.

Once the general layout is approved, the Contractor shall include following as a minimum requirement:

- design of all works required for the implementation and extension of the telecommunication



system, general layouts of the telecommunication system, engineering of telecommunication system, all necessary calculations.

These engineering services shall also include:

- design reports,
- complete drawings of all system,
- integration in the existing telecommunication system.

1.4 Detailed Description of the Scope of Supply for SCADA, Control & Monitoring System

1.4.1 Overall Scope of Work and Supply

The SCADA system will be based on:

- The communication with the NLDC shall be via the supplied gateway for Control and Monitoring System of the substation.
 - Industrial gateway shall be implemented at each involved substation for remote monitoring & control from the National Despatch Centre. It shall provide all the necessary control and monitoring facilities for 400kV, 230kV, 132 kV level and auxiliaries.
 - At existing substation, monitoring shall be provided through existing RTU. Contractor shall supply & install of necessary equipment such as sub rack, IED/relay, transducers, DI, DO card etc. for integrating new bays through existing RTU.
 - Contractor shall supply, install 2 (two) numbers of Industrial gateway and will be configured as master - hot standby mode or one gateway will report to main station & another will report to backup station. Gateway shall be capable report to both Main master station at Rampura (through VLAN network) & Standby Master Station at Bidyut Bhaban (through routed network) simultaneously. It will be configured according to the signal list, communication parameter, IP address, station address etc. provided by PGCB. The Gateway shall have adequate capacity (minimum 25% additional spare point with license) to meet to the future extensions of substation.
 - In case of windows operating system based gateway there should be USB port, VGA port, HDD/flash memory with one spare parts, TFT monitor with mouse and key board etc. Hard disk should be 50% free and CPU loading maximum of 30% at normal condition. If gateway is firmware based then 02(two) nos. of control card is required. Gateways also have minimum 06 nos. LAN port & redundant power supply. There should be GPS facilities for time synchronization. In addition, cyber security has to be ensured at field level with firewall. Supported Protocol shall be IEC 60870-5-104, 61850 & MOD Bus etc.
 - One laptop for each vendor & same software version is required with Acronis True image or Ghost or similar software for system back up & restoration.
 - All necessary adaptation work and configuration of the existing SCADA platform of the NLDC to integrate the Substations and the new bays shall be provided.
 - Minimum of four (4) or five (5) numbers, respectively, of 33 kV shed feeders shall be controlled from the SCADA system at each substation. All necessary equipment, including required number of BCU and panels shall be provided under the scope of the project.
- A scheme of the substation automation system is attached.

1.4.2 Adaptation and Configuration of the NLDC

Integrating Gateway with NLDC, the following work shall be done at Master Station and Standby Master Station.

Scope of work includes following:



Pre Database Work

- a) Collection of network data for EMS application
- b) Modelling, database creation, verification and update should be done at both NLDC
- c) Modification and update of database for far end substation related to the Sub Station
- d) The following work should be done at Master station and Backup station:
 1. SCADA Database Modelling
 2. Substation Display
 3. Network database Modelling
 4. DTS Database Modelling
 5. Alarm database Modelling
 6. Validation
 - Cross validation of all databases and create update copy of those databases.
 - On-lining of databases in DTS (Simulator) server
 - Checking and modifying (if require) topology of Substations, Devices, Network etc.
 7. Gateway configuration
Configuring the Gateway according to requirements/ signals, mapping address, data Communication Parameters, Source IP, Destination IP etc.
 8. Local Test
The following test will be carried out at site using e-terracontrol software
 - Verification of all Analog Measurement and checking of Limit, Deadband, Polling Time
 - Verification of Digital signals status (OPEN, CLOSE, BETWEEN, INVALID)
 - Verification of ALARMS, EVENTS etc.
 - Verification of Control and Interlock
 9. Database Update
The following activities will be carried out in Master NLDC and Backup NLDC after successful site test.
 - On-lining of all databases in Running Servers
 - IP/VLAN Configuration on Polling servers and switch
 - Compilation & On-lining of all the displays on WEB servers
 10. Tuning of Power System Application
• Tuning will be done for all available Network applications in SCADA/EMS server DTS (Dispatcher Training Simulator).
 11. End to End Test
The following activities will be carried out in NLDC Master Station and Standby Master Station
 - Verification of all Analog Measurement,
 - Verification of Digital signals and Controls
 - Verification of displays including Single line, Pop up, alarms etc.
 - Verification of communication line for Redundancy
 - Verification of continuous and complete reporting of the Gateway to NLDC.

Notes:

- Data communication path creation for both NLDC Master Station and Standby master Station is scope of Integration
- Collection of Network parameter value required for modelling network database is in Contractor's scope of work
- Contractor will conduct necessary work for both at NLDC & Substation (if required)

Requirements / Signals

- Indications: Digital Input (Double Point)
The following indications shall be provided
 - Circuit Breaker, Isolator & Earth Switch Open/ Close for line, transformer, bus coupler
 - Circuit Breaker for Reactor/Capacitor bank & 33kv Loadshed feeder
 - Load Flows, System Voltage and frequency
- Electrical quantities shall be provided to enable the following measurements
 - Voltage (kV), Frequency (Hz) for Busbar



- Megawatt (MW), MegaVar (MVAR), Amperes (AMP), Voltage (kV) for Line
 - MW, MVAR, Amperes, kV at both sides, Tap Position Indication (TPI) for Transformer
 - Megara for Reactor/Capacitor bank
 - Alarms: Digital Input (Single Point):
 - Remote/ Local Switch for all Circuit Breakers.
 - Bay Fault (DC Fail for Transformer Panel).
 - Breaker Fault (OR gate Spring Charge, SF6 Low).
 - Protection Class-1 (Distance, Differential).
 - Protection Class-2 (Over current, Earth fault).
 - Protection Class-3 (bus bar).
 - Transformer Alarm (Buchholz Alarm, Oil Level Low).
 - Transformer Trip (Buchholz Trip, PRD Trip)
 - Transformer Temperature Alarm (Oil Temp Alarm, Winding Temperature).
 - Transformer Temperature Trip (Oil Temp trip, Winding Temperature trip).
 - Tap Changer Alarm.
 - Tap changer trip.
 - Tap changer high limit.
 - Tap changer low limit.
 - Auto recloses operated
 - DC fail
 - AC fail
 - Controls-Digital Output (Double point)
- The following facilities shall be controlled from the NLDC
- Circuit Breaker and Motorized Isolator Open/ Close for Line, Transformer bay & bus coupler,
 - Circuit Breaker Open/ Close for 33kV load shed feeder
 - Tap Changer Raise/ Lower for Transformer
 - Network modelling parameters
- Line length, line conductor type, short circuit data for zero sequence (%R, %X, % of full charging susceptance) etc.

The SCADA system of the National Load Despatch Centre is based on ALSTOM platform. The communication protocol to be used for data exchange between the NLDC and the substations shall be IEC 60870-5-104 for the data transmission from substation.

Adaptation work and configuration of the NLDC will mainly consist of:

- Modelling the new substations and new bays.
- Database update of NLDC (ABB Network Manager Platform).
- Configuration of ABB Network Manager Platform to display the single line diagrams, statuses, alarms, measurements of the new substations and new bays.
- Database creation / modification & update at respective SCADA/EMS servers at all master station.
- Creation of associate display and modification of existing displays wherever required.
- Point to point test.

1.4.3 General Principle and Description of SCMS

The substation control and monitoring system shall have distributed client/server architecture. It shall consist of:

- The BCU equipment, which will be installed at the bay level,
- The substation level equipment, to be installed in the control room,
- A redundant communication network between station level and bay level for data exchange to limit the number of cables and ensure extension of the system. The exchange of information between distributed single bay unit and central substation control level shall be performed through redundant fibre optic wires. The communication network shall be based on the following architecture:
 - One optical double-ring LAN with protection and BCU,
 - One UPT CAT 5 redundant LAN at substation level.



The station level equipment will be power supplied from the two independent AC sources:

- One from the AC station auxiliaries 230 V AC 50 Hz,
- The second one from a UPS,
- An automatic change over shall prevent supply interruption.

In the event of loss of supply or disconnection for any reason, the system shall reboot automatically (without loss of stored information) and will update statuses of all devices when the power supply recovers. The updating process shall not inhibit control functions.

The substation control level must support future expansion of substation control system, having a 25% of resources as minimum.

At bay level, all control functions, data acquisition interlocking functions shall be done in the bay control devices within the bay level equipment. Each feeder shall be equipped with an individual bay control device.

For the data acquisition of substation auxiliaries, information (LV/MV switchgear, station battery, charger, UPS etc.,) a local RTU (or BCP) shall be provided and installed in the control building. The bay control devices shall be connected to the station level via a redundant optical fibre communication link.

The bay level equipment shall comprise at least the following elements:

- Bay control unit (BCU). Bay computer shall be separate unit (not incorporated in the protection unit).
- Input / output modules for digital and analogue signals,
- Communication with protection equipment and analogue signals,
- Redundant optical fibre communication with substation level or ring bus communication,
- Backup mimic panel for maintenance control and measurements. One two position switch shall be provided on control panel:
 - Local: Only local control is enabled, the interlocking function is on bay level only, no synchronization,
 - Remote: Only remote control is enabled.
- In both cases, all the data must be transmitted to the higher level (NLDC),
- Communication port for operation / maintenance from a laptop computer.

Bay control units shall be supplied from 110 V DC.

In the event of loss of supply or disconnection for any reason, the system shall reboot automatically (without loss of stored information) and will update statuses of all devices when the power supply recovers. The updating process shall not inhibit control functions. There should not be any loss of data due to the loss of auxiliary supply.

It shall be taken into consideration that additional bay control units can be added to the system, without disturbance of the system, for future expansion. A provision of 20% in bay units' expansion is required, as well as a provision of 10% in I/O signals, within each bay. Control and supervision of the system will be possible from different levels:

- NLDC,
- Substation control level from the operator workstation,
- Bay control level.

On all levels, a correct interlocking will be ensured which provides the highest safety for staff and equipment. On the substation control level, the interlocking is managed by the microprocessor-based system, on the bay level it is performed by hard wiring. The substation control system shall follow the specifications of IEC family 61850, 60870-5-101/104, 60870-5-102 and 60870-5-103. It is an obligatory requirement that the same Manufacturer supplies equipment and software for both the substation control and supervision system and the protection system.

List of Signals

The list below states the types of signals for the different configurations of bay types to assist in the determination of needs and possibilities for each of analyzed systems of the future substation. The estimated signals are shown in the tables and include but not



limited to:

Signaling:

- Protection (start, tripping, zones/phases, AR, communication send/receive),
- Automatic systems (start, tripping, operation, working mode)
- Central systems (backup trips, trip during long power swing, busbar protection and breaker failure, protection off, remote control off, feeder maintenance off),
- Switching equipment (manual control, emergency trip),
- Mode of operation: Local / Remote.

Warning:

- Protection (faults),
- Automatic systems (faults),
- Fault locator (faults),
- Event recorder (faults),
- Control systems (voltage control),
- Breaker (control blocking from a gas pressure low, a gas pressure low, AR inhibit from driver fault, driver supply voltage loss, driver fault, pole discordance).
- High voltage switch position:
- Breaker (separate pole - each 2 bits),
- Disconnectors (separate pole - each 2 bits),
- Earth switches (separate pole - each 2 bits).

Control:

- Breaker (close, open),
- Disconnectors (close, open),
- Line earth switch (close, open),
- Automatic systems (off, on,)
- Voltage regulation systems (choice of voltage level, regulation mode, tap changer control).

Series interfaces:

- From digital protections and disturbance recorder,
- From diagnostic system of primary equipment,
- From monitoring system (transformer, etc.).

Measurements:

- Phase currents,
- Phase voltages
- Real power and energy for both directions,
- Reactive power and energy for both directions,
- Frequency, power factor,
- Device switching statistics.

Metering (for planning / operation not for commercial purpose):

- Real energy for both directions,
- Reactive energy for both directions.

Auxiliary systems:

- Aux 33 kV AC,
- Aux.400/230 V AC,
- Aux.110V DC,
- Aux.220V AC UPS,
- Aux.48 V DC,
- Fire protection,
- Security light,
- Alarm system,
- HVAC,
- Telecommunication alarms,
- GPS time synchronizing input (NTP Protocol)

1.4.4 Scope of Work and Supply at New Substations



The substation control system refers to the station level and bay level controls. The station level control equipment shall include the following:

Station Level

- Arrangement of the all bays
- 2 (two) independent station computers operating on a main and hot standby basis,
- 2 (two) operator workstations including 2 x 21" colour monitors (complete with appropriate desk and chair).
- The second operator workstation shall have the capability to be used as Employer's Representative workstation,
- Two (2) numbers of independent SCADA Gateways
- Black & white A 4 laser printer,
- Colour A 3 laser printer,
- Common bay control unit for monitoring auxiliary power supply and all other equipment on a substation level (telemetry, telecommunication, HVAC, fire protection, etc.),
- Satellite clock, which should run on SNTP protocols. The satellite clock will provide the reference time to the comprehensive Substation Control and Monitoring System and protection relays through IEC61850 substation LAN., The satellite clock system will be complete with GPS receiver, antenna and time synchronization ports.
- Interface for laptop computer for maintenance, information transfer and emergency HMI,
- Non-fail power supply system,
- Communication network equipment (substation local area network, field communication network, optical couplers, etc.),
- Optical connection for data exchange with the NLDC.
- Configuration of the new/existing gateway.

The station computers in the substation must be separate machines from the station HMI (operator workstation) and should be located in the control panels, and not on the control desk with the HMI.

Bay Level

The control system of the bay level at substation shall be carried out with microprocessor based Bay Control Unit (BCU) control system. All BCUs shall be provided with IEC 61850 Edition 2 communication ports.

The connections between BCUs and the station level shall be based on redundant fibre optic links. These communication ports will be used for control, indication and alarm systems to the substation automation system and SCADA. The BCU shall be provided for all:

- 132 kV transmission line bays,
- 132/33 kV power transformers,
- 132 kV busbars
- Four (4) numbers of 33 kV load shed feeders (BCU and panels) and
- Auxiliaries.

A bay control unit (BCU) shall provide the following:

- Control for each individual circuit / bay with a LCD mimic and user interface for control and monitoring of the circuit / bay,
- Interface for protection devices that cannot directly interface with the substation control system local area network,
- Interface for laptop computer for maintenance, information transfer and emergency HMI,
- Interlocking functions (soft and hard wired).

Station level control functions shall include the following:

- Control of all switching devices,
- Real-time indication of events and alarms,
- Display of analogue values and high / low limit checking,
- Display of historical values,
- Data archiving,
- Disturbance monitoring and analysis,
- Trend display,
- Protection and control relay setting information,



- Protection relay fault and disturbance records,
- Time synchronization,
- Interlocking function to prevent unsafe operator action (display message if operator attempts an inappropriate action),
- Self-check and diagnostic,
- Manual data setting by the operator, including:
 - Hand dressed data entry,
 - Control inhibit setting,
 - Alarm inhibit setting,
 - Maintenance tag setting,
 - High / low limit setting.
- Remote access to substation control system from SCADA system using a TCP / IP link.

All peripheral devices that constitute the substation automation system should be supervised and monitored by Control through IEC 61850 or any other compatible protocol.

1.4.5 Scope of Work and Supply at Existing Substations

The existing SCMS shall be extended to integrate the new feeders.

The BCU shall be provided, with IEC 61850 Edition 2 communication ports, for each feeder.

The connections between BCUs and the station level shall be based on redundant fibre optic links. These communication ports will be used for control, indication and alarm systems to the substation automation system and SCADA.

A bay control unit (BCU) shall provide the following:

- Control for each individual circuit / bay with a LCD mimic and user interface for control and monitoring of the circuit / bay,
- Interface for protection devices that cannot directly interface with the substation control system local area network,
- Interface for laptop computer for maintenance, information transfer and emergency HMI, Interlocking functions (soft and hard-wired).

All necessary optical/Ethernet switches shall be provided to connect the new BCUs to the station level of SMS. All necessary adaptation work shall be provided. The signal list will follow the same rules as for new substations.

1.4.6 Engineering Services

General:

The Engineering services shall be provided by the Contractor to the extent and detail necessary for a turnkey project. They shall include drawings, instructions and all other technical documents required allow the Contractor to build, erect, commission, operate and maintain the substation systems, even if these are not specifically mentioned in these Technical Requirements.

Design Services:

The Contractor shall design in detail the general layout of the SCADA and substation control system, based on the preliminary design and modifications agreed. This general layout shall be submitted to the Employer / Employer's Representative for approval and comments. It shall also include all detailed structural drawings, detailed descriptions and reports required to permit an exact understanding of the solution adopted.

Once the general layout is approved, the Contractor shall include the following as a minimum requirement:

- Design of all works required for the implementation and extension of the SCADA and substation control system,
- General layouts for the SCADA and substation control system,
- Engineering of SCADA and substation control system,
- All necessary calculations.
- These Engineering services shall also include:
 - Design reports,



- Complete drawings of all systems,
- Integration in existing SCADA system.

1.5 Terminal Points

1.5.1 Transmission Line Circuit Connections

The slack spans including overhead earth wires between the 400kV, 230kV and 132kV overhead line terminal towers and the substation gantry structures shall be supplied and terminated by the overhead line Contractors. All required insulators and hardwires shall also be supplied by the overhead line Contractors.

Eyebolts/U-bolts or other suitable fixtures for terminating the slack spans on the switchyard gantry shall be provided under this substation contract.

The overhead line Contractor shall provide a jumper from the slack span of sufficient length to terminate on the substation entry equipment. The supply of appropriate clamps and the actual termination of the jumper to the substation equipment shall be carried out under this contract.

PLC facilities such as line trap and coupling capacitor, new or currently used in existing substations shall be carried out under this contract.

Bonding of the incoming earth wire to the station earthing screen and supply of earthing conductor and connection of the terminal tower earth electrode into the substation earth grid shall be carried out under this contract.

The overhead line Contractor shall terminate the OPGW at the substation gantry in the terminal joint boxes provided by the overhead line Contractors. The connection between OPGW joint boxes at the substation gantry and control room building via underground optical fibre cables shall be carried out under this contract; it includes supply & installation of fibre optic cable of a size similar to the OPGW.

1.5.2 Communication and SCADA Equipment

The voice communication, tele-protection signaling and main distribution frame (MDF) for optical fibre cable will be supplied and installed under this contract.

Necessary equipment for incorporating new & existing equipment system into the existing SCADA system shall also be supplied and installed under this contract:

Complete design, supply, delivery, installation, testing & commissioning of hardware and software shall be provided for the tele-control & tele-metering facilities required at the existing National Load Despatch Centre (NLDC) at Rampura for integration of the scope of the work.

In order to provide the tele-control & tele-metering facilities required at the existing NLDC, all plant supplied under this contract shall be equipped with potential free auxiliary contacts for indications and alarms. CT and VT circuits shall be fitted, where required, with the appropriate shorting and fused terminals.

All required electrical signals for signalization and control shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system or RTU. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway or RTU of the substation automation system using IEC 60870-5-104 protocol. Necessary transducer, control & interposing relays, RTUs, etc. shall be used. Necessary interfacing between the Substation Automation gateway and the communication equipment is to be carried out.

Sufficient investigations shall be made on the existing telecommunication and SCADA system for new and existing transmission lines and associated new and existing substations so that the necessary equipment shall be provided for complete telecommunication system after the new and existing transmission lines and substations are connected/reconnected.



All and complete connection between the new equipment and the existing equipment for control & protection system, SCADA, communication system, and low voltage supply system shall be provided.

The other ends of Transmission Lines have to be covered from the tele-communication point of view under the scope of this contract. All equipment and services have to be provided.

In addition, to implement the complete SCADA system after completion of the project, modification of the existing software in the master and back-up computer of the national control centre, and modification /extension /renovation of hardware (installing additional printed circuit cards or other equipment, etc. if required) shall be made under this contract.

1.6 Training and Inspection

The Contract Price shall include all costs of training & inspection of Employers and the instruction of staff on site for the following:

(a) **International Training:** Deleted.

(b) **International Witnessing:** The following engineers nominated by the Employer shall participate in the inspection and witnessing of factory acceptance tests at manufacturers' works as follows:

SL	Description	No. of Engineers	Duration (Days) excluding travelling time	No. of Trip/ Visit
		Each Visit		
1.	Transformers		0	0
2.	GIS		0	0
3.	Circuit Breaker (400 kV)		0	0
4.	Bus Reactor		0	0
5.	Disconnecter (400 & 230kV)		0	0
6.	Instrument Transformer (400kV)		0	0
7.	Lightning Arrester (400 kV)		Deleted	0
8.	Control, protection & SAS		Deleted	0
9.	Communication Equipment and SCADA gateway		Deleted	0
10.	DC system		Deleted	0

During factory witnessing the following sample rate of the tested Equipment shall be applied:

All power transformer (if any) & shunt reactor (if any) shall be factory tested in front of Employers Engineers.

For GIS, at-least one from Each type of bay, such as Bus Coupler bay, transformer bay, line bay, cable bay, Bus PT bay shall be tested.

For CB 25% of the Supplied quantity shall face witness of Employers Engineers.

For CRP, at-least one from Each type of relay, such as Busbar protection relay, transformer protection relay, line protection relay, cable protection relay (if any) shall be tested.

For SAS, point-to-point communication, Relay communication protocol (PRP, HSR, RSTP etc. as



applicable) test, inter-operability test (if applicable) shall be performed.

For other Equipment (DS, IT set, LA set, battery & charger) 10% the Supplied quantity shall face witness of Employers Engineers. For Instrument Transformer, each type (associated with voltage level and model) shall be tested.

(c) **Local Training:** Deleted.

(d) On-site instruction by the manufacturer's engineer on operations and maintenance

SL	Description	No. of Engineer	Duration (days)
1.	HV AIS/GIS switchgears	10	06
2.	Transformers	Deleted.	
3.	Protection & Substation automation system	10	06
4.	Telecommunication and SCADA	10	06

The Contractor shall be responsible for bearing all costs for the trainees (for item (a)+(b)), including air fares, accommodation, meal, healthcare, transportation, visa fees etc. together with payment of a daily allowance of **US\$ 80** for each of the Employer's trainee. The Employer's engineer attending the Pre-shipment inspection (as mentioned in item no.-b) shall be provided with the same facilities except the payment of daily allowance which is to be **US\$ 100**. For local trainings, (item no. C), contractor shall provide daily allowance of **BDT 1000.00 for each of the trainee**. For on-site instruction training, trainings shall have to be arranged at any Substation's respective local Grid Circle or GMD area with the consultation of Superintending Engineer, Grid Circle.

The contractor shall consider the cost for international witnessing (Item: b), and the cost shall be included in the price of the respective equipment for which the pre-shipment inspection shall be done.

Due to any unavoidable circumstances, if any pre-shipment inspection can't be done by the engineers nominated by the Employer, Third Party Inspection shall be done. Otherwise a fixed amount of **US\$** per man-day shall be deducted from the price submitted by the contractor. The amount shall be finalized by a committee of PGCB.

Between Employer's Factory Acceptance Tests Witness & Third Party Inspection, the employer shall have the right to choose how the inspection will be performed.

Note: The Contractor shall have to submit the Schedule of each Training & FAT and taken approval from the Employer prior to each Training & FAT. The International training shall have to be arranged within one (1) year from the date of contract signing.

1.6.1 Training Contents: Deleted.

For each Training, Trainers shall have minimum 5 years' experience in the related fields. For Transformer & HV substation training, the trainer shall be experience of at least 245kV Class, 300MVA Substation & transformer design experience for at least 5 years. The CV of proposed trainers shall be submitted to employer & taken approval during execution. If the proposed trainer does not meet the minimum requirement mentioned here, the Employer shall preserve the right to ask the contractor to change the trainer as per requirement.



INTRODUCTION & PREAMBLE TO THE PRICE & TECHNICAL SCHEDULES

BRIEF DESCRIPTION OF THE WORKS

The bidder shall be deemed to have visited site, inspected, gathered data and verified details of the as-built system in order to design, supply and interface their new equipment. All necessary materials, adjustments, dismantling, re-routing, temporary, remedial and tidying-up work in order to complete the work specified shall be included in the contract price. **The contractor is responsible for ensuring that all and/or any item(s) of work required for the safe, efficient and satisfactory completion and functioning of the works, are included in the Bid Price whether they be described in the specification, schedule or not.**

The equipment/plant to be designed, supplied, installed, tested & commissioned as stipulated in bid specification & shown in bid drawings (Volume 2 of 3) and technical requirements (particulars) as described in schedule-E (GTP, volume-3 of 3) .

Section-I: Kaliakoir 400kV AIS Bay extension:

Brief Description of Works:

The Kaliakoir Substation is an existing 400/230/132kV AIS substation of PGCB. Under this project, scope of work include extension of two (02) AIS bays at Kaliakoir Substation for Kaliakoir-Bogura 400kV overhead double-circuit transmission line. The busbar scheme for existing 400kV system is one & half breaker busbar scheme. Land development will be done by other contractor. Developed & empty land shall be handed over for bus extension & constructing two (02) nos. of new bays.

420kV Air Insulated Switchgear (AIS) and Switch Yard:

- Extension of 400kV Bus.
- The configuration of the 420kV busbar shall be one & Half Breaker scheme.
- Re-location of Bus LA, ES & CVT, if required.
- 400kV CB, DS, CT, PT, LA, local control kiosks, steel structures, conductors, jumpers, insulators, fittings, LV cables, etc.
- 400kV switchgear rating shall be minimum 4000A, 63kA/1s.

Control, Protection, Substation Automation & Metering:

Associated control, metering, protection equipment, synchronizing scheme and substation automation system for extension of substation. The SAS system shall be equipped with a common alarm unit to incorporate MCB status. The contractor shall provide with their Bid Detail BOQ of SAS system as per Bid requirement. Existing Control, protection, SAS and busbar protection manufacturer is ABB Switzerland.

Earthing & Lightning Protection:

Complete design, supply, delivery, installation, testing & commissioning of extension of earthing & lightning protection for the present scope of work.



SCADA system for Telecontrol and Telemetry:

Complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC) at Rampura and Siddhirganj for integration of extension of two new bays at 400kV Kaliakoir substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. 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 at Rampura NLDC and Siddhirganj are to be carried out.

The contractor shall provide with their Bid Detail BOQ for complete extension of SCADA system as per Bid requirement

Digital Fault & Disturbance Recorder (DFDR):

Supply, installation, testing & commissioning of existing DFDR extension at Kaliakoir 400kV substation to incorporate new bays. The contractor shall provide with their Bid Detail BOQ for extension of DFDR system as per Bid requirement. Existing DFDR manufacturer is Qualitrol, UK. The contractor shall supply above items from the same manufacturer under this contract.

Fibre Optic Multiplexer Equipment for Communication and Protection:

Extension of Indoor type Fibre Optic Multiplexer and communication Equipment for protection & communication and integration with existing communication network (i.e. NLDC Rampura and Siddhirganj) of PGCB. The contractor shall provide with their Bid Detail BOQ for extension of Fibre Optic Multiplexer Equipment system as per Bid requirement. Existing Fiber optic Multiplexer manufacturer is ABB Switzerland make FOX 615.

DC and LVAC System:

Extension of Complete set of DC and LVAC system with all necessary materials required for 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board.

Land Development, Civil Works, Building and Foundation:

Complete civil works and facilities for One new 420 kV Switchyard Panel Rooms (SPR) including foundation works, super structure works, finishing works like rendering, painting, floor finishing, rain water drainage system, lightning protection, etc.

Complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, entrance & internal roads, outdoor lighting system, cable trenches, earth filling, surfacing, drainage, internal & security fences, security wall, earthing & lightning protection, switchyard lighting, switchyard gravelling, etc.



Complete design, supply and construction of all civil items including all necessary architecture & structural requirements; cable trays, fittings and flooring & finishes; air-conditioning and lighting for the extension part including control room etc.

Scope included all other ancillary system, necessary substation facilities and supply of mandatory spare parts and maintenance tools.

The extent of supply and service is described in the following clauses and in the respective sections of the specification. All work not expressly called for in the Specification, but necessary for the completion of the work shall be performed and furnished by the Contractor at no additional cost to the Employer.

The scope of works under this turnkey contract is: design, supply, manufacture, quality assurance, inspection and testing, delivery, new packing for export, insurance, shipment & transport to the site, complete construction and installation, jointing, terminating, bonding, earthing, painting, setting to work, site testing and commissioning, defect liability for all equipment, including all civil works.

Especially the civil design has to incorporate countermeasures against flooding so as not to affect any substation equipment during the wet season.

The Contractor's responsibility is to provide that all parts of the works be completed in every respect for commercial operation, to the requirements of the Engineer. All details, accessories etc. required for the complete installation and satisfactory operation of the works not specifically mentioned in this specification are deemed included in the contract price.

The Contractor is responsible for ensuring that all and/or any item(s) of work required for the safe, efficient and satisfactory completion and functioning of the works, are included in the Bid Price whether they be described in the specification, schedule or not. All necessary materials, adjustments, dismantling, remedial and tidying-up work in order to complete the work specified shall be included in the contract price. The Bid Price shall include all other miscellaneous works required.

In case of extension & renovation works, all required as-built drawings may not be available for the existing plants & equipment which are required to be modified/renovated; the contractor is also responsible to make drawings as required to complete the works.

The "Schedule of Requirements" (the scope of work described herein, stated detail in schedule-A) for equipment, materials and services and the detailed technical specifications of equipment and materials of the Bidding Documents shall be read in conjunction with the detailed technical specifications of equipment and materials described in Volume 2 of the bidding documents & technical particulars (GTP in schedule-E) of volume-3. The drawings provided in the Bidding Documents are indicative only and hence the entire scope of work is not fully reflected in those drawings.

The programme of works shall be as shown in schedule C of Times for Delivery and Completion. Within one month of acceptance of the Bid, the contractor shall submit a programme chart detailing times required for the design, manufacture, testing, delivery and erection for the complete work.



The bar chart shall indicate the various phases of work for all appropriate items of the Contract, from commencement of the Contract to its final completion e.g. design, survey, approval of drawings, ordering of materials, manufacture, testing, delivery, erection and commissioning. The bar chart shall, when appropriate, allow the requisite periods of approval by the Employer, and/or any other regulatory body.

If at any time during the execution of the contract it is found necessary to modify the approved bar chart, the Contractor shall inform the Employer and submit a modified bar chart for approval. Such approval is not deemed to be consent to any amendments to the contractual completion date(s).

Modifications that may affect site work and associated local arrangements must provide a sufficient notice period to allow for any necessary re-arrangements.

The Employer intends that access will be given to a reasonable number of sites to provide continuity of work. However, the Contractor shall accommodate reasonable delays in access to some individual area of the sites that may prevent sequential foundation installation and support erection work being carried out. Provided he has overall continuity of work, this shall not affect the Contractor's programme.

The detailed requirements are listed in Schedule-A (Schedule of Requirements) and Schedule-B (Schedule of Rates & Prices) of volume 3 of 3 in the Bidding Documents.

The various items of work are described very briefly in the relevant Price Schedules. The various items of the Schedule of Prices shall be read in conjunction with the schedule of requirements (schedule-A), corresponding sections in the Technical Specifications & bid requirements including amendments and, additions, if any. The Bidder's quoted rates shall be based on the description of activities in the Schedule of Prices as well as other necessary operations required to complete the works detailed in these Technical Specifications.

The unit rates quoted shall include minor details which are obviously and fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of the various works. The unit rate quoted shall be inclusive of all plant equipment, men, material skilled and unskilled labour etc. essential for satisfactory completion of various works.

All measurements for payment shall be in S.I. units, lengths shall be measured in meters corrected to two decimal places. Areas shall be computed in square meters & volume in cubic meters rounded off to two decimals.

METHODE OF REFERENCE

The following method of reference shall be used to identify the various required items:

Denomination	Description
A	420 kV switchgear, structures & connections
B	245 kV switchgear, structures & connections
C	145kV switchgear, structures & connections
D	36 kV switchgear, structures & connections
E	Transformer



Denomination	Description
F	Control, protection, substation automation and metering
G	DFDR
H	SCADA system for Telecontrol and Telemetry
I	Telecommunication System
J	Power Cable
K	Multicore Cables
L	Earthing and lightning protection
M	Batteries, Chargers and DC Distribution
N	LVAC Distribution
O	Civil works, building and foundations
P	Lighting, Small Power, Fire fighting, Air Conditioning and Ventilation



SCHEDULE A

(SCHEDULES OF REQUIREMENTS)

The equipment/plant to be designed, supplied, installed, tested & commissioned as stipulated in bid specification, shown in bid drawings (Volume 2 of 3) and other technical requirements as described in volume 3 of 3.

For detail description of supply & works, price schedules shall be read in conjunction with schedule of requirements (schedule-A), bid specification and technical requirements. The detail scope of plant, which shall have to be designed, supplied, installed, tested & commissioned, are as follows:

Section-I: Kaliakoir 400kV AIS Bay extension:

Item	Description
1A	400kV Switchyard, structures & connections
	Busbar configuration is one and half scheme.

Item No.	Descriptions & Requirements
1A1	420kV Air Insulated Switchgear, Equipment Connection and Steel Structure
1A1.1	Four (04) sets of 420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, live tank type, single-pole operation , SF6 gas circuit breakers with spring-stored energy operating mechanism with support structure. PIR (Pre insertion resistor) / CSD (Control Switching Device) is required for line switching which shall have to be considered for 400kV circuit breaker. For Mid breakers, combination of PIR & CSD shall be considered. For Line breakers, PIR/CSD shall be considered. PIR value shall have to be justified by calculation.
1A1.2	Two (02) sets of 420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors with motor-operated earthing switch .
1A1.3	Eight (08) sets of 420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors without earthing switch
1A1.4	Eighteen (18) nos. of single-phase, 6-core, 400kV, 63kA/1sec, 4000-2000/1A, 50Hz, 1425kVp BIL post type current transformer
1A1.5	Six (06) nos. of single-phase, 3-core, 400kV, 50Hz, 1425kVp BIL, capacitor type voltage transformers.
1A1.6	Six (06) nos. of 390kV rated voltage, 312kV(rms) continuous operating voltage at 50°C 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters. MCOV value shall have to be justified by calculation.
1A1.7	Two (02) nos. of Wave traps, single phase (phase to earth), 420kV, 4000A, 63kA/1s, 1mH
1A1.8	One (1) lot of 400kV post type support insulators required for completing 400kV busbar and switchgear as specified in the technical specifications and bid drawings.
1A1.9	One (01) lot of rigid tubular bus [Aluminium of grade 63401 WP] / flexible conductors, insulators, fittings including all necessary clamps and connectors required for completing 400kV busbar and switchgear connection as specified in the technical specifications and bid drawings. Bus capacity shall be 5000A. Existing Bus is Aluminium Tube with outer dia. 200mm.
1A1.10	One (1) lot of steel structures for gantry and equipment supports required for completing 400kV busbar and switchgear as specified in the technical specifications and bid drawings.



- 1A2 400kV GIS Switchyard, structures & connections (Not Applicable)**
Not Applicable
- 1B 245kV GIS Switchyard, structures & connections**
Not Applicable
- 1C 145kV GIS Switchyard, structures & connections**
Not Applicable
- 1D 36kV Switchgears and Connections with Auto Transformer & Earthing/ Auxiliary Transformers**
Not Applicable
- 1E Power Transformers & Auxiliary Transformer**
Not Applicable
- 1F Control, Protection, Substation Automation & Metering**

1F.1	Control, Protection, Substation Automation System & Metering
	400 KV circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of: -
1F.1	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation Facility including event recording function for two (02) sets of 400KV overhead line circuits bays. Main-1 & Main-2 relay shall from different manufacturer. Line Differential Relay model shall have to be matched with other end Substation's Relay. Remote end substation's relay model is Siemens -7SA87 & Multiin D60. Control Panels dimension shall be similar to existing control panels and adequate space for other bay of the diameter shall be considered.
1F.2	One (1) lot of Renovation/Extension of existing Busbar protection (Main-1 & Main-2 for each Bus) for 400kV system. Existing busbar protection model is: ABB:Reb500
1F.3	One (01) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4wire import and export MWh and MVARh meters (accuracy class 0.2) for each 400-kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, USA, Japan or equivalent origin. Printed catalogue, operation and service manual are to be provided.
	Substation Automation System
1F.4	Extension and integration of SAS including all required equipment & accessories excluding protection panel & relay for the whole Substation. SAS system shall include BCUs, Ethernet Switches, extension of alarm unit & software, panels, Cables etc. The SAS system shall be equipped with a common alarm unit to incorporate MCB's(DC/AC) status The existing SAS's manufacturer at Kaliakoir 400kV Substation is ABB, Switzerland.
1G	DFDR
1G.1	One (01) lot of modification / Extension and integration of Digital Fault and Disturbance recorder (DFDR) to monitor complete substation including newly added two (02) bays for 420kV AIS. Existing DFDR model is BEN 6000 (Qualitrol).



1H	SCADA system for Telecontrol and Telemetry
1H.1	One (1) lot of extension/modification of complete set of design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC) at Rampura and backup station at Biddut Bhaban for integration of extension of 400kV Kaliakoir AIS substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. 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 & Biddut Bhaban are to be carried out. Scope of supply work in Kaliakoir Substation shall include of 01 (one) no of industrial gateways with redundant Ethernet switches, one hardware firewall, cables, separate panel with wiring & all other accessories needed for the extension work. Therefore, necessary hardware & software shall be installed here (if required)

1I Telecommunication System, Fibre optic multiplexer equipment for communication and protection

1I	Fibre Optic Multiplexer Equipment for Communication and Protection				
1I.1	One (01) complete lot of equipment for extension of existing fibre optic multiplexer equipment at local and remote end Substation for protection & communication, for required part of substation, shall be designed, supplied, delivered, installed, tested and commissioned and integrated into the existing system, under this contract. Fibre optic multiplexer equipment is to be provided for - <table><tr><td>21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC)</td></tr><tr><td>Distance relay carrier signal (main and back-up)</td></tr><tr><td>SCADA data from switchgear and control system through SAS</td></tr><tr><td>Hot-line telephone system</td></tr></table> The equipment to be supplied, installed and commissioned shall be as shown on bid drawing. Supply/Extension/Modification of Indoor Fibre Optic Multiplexer Equipment at local and remote end substations each comprising 1) At Local and Remote End Substation- a) Modification of ADM with TP unit without booster each comprising i. One (01) set Duplicate CPU (if required) ii. One (01) set Duplicate PSU (if required) iii. One (01) lot of Optical STM-16 ports for each direction of 400 kV line iv. Optical STM-16 ports for each direction of 230 kV line – N/A v. Optical STM-4 ports for each direction of 132 kV line – N/A vi. One (01) set of 16x2 Mbps (E1) card (if required) vii. One (01) set of card with minimum Eight ports 10/100 Base T LAN (if required) viii. One (01) set of card with minimum Eight ports 10/100 Base T Router (if required) ix. One (01) set of card with 20x2-w voice for FXS (if required) x. One lot of Required no of cards with 4 commands for distance protection after detail design b) One (01) lot of Optical Booster (if required) c) One (01) set of IDF/SDF d) One (01) lot of Cables e) One (01) lot of EOW telephone with board (if required) f) One (01) lot of Panel including wiring, lighting, filtering fan, humidity controller, heater, power socket & other accessories (if required)	21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC)	Distance relay carrier signal (main and back-up)	SCADA data from switchgear and control system through SAS	Hot-line telephone system
21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC)					
Distance relay carrier signal (main and back-up)					
SCADA data from switchgear and control system through SAS					
Hot-line telephone system					



	g) Other accessories (if any) 2) Other Indoor equipment comprising of i. One (01) set of PABX Card (FXO) ii. Two (02) sets of Primary phone (IP phone) (if required) iii. Ten (10) sets of Secondary phone (2W phone) (required) iv. One (01) lot of Extension of MDF v. One (01) lot of Pigtail cables vi. One (01) lot of ODF *Existing Telecom panels are from GE and ABB. BOQ shall be finalized at the time of execution with the consent of Communication Circle, PGCB.
11.2	A lot of Armoured Underground Optical Fibre (48 cores) cables from terminal box at gantry structure to MDF (Main distribution Frame) shall be designed, supplied, delivered, installed, tested and commissioned, including supply and installation of MDF and digital cables, for required part of substation each comprising of – i. One (01) lot of Underground optical fiber cable, armoured, 48 core ii. One (01) lot of Outdoor termination box
11.3	PLCC System: One (01) lot of the equipment to be supplied, installed and commissioned shall be as per the approved SLD. 400kV Two (02) sets: - Indoor PLC (line traps, cables, etc.) & tele-protection equipment (including tele-protection at Kaliakoir Substation for (direction Kaliakoir-Bogra and vice versa) 400 kV line 02 nos.: - Line matching units for phase to earth circuit coupling for 400kV lines at Kaliakoir Substation. Additionally, if any Interfaces are required for system configuration at each remote end substation, then interface devices shall be installed in each existing system as a lot.

1J	Power Cable
IJ.1	Deleted

1K	Multicore Cables
1K.1	One (1) lot complete set of multicore low voltage 06/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract and integration of the new equipment with the existing equipment shall be designed, supplied, delivered, installed, tested and commissioned with necessary gland, terminated, and identified by colours & tags.. The overall substation cable routing and core schedules shall also be provided.

1L	Earthing and Lightning Protection
1L.1	One (1) lot extension of supply and installation of earthing system for outdoor switchyard equipment, SPR & Control Room with necessary connectors and clamps, with design to suit the work under this contract arrangement. If soil resistivity is different for different layer, calculation and GPR shall have to be shown using software like CYMGRD, if existing earthing design is available.



1L.2	One (1) lot of supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in Rolling Sphere/ Rez-vig method. Required number of Lightning Mast (for switchyard & Building) shall be provided as per DSLP calculation during detail design stage.
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1M	Batteries, Chargers and DC Distribution
1M.1	110V substation Ni-Cd batteries complete with chargers and extension of existing distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment Scope of work shall include: i. One (1) set of 100% batteries complete, each capacity shall not be less than 410Ah at the 5-hour rate of discharge and total quantity not less than 94 nos. During execution stage, the capacity shall be confirmed with calculation by the contractor considering the bays under scope of work and future bays as per section 8 of Volume 2 of 3 of the bidding document. The battery with higher capacity if required after calculation, shall be supplied within the same price. ii. One (1) set of battery charger complete, each charge shall not be less than 150A rating and input voltage three phase 50Hz, 415V AC The rating shall be based on battery boost charging rate & continuous DC load. The higher charging rated charger than minimum specified, if required after calculation, shall be supplied within the same price. iii. One (01) lot of Extension of existing 110V DC distribution board/ new DCDB panel (if required) to provide DC connections to all equipment required for bay extension work under this contract. iv. One (01) lot of Insulation monitoring for the DCDB Batteries and battery chargers shall be located in the SPR building. All DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
1M.2	One (01) lot of Extension of existing 48V DC distribution board/ new DCDB panel(if required) to provide DC connection to fibre optic multiplexer equipment for communication, protection to all equipment required for bay extension work under this contract. 48V DC system and distribution equipment is located in the Main Control Building. All 48V DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.

1N	LVAC Distribution
1N.1	One (1) lot extension of LVAC switchboard for two (02) new bays at 400kV Kaliakoir substation



	to be supplied, installed and commissioned to provide the 415/240V supplies to all equipment being supplied under this turnkey project. All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in substation automation system. MCB must have in built NO/NC contacts. All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm) shall be incorporated in substation automation system.
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1O	Civil Works, Building and Foundation
1O.1	One (1) lot of Complete design, supply and construction of all civil items required for extension of bays at 400kV level. The outdoor works shall include necessary Land development, filling/cutting of soil and leveling up to finished level and within the property line suitable for switchyard gantry & equipment foundations, Extension of internal roads, cable trenches including soak pit, septic tank, switchyard drainage system including outfall, fences, sentry post, PVC pipes etc., switchyard surface finishing and gravel surfacing etc. shall be included.
1O.2	Complete design, supply and construction of all civil items and facilities required for the a new 400kV Switchyard Panel Room (SPR) and modification works of Main Operation building to incorporate two new bays.
1O.3	One (01) Testing of pile Foundation, Compression & uplift on random basis

1P	Lighting, Small Power, , Fire fighting, Air Conditioning and Ventilation
1P.1	One (1) lot of complete design, supply, installation and commissioning of equipment to provide indoor lighting (LED type), LV power supply, and emergency DC lighting for new SPR and extension work.
1P.2	One (1) lot of complete design, supply, installation and commissioning of equipment to provide Air Conditioning system (cassette type), Ventilation system for new SPR.
1P.3	One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) for security, roadway, switchyard and emergency DC lighting at strategic locations for equipment operation and inspection for extension work.
1P.4	1 lot of Fire Fighting system for SPR.

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 are to be supplied from Europe, USA, Japan or equivalent origin. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Employer.



1. Schedule B: Bid Prices & Schedules

General

The Price Schedule is attached as “Attachment-1”.

1. The Price Schedules are divided as follows:

Schedule No. B1: Plant and Mandatory Spare Parts Supplied from Abroad
 Schedule No. B2: Plant and Mandatory Spare Parts Supplied from within the Employer's Country
 Schedule No. B3: Design Services
 Schedule No. B4: Installation and Other Services
 Schedule No. B5: Grand Summary
 Schedule No. B6: Recommended Spare Parts

2. *The Schedules do not generally give a full description of the plant to be supplied and the services to be performed under each item. To have comprehensive understanding of the technical specification of each equipment the bidder shall read technical specification in relevant sections in volume 02; Employer's Requirements & other sections of the Bidding Document (Requirement in Schedule A of Volume 03, GTP requirement in A*

Appendix of Schedule A or Schedule E) and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices The entered rates and prices shall be deemed to cover the full scope as previously mentioned, including overheads and profit.

3. If Bidders are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITB 7 prior to submitting their bid.

Pricing

4. The units and rates in figures entered into the Price Schedules should be typewritten or if written by hand, must be in print form. Price Schedules not presented accordingly may be considered nonresponsive. The Bidder shall initial any alterations necessary due to errors, etc.

As specified in the Bid Data Sheet and Special Conditions of Contract, prices shall be subject to adjustment in accordance with the corresponding Appendix (Price Adjustment) to the Contract Agreement.

5. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Bidders in the Bidding Document.

For each item, Bidders shall complete each appropriate column in the respective Schedules, giving the price breakdown as indicated in the Schedules.



Prices given in the Schedules against each item shall be for the scope covered by that item as detailed in Volume I (Employer's Requirements) or elsewhere in the Bidding Document.

6. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.



7. When requested by the Employer for the purposes of making payments or part payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedules.

Notes

- i. Items identified as lot in price schedule shall include all the materials required for proper completion of work against that item.
- ii. Items identified as meters, such as Cable, GIL, GIB etc. shall be deemed to be tentative & based on preliminary design which shall be variable during detail design in execution stage. Hence, payment shall be on actual basis, but the unit price shall remain constant throughout the contract.
- iii. Items identified as Cubic feet or meters, such as land/earth filling etc. shall be deemed to be tentative & based on preliminary estimation which shall be variable during execution stage. Hence, payment shall be on actual basis, but the unit price shall remain constant throughout the contract.
- iv. For Items under steel gantry, column & beam has been added as number basis so that payment can be made on actual basis if no. of column changes during detail Engineering in Execution stage while unit price shall remain fixed.
- v. Equipment support structure & foundation for Transformer, switchgear etc has been added on Number basis based on tentative & preliminary design so that payment can be made on actual basis if no. of structure changes during detail Engineering in Execution stage while unit price shall remain fixed.

Schedule B: Schedules of Rates and Prices

Schedule No. B1: Plant and Mandatory Spare Parts Supply from Abroad

Schedule No. B2: Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

Schedule No. B3: Design Services

Schedule No. B4: Installation and Other Services

Schedule No. B5: Grand Summary

Schedule No. B6: Recommended Spare Parts

Please see the separate Excel file for the above.

The attached price schedules shall be filled by the Bidder, signed and stamped and shall be attached to the bid.

Please use the attached excel file.



3. Schedule C: Bar Chart Program of Key Activities - Delivery & Completion Time Schedule

(To be filled by the Bidder to be attached to the bid.)

3.1 Times for Delivery and Completion

The individual dates are all contractually binding.

The times given include all necessary control, relay, metering, auxiliary power and ancillary equipment to enable the respective circuit or item of plant to be completely commissioned and put into commercial operation, together with such other associated equipment, e.g. busbar, etc. as well ensure that subsequent shut-downs are unnecessary or at least only of a temporary or short time nature.

Completion time for bay extensions works at 400 kV Kaliakoir is 18 months i.e. 540 days.

The following dates shall be from the commencement date of the Contract. Key dates to be provided as follows.

- E - Target completion dates planned by the Contractor
- D - Construction (delivery, erection and commissioning) date guaranteed by the Contractor.
- C - Shipping completion dates guaranteed by the Contractor.
- B - Date of arrival of first shipment guaranteed by the Contractor.
- A - Earliest date by which access is required by the Contractor.

Site/Descriptions	A Earliest Access Permitted Months	B Months	C Months	D Months	E Months
<u>400kV Kaliakoir AIS SS</u> (1) Civil works (2) 400kV AIS Equipment (3) SAS (4) Protection (5) AC/DC (6) Tel/SCADA					



4. Schedule D: Manufacturers, Places of Manufacture and Testing

The following form shall be filled and attached to the bid. Bidders are free to propose/list more than one Manufacturer for each item. Quoted rates and prices shall be deemed to apply to whichever Manufacturer is appointed, and no adjustment of the rates and prices will be permitted. Their participation shall be confirmed with the Manufacturer's Authorization letter(s), as required. In case that more than one Manufacturer has been proposed, the employer have right to choose one or more of them, or can ask for replacement Prior to signing the Contract, the corresponding Appendix to the Deed of Agreement shall be completed, listing the approved manufacturers for each (major) item concerned. For the items not listed in Appendix to the Deed of Agreement, manufacturers shall be selected from the list in this schedule-D.

Manufacturers

The following Manufacturers are proposed for carrying out the facilities: (this is a general format; put 'Not Applicable' against any item which is outside scope)

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nationality
1. Power Transformer(Not Applicable)					
1.1	Auto transformer 230/132/33 kV				
i.	Complete				
ii.	Tap Changer				
iii.	Bushing: HV/LV/TV/NV				
iv.	Silicon Core				
v.	Copper Winding				
vi.	Winding Insulation Material				
vii.	Oil				
viii.	Tank				
ix.	Radiator				
x.	Fan				
xi.	Motor				
xii.	Temperature Indicator (Oil Temperature, Winding temperature)				

xiii.	PRD				
xiv.	Oil Valve				
xv.	Silica Gel				
xvi.	Gas/Oil actuated relay				
xvii.	AVR				
xviii.	Indicating Instruments				
xix.	Cooler control Equipment				
xx.	Remote control panel				
xxi.	Magnetic Shunt				
xxii.	Clamp				
xxiii.	Bucholz Relay				
xxiv.	Membrane				
1.2	Power transformer 132/33 kV(Not Applicable)				
i.	Complete				
ii.	Tap Changer				
iii.	Bushing: HV/LV/TV/NV				
iv.	Silicon Core				
v.	Copper Winding				
vi.	Winding Insulation Material				
vii.	Oil				
viii.	Tank				
ix.	Radiator				
x.	Fan				
xi.	Motor				
xii.	Temperature Indicator (Oil Temperature, Winding temperature)				
xiii.	PRD				

xiv.	Oil Valve				
xv.	Silica Gel				
xvi.	Gas/Oil actuated relay				
xvii.	AVR				
xviii.	Indicating Instruments				
xix.	Cooler control Equipment				
xx.	Remote control panel				
xxi.	Magnetic Shunt				
xxii.	Clamp				
xxiii.	Bucholz Relay				
xxiv.	Membrane				
1.3	Auxiliary Power /Zigzag Transformer(Not Applicable)				
i.	Auxiliary power transformer 250MVA, 33/0.415 kV				
2. Shunt/Bus Reactor (Not Applicable)					
i.	Complete				
ii.	Bushing HV/NV				
iii.	Copper Winding				
iv.	Winding Insulation Material				
v.	Porcelain for insulators				
vi.	Core plates				
vii.	Radiators				
viii.	Reactor Oil				
ix.	Oil valves				
x.	Tank				
xi.	Temperature Indicator				
xii.	PRD				

xiii.	Oil Valve				
xiv.	Gas/Oil actuated relay				
xv.	Remote control panel				
xvi.	Indicating Instruments				
3. 420 kV Equipment					
3.1	400kV GIS (Not Applicable)				
	GIS 400 kV Complete				
	Enclosure				
	SF ₆				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnecter				
	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
3.2	400kV AIS				
3.2.1	Circuit breakers 400 kV				
	Drive Mechanism				
	Interrupter Chamber				
	Insulator				
3.2.2	Disconnectors 400 kV				
	Drive Mechanism				
	Male-Female Contact				
	Insulator				
3.2.3	Current transformers 400 kV				
	Core				
	Winding				

	Insulator				
3.2.4	Voltage transformers 400 kV				
	Core				
	Winding				
	Insulator				
3.2.5	Surge arresters 400 kV				
	ZnO Resistor Block				
	Housing				
	Surge Counter				
3.2.6	Wave Trap				
4. 245 kV Equipment(Not Applicable)					
4.1	230kV GIS				
	GIS 230 kV Complete				
	Enclosure				
	SF ₆				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnecter				
	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
4.2	230kV AIS				
4.2.1	Circuit breakers 230 kV				
	Drive Mechanism				
	Interrupter Chamber				
	Insulator				
4.2.2	Disconnecter 230 kV				
	Drive Mechanism				
	Male-Female				

	Contact				
	Insulator				
4.2.3	Current transformers 230 kV				
	Core				
	Winding				
	Insulator				
4.2.4	Voltage transformers 230 kV				
	Core				
	Winding				
	Insulator				
4.2.5	Surge arresters 230 kV				
	ZnO Resistor Block				
	Housing				
	Surge Counter				
5. 145 kV Equipment(Not Applicable)					
5.1	132kV GIS				
	GIS 132 kV Complete				
	Enclosure				
	SF ₆				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnecter				
	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
5.2	132kV AIS				
5.2.1	Circuit breakers 132 kV				
	Drive Mechanism				
	Interrupter				

	Chamber				
	Insulator				
5.2.2	Disconnectors 132 kV				
	Drive Mechanism				
	Male-Female Contact				
	Insulator				
5.2.3	Current transformers 132 kV				
	Core				
	Winding				
	Insulator				
5.2.4	Voltage transformers 132 kV				
	Core				
	Winding				
	Insulator				
5.2.5	Surge arresters 132 kV				
	ZnO Resistor Block				
	Housing				
	Surge Counter				
6. 33 kV Equipment(Not Applicable)					
6.1	Circuit breakers 33 kV				
6.2	Disconnectors 33 kV				
6.3	Current transformers 33 kV				
6.4	Voltage transformers 33 kV				
6.5	Surge arresters 33 kV				
7.Control, Protection, and Metering Equipment					
7.1	Control & monitoring equipment				
7.2	Relay protection equipment				
7.3.	Control & protection panels				

7.4.	Metering equipment				
7.5.	Metering panels				
7.6	Auxiliary Switches				
7.7.	Auxiliary Relays				
7.8.	Trip Relays				
7.9.	TCS Relays				
7.10.	Relay Test Block				
7.12	Humidity Sensor				
8. Substation Automation System					
8.1	Bay Control Unit				
8.2	Industrial Server				
8.3	Server Processor				
8.4	Firewall				
8.5	Gateway Server				
8.6	GPS system				
8.7	Ethernet Switch				
8.8	Modem				
8.9	LCD Monitor				
8.10	Monitor & Keyboard				
8.11	Printer				
8.12	55" LCD Monitor				
8.13	Cables (FO, EC,CC)				
9.Digital Fault & Disturbance Recorder					
9.1	Control Card				
9.2	Data Acquisition material				
9.3	Panel				
9.4	Processor				
9.5	Copper cable				
9.6	Fiber optic Cable				
9.7	Laptop				
10.Telecommunication Equipment					
10.1	Communication equipment				
10.2	Multiplexer				
10.3	Fiber Optic cable				
10.4	PLC Communication				

10.5	Complete				
10.6	Panel				
10.7	Line matching Unit				
10.8	Surge arrester				
10.9	Wave Trap				
11. XLPE Cable & Cable Termination Kit & Cable Trays(Not Applicable)					
XLPE Cable					
11.1	400kV				
11.2	230kV				
11.3	132kV				
11.4	33kV				
Cable Sealing End/ Cable Termination Kit (AIS)					
11.5	400kV				
11.6	230kV				
11.7	132kV				
11.8	33kV				
Cable Sealing End/ Cable Termination Kit (GIS)					
11.9	400kV				
11.10	230kV				
11.11	132kV				
11.12	33kV				
11.13	Cable Trays for Power Cables				
12.Auxiliary Power Supply Equipment					
12.1	ACU battery				
12.2	Charger				
12.3	DC distribution Panel & Switchboard				
12.4	AC distribution Panel & Switchboard				
12.5	Inverter				
13.Conductors, Insulators & Fittings					
13.1	Conductors				
	Tubular Conductor				
	Flexible Conductor				

13.2	Insulators				
	Post Insulator				
	Disk Insulator				
13.3	Fittings, Clamps & connectors				
14. Earthing & Lightning					
14.1	Copper Conductor				
14.2	Insulated Copper Conductor				
14.3	Earthing Wire				
15. Multicore LV Auxiliary Power and Control Cables					
15.1	LV Cables				
15.2	Cable Trays				
Name of Bidder:					
Signature of Bidder:					

5. Schedule E: Technical Particulars and Guarantees

General

The technical data schedules hereafter provide more details on the specific technical criteria and complement the Information given in the Bidding documents.

They form an essential part of bid submission and will be used in bid evaluation.

They should be fully completed and submitted with the bid.

Switchgear Equipment

Please find hereafter the technical data schedules.

Part-1: AIS Switchgear**A1.1:400kV Circuit Breaker:**

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	Circuit Breaker - General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-100	
			IEC 60273	
			IEC 60694	
			IEC 60815	
			ISO 9001	
1.6	Quality control		ISO 14001	
			ISO 18001	
1.7	Isolating and quenching medium		SF6	
1.8	Type of circuit breaker		Outdoor	
1.9	Design		Double breaking	
1.10	Operating mechanism		Spring	
	Closing type		Insert	
	Opening type		Insert	
1.11	Number of poles	pcs.	3 (1 per phase)	
1.12	Number of operating mechanisms per circuit breaker	pcs.	1 / 3 (1 per phase)	
2.	Circuit Breaker - Characteristics			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment Um	kV rms	420	
2.3	Rated lightning impulse withstand voltage	kV peak	1425	
	i) between phase to ground and between phases			
	ii) across open switching device and/or isolating distance	kV peak	1425(+240)	
2.4	Rated switching impulse withstand voltage between phase to ground	kV	1050	
2.5	Rated Power frequency withstand voltage (dry), 1 minute	kV	520	
	i) between phase to ground and between phases			
	ii) across open switching device and/or isolating distance	kV peak	610	
2.6	Standard value of transient recovery voltage (T100)	kV	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
2.7	Rate of rise recovery voltage	kV/ μ s	Insert	
2.8	Corona extinction voltage with CB open or close	kV rms	320	
2.9	Radio interference voltage for frequency between 0.5MHz and 2MHz (at $1.1 \cdot U_m / \sqrt{3}$)	μ V	1000	
2.10	Rated frequency fr	Hz	50	
2.11	Rated current Ir	A	4000	
2.12	Rated short-circuit breaking currents, Isc	kA rms	63	
	Three phase Symmetrical breaking currents at 400kV	kA rms	Insert	
	Three phase Asymmetrical breaking current at 400kV	kA rms	Insert	
	Single phase Symmetrical breaking current for line to ground	kA rms	Insert	
	Single phase Asymmetrical breaking current for line to ground	kA rms	Insert	
2.13	D.C. component of the rated short-circuit breaking current	%	> 50	
2.14	a) Duration of short-circuit	s	> 1	
2.15	Rated capacitive switching capability (breaking currents):			
	a) Line charging	A rms	Insert	
	b) Cable charging	A rms		
	c) Capacitor Bank breaking current	A rms		
	Rated inductive switching capability:	A	Insert	
	Small inductive Magnetizing current for Reactor	A	Suitable for 25 Mvar	
	Maximum switching surge per unit value	p.u		
2.16	Rated peak withstands current Ip	kA peak	Insert	
2.17	a) Rated out-of-phase breaking current	kA	Insert	
	b) Rated out-of-phase making current	kA	Insert	
2.18	Rated short line fault breaking current capability			
	a) Percentage of rated breaking current	%	Insert	
	b) Surge Impedance	Ohms	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
	c) Amplitude factor		Insert	
	d) Critical percentage of rated breaking current	%	Insert	
	e) Maximum arc duration	ms	Insert	
2.19	First-pole-to-clear factor			
	a) Terminal fault		1.3	
	b) Short-line fault	p.u.	1.0	
	c) Out-of-phase		2.0	
2.20	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.21	Auto reclosing		1p+3p	
2.22	Maximum total break time (trip initiation to final arc extinction) (pos.3.7.135 acc. to IEC 62271-100)	ms	40	
2.23	Closing time	ms	70	
	i. Without current	ms	Insert	
	ii. With 100 % rated breaking current	ms	Insert	
2.24	Opening time (trip initiation to contact separation)	ms	Insert	
	i. With rated current	ms	insert	
	ii. With 100 % rated breaking current	ms		
2.25	Maximum time interval between opening interrupters	ms	Insert	
2.26	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	Insert	
2.27	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.28	Minimum time for auto reclosing (dead time)	ms	Insert	
	i. Single phase	ms	insert	
	ii. Three phase	ms		
2.29	Pole discrepancy for the closing operation of CB ie, Maximum difference in closing Time between first contact touch and Last phase to close.	ms	Insert	
2.30	Restrike performance during capacitive current switching	Class	C2	
2.31	Number of operations without maintenance		> 10000	
	a) CO at no-load			

No.	Description	Unit	Minimum Requirements	Guaranteed
	b) CO at rated current		> 2500	
	c) CO at rated breaking current I _{sc}		> 5	
2.32	The frequency of mechanical operations	Class	M2	
2.33	Rated electrical endurance	Class	E2	
2.34	Rated pressure of a circuit breaker	Mpa	Insert	
2.35	Total mass of SF6 gas in a circuit breaker	kg	Insert	
2.36	Rated mechanical terminal loads			
2.36.1	Static horizontal force, longitudinal F _{thA}	N	≥ 1750	
2.36.2	Static horizontal force, transversal F _{thB}	N	≥ 1250	
2.36.3	Static vertical force F _{tv}	N	> 1500	
2.36.4	Dynamic horizontal force, longitudinal F _{wx}	N	Insert	
2.36.5	Dynamic horizontal force, transversal	N	Insert	
2.37	Is circuit-breaker re-strike free	Yes/No	Insert	
2.38	Rated supply pressure of gas for interruption Maximum Normal Minimum Low Pressure Alarm Lockout Alarm	MPa (g)	Insert	
2.39	Limits for correct operation Max Normal min	Mpa (g)	Insert	
2.40	Trip free/or fixed trip		Trip Free	
2.41	Is lockout facility fitted?	Yes/No	Insert	
2.42	Rated supply voltage of shunt opening release	V	Insert	
2.43	Current required at rated supply voltage to open circuit-breaker	A	Insert	
2.44	Maximum pressure rise in circuit breakers due to the making or breaking of rated current		Insert	
2.45	X/R ratio		Insert	
2.46	Number of successive auto-Reclosing operations without derating		Insert	
2.47	Number of close-open		Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
	operations possible without recharging			
2.48	Whether anti pumping facility is provided in the Circuit breaker mechanism	Yes/No	Insert	
2.49	Type of transmission of mechanical energy from the operating mechanism to the interrupter unit i.e. whether single mechanism coupled to three phases or three independent mechanisms		Insert	
2.50	Spring Charging Time	ms	Insert	
2.51	Whether there is provision for manual spring charging.	Yes/No	Insert	
2.52	Whether facility to close / open the CB manually in the Absence of DC control supply to the operating mechanism	Yes/No	Insert	
3.	Circuit Breaker - Design and Construction			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min > 25	
3.1.2.1	Total creepage distance	mm	Insert	
3.1.3	HV terminal	pcs.	2	
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 200 x 100	
3.1.3.3	Number of holes		Min 8	
3.1.3.4	Dimensions of holes	mm	Insert	
3.1.3.5	Distance between holes	mm	Insert	
3.1.3.6	Material suitable for		Al terminal	
3.1.5	Weight and dimensions			
3.1.5.1	Support insulator height	mm	Insert	
3.1.5.2	Total height	mm	Insert	
3.1.5.3	Pole weight	kg	Insert	
3.1.5.4	Weight of operating mechanism	kg	Insert	
3.1.5.5	Total weight (with metal structure)	kg	Insert	
3.1.6	Minimum distance			
3.1.6.1	Between poles	mm	Insert	
3.1.6.2	To ground	mm	Insert	
3.1.7	Degree of Protection for			
	(a) auxiliary circuits		Insert	
	(b) moving parts		Insert	
3.1.8	Minimum clearances in air:			
	(a) between phases	mm	Insert	
	(b) phases to earth	mm	Insert	
	(c) across interrupters	mm	Insert	
	(d) live parts to ground level	mm	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.1.9	Length of each break	mm	Insert	
3.1.10	Length of stroke	mm	Insert	
3.2	Operating mechanism			
3.2.1	Type		Insert	
3.2.2	Motor - auxiliary supply voltage	V. AC	230/415	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Control voltage	V. DC	110	
3.2.5	Number of making coils	pcs.	1	
3.2.6	Rated power of making coils	W	Insert	
3.2.7	Number of breaking coils	pcs.	2	
3.2.8	Rated power of breaking coils	W	Insert	
3.2.9	Heater		Yes	
3.2.10	Heater supply voltage	V, Hz	230, 50	
3.2.11	Total heater power	W	Insert	
3.2.12	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.13	Water-tight corrosion-resistant housing		IP55	
3.2.14	Operating mechanism material		Al or stainless steel	
3.2.15	A crank for manual spring loading		Yes	
3.3	Accessories in central control panel			
3.3.1	Anti-pumping relay		Yes	
3.3.2	Local/remote control selector switch		Yes	
3.3.3	Local operation push buttons		Yes	
3.3.4	Minimum pressure lock-out and alarm relays		Yes	
3.3.5	Service outlet (socket) - 230 V, 50 Hz		Yes	
3.3.6	Lighting switch		Yes	
3.3.7	Lighting - 230 V, 50 Hz		Yes	
3.3.8	Heater - 230 V, 50 HZ		Yes	
3.3.9	Humidity Sensor-Hygrometer		Yes	
3.3.10	Operation counter		Yes	
3.3.11	Motor MCB (miniature circuit breakers) (for all operating mechanisms)		Yes	
3.3.12	Time phase discrepancy relay		Yes	
3.3.13	Weatherproof, corrosion resistance enclosure, Al or stainless steel		IP55	
3.3.14	Copper earthing rails inside central control cabinet		Yes	
3.3.15	Detachable plates, the bottom of central control cabinet		Yes	
3.3.16	Set of cables for connection of operating mechanism and		Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
	central control panel of circuit breaker			
3.3.17	Galvanized horizontal and vertical metal structure with minimum 70 μm zinc layer		Yes	
4	Pre-insertion resistor			
4.1	Pre insertion Resistor (PIR) for 400kV	Ohm	400 $\pm$ t ohms (depend on manufacturer's design to meet switching over voltage requirement)	
4.2	Pre-insertion time	ms	10 $\pm$ 2 ms (or depend on manufacturer's design to meet switching over voltage requirement)	
5	Control Switching Device (CSD)			
5.1	Manufacturer's name and address		Insert	
5.2	Country of origin		Insert	
5.3	Type		Insert	
5.4	Model No.		Insert	
5.5	Standard		BS 402	
			IEC 60255	
			IEC 61810	
5.6	Operation voltage	V	Insert	
6	Others			
6.1	Type test certificate date/reference	Required	Yes	
6.2	Period of time equipment has been in commercial operation	years	Insert	
6.3	Number of the same type of disconnectors supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

A1.3: 400kV Disconnecter: Without Earth Switch

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	Disconnecter- General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-102	
			IEC 60273	
			IEC 60694	
			IEC 60815	
1.6	Quality control		ISO 9001	
			ISO 14001	
			ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design (Operating type)		Insert	
1.8.1	Type of Break		Horizontal	
1.8.2	Number of columns		Three Column	
1.8.3	Number of breaks per pole		Double Break	
1.8.4	Type of Contacts		Insert	
1.8.5	Material of contact surfaces		Insert	
1.8.6	Method of Operation		Insert	
1.9	Number of poles	pcs.	3	
1.9.1	Number of support insulation for pole		Insert	
1.10	Type of main blade operating mechanism		Motor Driven	
1.11	Number of main blade operating mechanisms	pcs.	3	
1.12	Type of earthing blade operating mechanism		Not Applicable	
1.13	Number of earthing blade operating mechanism		Not Applicable	
2.	Disconnecter - Characteristics			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment Un	kV rms	420	
2.3	Rated lightning impulse withstand voltage i) between phase to ground and between phases	kV peak	1425	
	ii) across open switching device and/or isolating distance	kV peak	1425(+240)	
2.4	Rated switching impulse withstand voltage i) between phase to ground	kV	1050	
	ii) across isolating distance	kV	900(+345)	
2.5	Rated Power frequency	kV	520	

No.	Description	Unit	Minimum Requirements	Guaranteed
	withstand voltage (dry), 1 minute i) between phase to ground and between phases ii) across isolating distance	kV peak	610	
2.6	Corona extinction voltage	kV rms	320	
2.7	Radio interference voltage for frequency between 0.5MHz and 2MHz (at $1.1 \cdot U_m / \sqrt{3}$)	μV	1000	
2.8	Rated frequency fr	Hz	50	
2.9	Rated normal current Ir	A		
	a) Diameter		4000	
	b) Transformer bay		NA	
	c) Line bay		4000	
2.10	Rated short withstand current I_k	kA rms	63	
2.11	Rated duration of short-circuit on main blades	s	3	
2.12	Rated duration of short-circuit on earthing blades	s	Not Applicable	
2.14	Rated maximum withstand current I_p	kA peak	Insert	
2.15	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	Insert	
2.16	Nominal supply voltage			
2.16.1	Controls and alarm (11 signaling) circuits	V d.c.	110	
2.16.2	Motors	V AC.	230	
2.16.3	Heaters	V a.c / Hz	230 / 50	
2.17	Opening time	ms	Insert	
2.18	Closing time	ms	Insert	
2.19	Mechanical endurance	Class	M2	
2.20	Rated mechanical terminal loads of terminals			
2.20.1	Direct loading, static Fa	N	> 2000	
2.20.2	Transversal loading, static Fb	N	> 660	
2.20.3	Vertical force Fc	N	> 1500	
2.20.4	Direct loading, dynamic	N	> 4500	
2.20.5	Transversal loading, dynamic	N	Insert	
2.21	Manual operating torque	kNm	Insert	
2.22	Load switching capability	A	Insert	
2.23	Rated bus transfer switching current	A	Insert	
2.24	Rated bus transfer switching Voltage	V	Insert	
3.	Disconnecter - Design and Construction			
3.1	Disconnecter			
3.1.1	Insulator material		Porcelain, brown	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.1.2	Minimum creepage distance	mm/kV	Min. > 25 mm/kV	
3.1.2.1	Total creepage distance	mm	Insert	
3.1.3	Quality of insulator		Min. C130	
3.1.4	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.5	HV terminals			
3.1.5.1	Shape		Flat	
3.1.5.2	Dimensions	mm x mm	Min 200 x 100	
3.1.5.3	Number of holes		Min 8	
3.1.5.4	Dimensions of holes	mm	Insert	
3.1.5.5	Distance between holes	mm	Insert	
3.1.5.6	Material suitable for		Al terminal	
3.1.7	Weight and dimensions			
3.1.7.1	Pole height	mm	Insert	
3.1.7.2	Support insulator height	mm	Insert	
3.1.7.3	Total height	mm	Insert	
3.1.7.4	Pole length	mm	Insert	
3.1.7.5	Distance between support axis of a pole	mm	Insert	
3.1.7.6	Shipping dimensions	mm	Insert	
3.1.7.7	Pole weight	kg	Insert	
3.1.7.8	Weight of operating mechanism	kg	Insert	
3.1.7.9	Total weight	kg	Insert	
3.1.7.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanisms	pcs.	3 (1 per phase)	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.9	Motor - auxiliary supply voltage	V, AC	230/415	
3.2.10	Heater, 230 V, 50 Hz		Yes	
3.2.11	Water-tight corrosion-resistant housing		IP55	
3.2.12	Selection switch (local/neutral/remote)		Yes	
3.2.13	Manual closing button		Yes	
3.2.14	Manual opening button		Yes	
3.2.15	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.16	Single-phase socket		Yes	
3.2.17	Voltage presence controller		Yes	
3.2.18	Motor MCB (miniature circuit breakers)		Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.2.19	Heater MCB (miniature circuit breaker)		Yes	
3.2.20	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.21	Equipotential bonding rails		Yes	
3.2.22	Housing of Al or stainless steel		Yes	
3.3	Degree of protection for auxiliary circuits moving parts		IP55	
3.4	Whether locking facilities are provided to Padlock the disconnectors in both open & Close positions	Yes/No	Yes	
3.5	Whether the insertion of handle for manual Operation will cut off the control supply to the concerned equipment	Yes/No	Yes	
4	Others			
4.1	Type test certificate date/reference	Required	Yes	
4.2	Period of time equipment has been in commercial operation	years	Insert	
4.3	Number of the same type of disconnectors supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

A1.2: 400kV Disconnecter with Earth Switch

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	Disconnecter- General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-102	
			IEC 60273	
			IEC 60694	
			IEC 60815	
1.6	Quality control		ISO 9001	
			ISO 14001	
			ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design (Operating type)		Insert	
1.8.1	Type of Break		Horizontal	
1.8.2	Number of columns		Three Column	
1.8.3	Number of breaks per pole		Double Break	
1.8.4	Type of Contacts		Insert	
1.8.5	Material of contact surfaces		Insert	
1.8.6	Method of Operation		Insert	
1.9	Number of poles	pcs.	3	
1.9.1	Number of support insulation for pole		Insert	
1.10	Type of main blade operating mechanism		Motor Driven	
1.11	Number of main blade operating mechanisms	pcs.	3	
1.12	Type of earthing blade operating mechanism		Motor Driven	
1.13	Number of earthing blade operating mechanism		3	
2.	Disconnecter - Characteristics			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment Un	kV rms	420	
2.3	Rated lightning impulse withstand voltage i) between phase to ground and between phases	kV peak	1425	
	ii) across open switching device and/or isolating distance	kV peak	1425(+240)	
2.4	Rated switching impulse withstand voltage i) between phase to ground	kV	1050	
	ii) across isolating distance	kV	900(+345)	
2.5	Rated Power frequency	kV	520	

No.	Description	Unit	Minimum Requirements	Guaranteed
	withstand voltage (dry), 1 minute i) between phase to ground and between phases ii) across isolating distance			
		kV peak	610	
2.6	Corona extinction voltage	kV rms	320	
2.7	Radio interference voltage for frequency between 0.5MHz and 2MHz (at $1.1 \cdot U_m / \sqrt{3}$)	μV	1000	
2.8	Rated frequency fr	Hz	50	
2.9	Rated normal current Ir			
	a) Diameter	A	4000	
	b) Transformer bay		NA	
	c) Line bay		4000	
2.10	Rated short withstand current Ik	kA rms	63	
2.11	Rated duration of short-circuit on main blades	s	3	
2.12	Rated duration of short-circuit on earthing blades	s	3	
2.14	Rated maximum withstand current Ip	kA peak	Insert	
2.15	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	Insert	
2.16	Nominal supply voltage			
2.16.1	Controls and alarm (11 signaling) circuits	V d.c.	110	
2.16.2	Motors	V AC.	415	
2.16.3	Heaters	V a.c / Hz	230 / 50	
2.17	Opening time	ms	Insert	
2.18	Closing time	ms	Insert	
2.19	Mechanical endurance	Class	M2	
2.20	Rated mechanical terminal loads of terminals			
2.20.1	Direct loading, static Fa	N	> 2000	
2.20.2	Transversal loading, static Fb	N	> 660	
2.20.3	Vertical force Fc	N	> 1500	
2.20.4	Direct loading, dynamic	N	> 4500	
2.20.5	Transversal loading, dynamic	N	Insert	
2.21	Manual operating torque	kNm	Insert	
2.22	Load switching capability	A	Insert	
2.23	Rated bus transfer switching current	A	Insert	
2.24	Rated bus transfer switching Voltage	V	Insert	
3.	Disconnecter - Design and Construction			
3.1	Disconnecter			
3.1.1	Insulator material		Porcelain, brown	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.1.2	Minimum creepage distance	mm/kV	Min. > 25 mm/kV	
3.1.2.1	Total creepage distance	mm	Insert	
3.1.3	Quality of insulator		Min. C130	
3.1.4	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.5	HV terminals			
3.1.5.1	Shape		Flat	
3.1.5.2	Dimensions	mm x mm	Min 200 x 100	
3.1.5.3	Number of holes		Min 8	
3.1.5.4	Dimensions of holes	mm	Ø 14	
3.1.5.5	Distance between holes	mm	50	
3.1.5.6	Material suitable for		Al terminal	
3.1.7	Weight and dimensions			
3.1.7.1	Pole height	mm	Insert	
3.1.7.2	Support insulator height	mm	Insert	
3.1.7.3	Total height	mm	Insert	
3.1.7.4	Pole length	mm	Insert	
3.1.7.5	Distance between support axis of a pole	mm	Insert	
3.1.7.6	Shipping dimensions	mm	Insert	
3.1.7.7	Pole weight	kg	Insert	
3.1.7.8	Weight of operating mechanism	kg	Insert	
3.1.7.9	Total weight	kg	Insert	
3.1.7.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	3+3	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts for Main Switch(NO/NC/V)		12NO+12NC+1V	
	Minimum number of available contacts for Earthing Switch(NO/NC/V)		6NO+6NC+1V	
3.2.9	Motor - auxiliary supply voltage	V, AC	230/415	
3.2.10	Heater, 230 V, 50 Hz		Yes	
3.2.11	Water-tight corrosion-resistant housing		IP55	
3.2.12	Selection switch (local/neutral/remote)		Yes	
3.2.13	Manual closing button		Yes	
3.2.14	Manual opening button		Yes	
3.2.15	Anti-condensation heater inside the operating mechanism cabinet		Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.2.16	Single-phase socket		Yes	
3.2.17	Voltage presence controller		Yes	
3.2.18	Motor MCB (miniature circuit breakers)		Yes	
3.2.19	Heater MCB (miniature circuit breaker)		Yes	
3.2.20	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.21	Equipotential bonding rails		Yes	
3.2.22	Housing of Al or stainless steel		Yes	
3.3	Degree of protection for auxiliary circuits moving parts			
3.4	Whether locking facilities are provided to Padlock the disconnectors in both open & Close positions	Yes/No	Yes	
3.5	Whether the insertion of handle for manual Operation will cut off the control supply to the concerned equipment	Yes/No		
4	Others			
4.1	Type test certificate date/reference	Required	Yes	
4.2	Period of time equipment has been in commercial operation	years	Insert	
4.3	Number of the same type of disconnectors supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

A1.4: 400kV Current Transformer

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	Current Transformers - General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 61869-1&2	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor	
1.8	Shape / design		Head type	
1.9	Sealing		Hermetically closed	

2.	Current Transformers - Characteristics			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment U_m	kV rms	420	
2.3	Rated lightning impulse withstand voltage	kV peak	1425	
2.4	Rated switching impulse withstand voltage	kV	1050	
2.5	Rated Power frequency withstand voltage (dry), 1 minute	kV	520	
2.6	Corona extinction voltage	kV rms	320	
2.7	Radio interference voltage for frequency between 0.5MHz and 2MHz (at $1.1 \cdot U_m / \sqrt{3}$)	μV	1000	
2.8	Electrical dissipation factor at power frequency test voltage			
2.9	Rated frequency fr	Hz	50	
2.10	Rated short time thermal current I_{th} i) 1 sec ii) 3 sec	kA rms	63 Insert Insert	
2.11	Rated dynamic current I_{dyn}	kA peak	Insert	
	Rated continuous thermal current (40°C):			
2.12	a) I core	% I_n	200	
	b) II core	% I_n	200	
	c) III core	% I_n	120	
	d) IV core	% I_n	120	
	e) V core	% I_n	120	
	f) VI core	% I_n	120	
2.13	Rated transformer ratio:			
	a) I core	A/A	4000-2000/1	
	b) II core	A/A	4000-2000/1	
	c) III core	A/A	4000-2000/1	
	d) IV core	A/A	4000-2000/1	
	e) V core	A/A	4000-2000/1	
2.14	f) VI core	A/A	4000-2000/1	
	Accuracy class:			
	a) I core		0.2S	
	b) II core		0.2S	
	c) III core		5P20	
	d) IV core		5P20	
	e) V core		5P20	
	f) VI core		5P20	
		Calculation is required during design		
2.15	Security factor: a) I core		Fs=5	
2.16	Minimum knee point voltage at lowest ratio	V	Not applicable	
2.17	Max. magnetizing current guaranteed at knee point voltage & the lowest ratio (mA)		Insert	
2.18	Max. resistance of secondary winding at 75oC and at lowest ratio (ohms)		Insert	

2.19	Rated power:			
	a) I core	VA	10-20	
	b) II core	VA	10-20	
	c) III core	VA	30-60	
	d) IV core	VA	30-60	
	e) V core	VA	30-60	
	f) VI core	VA	30-60	
			Calculation is required during design stage	
2.20	Rated mechanical terminal loads	Class	Min. Class II	
3.	Current Transformers - Design and Construction			
3.1	Insulator material		Porcelain, brown	
3.2	Insulating medium		Oil-paper	
3.3	Insulation Class		A	
	Minimum creepage distance	mm/kV	Min. > 25 mm/kV	
3.4	Total creepage distance	mm	Insert	
	Permissible level of partial discharges:			
3.5	a) Test voltage $1.2 \cdot U_m / V_3$	pC	Max. < 5	
	b) Test voltage U_m	pC	< 10	
3.6	Min. LV enclosure protection		IP55	
3.7	HV terminals			
3.7.1	Shape		Flat	
3.7.2	Position		Horizontal	
3.7.3	Dimensions	mm x mm	Min 200 x 100	
3.7.4	Number of holes		Min 8	
3.7.5	Dimensions of holes	mm	Insert	
3.7.6	Distance between holes	mm	Insert	
3.7.7	Material suitable for		Al terminal	
3.8	tg5 test terminal		Yes	
3.9	Oil drain cock and sampling device		Yes	
3.10	Secondary reconnection		Yes	
3.11	Outdoor metal part made of aluminium or stainless steel		Yes	
3.12	Mass and dimensions			
3.12.1	Total mass	kg	Insert	
3.12.2	Height	mm	Insert	
3.1	Is earth screen fitted between primary and secondary windings	Yes/No		
4	Others			
4.1	Type test certificate date/reference	Required	Yes	
4.2	Period of time equipment has been in commercial operation	years	Insert	
4.3	Number of the same type of CTs supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

A1.5: 400kV Capacitive Voltage Transformer

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	Voltage Transformers - General			
1.1	Manufacturer		Insert	
1.2	Type		Capacitive	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 61869-1&3	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor	
1.8	Shape		Insert	
1.9	Sealing		Hermetically closed	
2.	Voltage Transformers - Characteristics			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment U_n	kV rms	420	
2.3	Rated lightning impulse withstand voltage	kV peak	1425	
2.4	Rated switching impulse withstand voltage	kV	1050	
2.5	Rated Power frequency withstand voltage (dry), 1 minute	kV rms	520	
2.6	Power frequency withstand tests on secondary windings, 1 min	kV rms	3	
	Power frequency withstand voltage between LV terminal and earth, 1min	kV rms	4 (10 if the low voltage terminal is exposed)	
2.7	Rated primary voltage	kV	400 / $\sqrt{3}$	
2.8	Rated secondary voltage			
	a) I winding	V	110V3	
	b) II winding	V	110V3	
	c) III winding	V	110V3	
2.9	Corona extinction voltage	kV rms	320	
2.10	Radio interference voltage for frequency between 0.5MHz and 2MHz (at $1.1 \cdot U_m / \sqrt{3}$)	μV	1000	
2.11	Rated frequency f_r	Hz	50	
2.12	Rated short-time thermal current I_{th} , 1 s	kA	63	
2.13	Rated dynamic current I_{dyn}	kV peak	Insert	
2.14	Accuracy class:			
	a) I winding		0.2	
	b) II winding		3P	
	c) III winding		3P	
2.15	Rated power:			
	a) I winding	VA	10-30	
	b) II winding	VA	20-50	

No.	Description	Unit	Minimum Requirements	Guaranteed
	c) III winding	VA	20-50	
			Calculation is required during design stage	
2.16	Rated Total thermal Burden			
	a) I winding	VA	200	
	b) II winding	VA	200	
	c) III winding	VA	200	
			The accuracy of 0.2 on winding I shall be maintained upto Rated total Thermal burden (200VA).	
2.17	Load		Simultaneously	
2.18	Voltage factor	p.u./s	1.2 continuous 1.5/30	
2.19	Rated mechanical strength	Class	Min. Class II	
2.20	Capacitor value: Capacitance C1 Capacitance C2	pF	Insert Insert	
2.21	High frequency capacitance for entire carrier frequency range		Within 80% to 150% of rated capacitance	
2.22	Phase angle error	minutes	20	
2.23	Equivalent series resistance over the entire carrier frequency range or temperature range	ohms	<40	
2.24	Stray capacitance and stray conductance of low voltage terminal over the entire capacitance		As per IEC 60358-1	
2.25	Standard reference range of frequencies for which the accuracies are valid		-97% to 103% for protection -99% to 101% for metering	
2.26	Maximum temperature rise	°C	Insert	
3.	Voltage Transformers - Design and Construction			
3.1	Insulator material		Porcelain, brown	
3.2	Insulating medium		Oil-paper - Mixed dielectric	
3.3	Minimum creepage distance	mm/kV	Min. > 25 mm/kV	
3.4	a) Test voltage $1.2 \cdot U_m / \sqrt{3}$	pC	Max. < 5	
	b) Test voltage U_m	pC	< 10	
3.5	Min. LV enclosure protection		IP55	
3.6	HV terminals			
3.6.1	Shape		Flat	
3.6.2	Position		Vertical or	

No.	Description	Unit	Minimum Requirements	Guaranteed
			horizontal	
3.6.3	Dimensions	mm x mm	Min 200 x 100	
3.6.4	Number of holes		Min 8	
3.6.5	Dimensions of holes	mm	Insert	
3.6.6	Distance between holes	mm	Insert	
3.6.7	Material suitable for		Al terminal	
3.7	Oil drain cock and sampling device		Yes	
3.8	Enable sealing after accuracy class checks (sealing possibilities)		Yes	
3.9	Outdoor metal part made of aluminium or stainless steel		Yes	
3.10	Mass and dimensions			
3.10.1	Total mass	kg	Insert	
3.10.2	Height	mm	Insert	
4	Others			
4.1	Type test certificate date/reference	Required	Yes	
4.2	Period of time equipment has been in commercial operation	years	Insert	
4.3	Number of the same type of CTs supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

A1.6: 400kV Surge Arrester

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
1	Surge Arresters - General						
1.1	Manufacturer		Insert	Insert	Insert	Insert	
1.2	Type		SM	SM	SM	SM	
1.3	Model designation		Insert	Insert	Insert	Insert	
1.4	Country of origin		Insert	Insert	Insert	Insert	
1.5	Standards		IEC 60099-4	IEC 60099-4	IEC 60099-4	IEC 60099-4	
1.6	Quality control		ISO 9001	ISO 9001	ISO 9001	ISO 9001	
1.7	Design		Metal oxide, gapless, outdoor	Metal oxide, gapless, outdoor	Metal oxide, gapless, outdoor	Metal oxide, gapless, outdoor	
1.8	Short circuit testing authority		Insert authority	Insert authority	Insert authority	Insert authority	

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
1.9	Type Test Report Reference		Insert	Insert	Insert	Insert	
2	Surge Arresters - Characteristics						
2.1	Voltage						
2.1.1	Nominal System Voltage	kV rms	400	230	132	33	
2.1.2	Highest voltage for equipment Um	kV rms	420	245	145	36	
2.1.3	Rated voltage of surge arrester Ur	kV rms	390	216	120	30	
2.1.4	Max. continuous operating voltage Uc	kV rms	312	176	102	24	
2.1.5	Reference Voltage	KVrms					
2.1.6	Gap between Vref & MCOV	% of MCOV	Insert	Insert	Insert	Insert	
2.1.7	TOV [Curve to be attached]						
a)	0.1s	pu [of MCOV]	Insert	Insert	Insert	Insert	
b)	1s	pu [of MCOV]	Insert	Insert	Insert	Insert	
c)	3s	pu [of MCOV]	Insert	Insert	Insert	Insert	
d)	10s	pu [of MCOV]	Insert	Insert	Insert	Insert	
2.1.8	Maximum residual voltage Ures						
a)	For switching impulse current 30/60 μ s at 0,5 kA	kV peak	≤ 745	≤ 375	≤ 235	55	
b)	For switching impulse current 30/60 μ s at 1 kA	kV peak	≤ 775	≤ 385	≤ 240	58	
c)	For switching impulse current 30/60 μ s at 2 kA	kV peak	≤ 805	≤ 405	≤ 255	62	
d)	For lightning impulse current 8/20 μ s at 5 kA	kV peak	≤ 862	≤ 435	≤ 280	67	
e)	For lightning impulse current 8/20 μ s at 10 kA	kV peak	≤ 916	≤ 465	≤ 300	72	
f)	For lightning impulse current 8/20 μ s at 20 kA	kV peak	≤ 990	≤ 515	≤ 320	77	
2.1.9	Dielectric endurance of arrester housing						
a)	Lightning impulse withstand voltage of arrester housing up (1.2/50 μ s)	kV					
b)	Power frequency withstand voltage of arrester housing (1 min	kV					

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
	wet)						
2.1.10	Arrester Protection Margin/level						
i)	Lightning Impulse Protection Margin/level		Min 1.55	Min 2.2	Min 2.1	Min 2.3	
ii)	Switching Impulse Protection Margin/level		Min 1.3	Min 1.5	Min 1.4	Min 1.4	
iii)	steep current impulse protection Margin/level		Min 1.4	Min 2.0	Min 2.0	Min 2.0	
2.2	Current						
2.2.1	Reference Current	mA					
2.2.2	Long duration current impulse (2000 μ s)	A	≥ 850	≥ 850	≥ 850	≥ 850	
2.2.3	Nominal discharge current In (8/20 μ s)	kA peak	10	10	10	10	
2.2.4	High current impulse of an arrester (4/10 μ s)	kA peak	100	100	100	100	
2.3	Others						
2.3.1	Line discharge class	Class	3				
2.3.2	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 8	≥ 7	≥ 6	≥ 6	
2.3.3	Thermal Charge Transfer Rating, Qth	Coulombs					
2.3.4	Repetitive Charge Transfer Rating, Qrs						
2.3.5	Rated frequency	Hz	50				
2.3.6	Partial Discharge Level	pC	≤ 10	≤ 10	≤ 10		
3	Surge Arresters - Design and Construction						
3.1	Designed Life	Years	30+				
3.2	MTBF		Insert	Insert	Insert	Insert	
3.3	MTTR		Insert	Insert	Insert	Insert	
3.4	Resistor Block						
3.4.1	Diameter	mm	Insert	Insert	Insert	Insert	
3.4.2	No. of ZnO Block in series at One unit	No.	Insert	Insert	Insert	Insert	
3.4.3	No. of separately housed arrester	No.					

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
	unit						
3.4.4	Housing design						
i)	A. Open or Case Design B. Closed or Wrap Design C. Hollow Tube Design		Insert	Insert	Insert	Insert	
ii)	Pressure relief device No. & Location						
iii)	Highest pressure developed during rated discharge current	kPa					
iv)	Highest pressure developed during rated pressure Relief Class	kPa					
v)	Alternate shed housing	Yes/No	Yes				
vi)	Color of housing						
vii)	Material of housing	SIR	Silicone Rubber				
viii)	Volcanizing Technology						
3.4.5	Design Considerations						
i)	Designed for Ambient Temperature	°C	-40 to +40	-40 to +40	-40 to +40		
ii)	Solar Radiation	kW/m2	≥1.1	≥1.1	≥1.1		
iii)	Altitude	m	1000	1000	1000		
iv)	Frequency of AC Power Supply	Hz	48-62	48-62	48-62		
v)	Wind Velocity	m/s	≤ 34 m/s	≤ 34 m/s	≤ 34 m/s		
3.4.6	Similar Model that passed Short Circuit Test						
i)	100% fault current	kA	Insert	Insert	Insert	Insert	
ii)	50% fault current	kA	Insert	Insert	Insert	Insert	
iii)	25% fault current	kA	Insert	Insert	Insert	Insert	
3.6.	Mechanical requirements						
3.6.1	Specified short-term load SSL (Fdyn)	N	Insert	Insert	Insert	Insert	
3.6.2	Specified long-term load SSL (Fstat)	N	Insert	Insert	Insert	Insert	

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
3.6.3	Maximum cantilever strength	Nm	Insert	Insert	Insert	Insert	
3.6.4	Maximum force due to wind (at maximum specified gust speed)	Nm	Insert	Insert	Insert	Insert	
3.7	Minimum creepage distance	mm/kV	≥ 25 mm/kV	≥ 25 mm/kV	≥ 25 mm/kV	≥ 25 mm/kV	
3.8.	Housing insulating material		Composite/ Silicon	Composite/ Silicon	Composite/ Silicon	Composite/ Silicon	
3.9	Insulating basement			Yes			
3.10	Surge arrester height	mm	Insert	Insert	Insert	Insert	
a)	Total leakage distance across outer insulator shedding for the complete arrester	mm	Insert				
b)	Protected leakage distance across outer insulator shedding for the complete arrester	mm	Insert				
c)	Clearance						
i)	phase to earth (from center line)	mm	Insert	Insert	Insert	Insert	
ii)	phase to phase (center line to center line)	mm	Insert	Insert	Insert	Insert	
3.11	Surge arrester weight	kg	Insert	Insert	Insert	Insert	
3.12	Voltage distribution ring present	Yes/No	Yes	Yes	Yes	Yes	
3.12.1	Ring Diameter	mm					
3.14	HV terminal						
3.14.1	Shape		Flat	Flat	Flat	Flat	
3.14.2	Dimension	mm x mm	Min 100 x 100	Min 100 x 100	Min 100 x 100	Min 100 x 100	
3.14.3	Number of holes		Min 4	Min 4	Min 4	Min 4	
3.14.4	Distance between holes	mm x mm	50 x 50	50 x 50	50 x 50	50 x 50	
3.14.5	Material suitable for		Al terminal	Al terminal	Al terminal	Al terminal	
3.15	Arrester Grounding	Yes/No	Yes	Yes	Yes	Yes	
3.16	Surge Counter		Insert	Insert	Insert	Insert	
3.16.1	Manufacturer		Insert	Insert	Insert	Insert	
3.16.2	Type		Insert	Insert	Insert	Insert	
3.16.3	Model designation		Insert	Insert	Insert	Insert	

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
3.16.4	Country of origin		Insert	Insert	Insert	Insert	
3.16.5	Leakage Current Measurement		Yes				
3.16.5	Range of Measurement	uA-mA	Insert				
3.16.6	Sensitivity of surge counter peak at a wave shape of micro sec		Insert	Insert	Insert	Insert	
3.16.7	Minimum counted Surge Ampere		Insert	Insert	Insert	Insert	
3.16.8	Error		Insert	Insert	Insert	Insert	
3.16.9	Grounding of Counter		Insert	Insert	Insert	Insert	
i)	Separate Insulated (from Counter housing) terminal at bottom of Counter		Insert	Insert	Insert	Insert	
ii)	Separate Insulated (from Counter housing) terminal at top of Counter		Insert	Insert	Insert	Insert	
iii)	Counter Body Earthing		Insert	Insert	Insert	Insert	
iv)	Earthing Conductor Material		Copper	Copper	Copper	Insert	
v)	Conductor Size	mm ²	Insert	Insert	Insert	Insert	
vi)	Conductor Insulation		Insert	Insert	Insert	Insert	
3.16.10	Short Circuit Test of Counter		Yes	Yes	Yes	Yes	
3.16.10.1	Test Authority		Insert	Insert	Insert	Insert	
4	Drawings						
4.1	GA Drawing with All dimension & clearance clearly marked		Yes	Yes	Yes	Yes	
4.2	Sectional Drawing to show internal blocks, PRD etc.		Yes	Yes	Yes	Yes	
4.3	HV terminal Drawing		Yes	Yes	Yes	Yes	
4.4	Surge Counter Drawing		Yes	Yes	Yes	Yes	
4.5	Surge Counter installation Drawing		Yes	Yes	Yes	Yes	
4.6	Earthing Terminal Drawing		Yes	Yes	Yes	Yes	
4.7	Quality & FAT/Routine Test		Yes	Yes	Yes	Yes	

No.	Description	Minimum Requirements					Guaranteed
		Unit	Data				Data
			400	230 (NA)	132 (NA)	33 (NA)	400
	Plan Attached						
Overall compliance with the requirements (yes/no)							

Wave Trap: 400kV

No	Description	Unit	Minimum Requirements	Guaranteed
1.	Surge Arresters - General			
2.	Type of Line Trap Installation		To be inserted into high voltage A.C transmission line phase in series	
3.	Type of mounting		Pedestal	
4.	Suitable for system Frequency	Hz	50	
5.	Nominal System Voltage	kV	400	
6.	Highest System Voltage	kV	420	
7.	Rated Continuous Current	A	4000	
8.	Rated Short time current for 1 second	kA	63	
9.	Asymmetrical peak value of the First half wave of the rates short Time current	kA	160	
10.	Rated inductance	mH	1.0	
11.	Type of Tuning		Band tuned line trap	
12.	Blocking Band frequency range	kHz kHz	Band-I: 56 to 124 Band-II: 76 to 500	
13.	Minimum Guaranteed resistive Component of impedance in Blocking Frequency Rang	Ohm	500	
14.	Protective device		a) Non-linear resistive type Gapped lightning arresters for A.C system. b) Polymer housed Metal oxide surge arrester without Gaps for A.C system.	
15.	Nominal discharge current of protective device	kA	10 kA However, Co-	

No	Description	Unit	Minimum Requirements	Guaranteed
			ordination shall be done by taking 20kA, 8/20 micro-sec discharge into consideration.	
16.	Rated voltage of protective device	kV rms	>15.72	
17.	Minimum value of power frequency spark over voltage (Dry & wet) of protective device	kV rms	>23.58	
18.	Visual Corona Extinction Voltage	kV rms	320 kV rms	
19.	Radio influence Voltage (RIV)	μV	<500 @280 kV	
20.	Attention in tuned frequency band	dB	<7.5 dB	
21.	Maximum tapping loss over blocking Band I & II stated above	dB	2.6 dB	
22.	Insulation class	Class	F	
23.	Maximum working stress		Twice the weight of wave trap+500 kgs.	

Post Insulator 400 kV

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	Post Insulators - General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain, outdoor	
2	Post Insulators - Characteristics			
2.1	Nominal system voltage	kV _{rms}	400	
2.2	Highest voltage for equipment U _n	kV _{rms}	420	
2.3	Rated lightning impulse withstand voltage	kV _{peak}	1550	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4	Rated short duration power frequency voltage	kV _{rms}	630/610	
2.5	Switching impulse withstand voltage (kVp)	kV peak	1050	
2.6	Corona extinction voltage	kV _{rms}	320	
2.7	Rated frequency f _r	Hz	50	
2.8	Minimum creepage distance	mm/kV	Min. ≥ 25 mm/kV	
2.9	Failing load bending (p0) (C10)	N	≥ 12000	
2.10	Failing load torsion	Nm	≥ 6000	
3	Post Insulators - Design and Construction			
3.1	Insulation material		Porcelain, brown	
3.2	Material quality acc. IEC 60672		Min. C130	
3.3	Min. material density ρ _a	Mgm ⁻³	≥ 2.5	
3.4	Min. stretch strength of material σ _{fg}	MPa	≥ 140	
3.5	Total min. cantilever strength (kg)	kg	1000	
3.6	Total creepage distance (mm) pedestal	mm	≥ 10500	
3.7	Total min. height of insulator (mm)	mm	3500	
3.8	Max. diameter of insulating part	mm	Insert	
3.9	Diameter of upper base	mm	Insert	
3.10	Number of holes on upper base		Insert	
3.11	Diameter distance between holes on upper base	mm	Insert	
3.12	Hole type on upper base		Insert	
3.13	Diameter on lower base	mm	Insert	
3.14	Number of holes on lower base		Insert	
3.15	Diameter distance between holes on lower base	mm	Insert	
3.16	Hole type on lower base		Insert	
3.17	Insulator weight	kg	Insert	
4	Others			
4.1	Type test certificate date/reference	Required	Yes	
4.2	Period of time equipment has been in commercial operation	years	Insert	
4.3	Number of the same type of CTs supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

String Insulator

	Description	Unit	Requirements	Guaranteed
1	Rated voltage	kV	400/230/132	
2	Type		Anti-FOG	
3	Size of insulators units	mmxm m	Insert	
4	Creepage distance of individual insulator unit (Minimum or as required to obtain total creepage distance)	mm		
5	Electromechanical strength	kN	210/160/120	
6	Power frequency withstand voltage of the complete string	kV rms	630/460/275	
7	Lightning impulse withstand voltage of the complete string with C.C. ring)	kVp	1425/1050/650	
8	Switching surge withstand voltage of the complete string with C.C. rings	kVp	1050	
9	Power frequency puncture withstand voltage for a string insulator unit		1.3 times the actual wet flashover voltage of the unit.	
10	Minimum corona extinction voltage level of the complete string with C.C. ring (Dry, kVrms)	kV rms	320/156/120	
11	R.I.V. Level of the complete string with C.C. ring	micro V	1000	
12	Total creepage distance (min.) of complete insulator string	mm	10500/6125/3625	

AUXILIARY POWER AND MULTICORE CONTROL CABLES

Item		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Number of core																
Core section	mm ²															
Core diameter	mm															
Conductor insulation	mm															
Type of filler																
Type of tape																
Sheath thickness	mm															
Sheath outer diameter	mm															
Armour wires	no.															
Armour wires diameter	mm															
Outer covering	type															
Outer covering thickness																
Completed cable:																
diameter	mm															
weight per metre	kg															
maximum drum	m															
length																
Minimum installed	mm															
bending	□C															
radius																
Maximum conductor																
temperature																

Control, Relay Protection, Substation Automation & Metering

Line Distance Protection

Line Distance Protection (Usable as Main-1/Main-2 of Line feeders):

SL. No.	Description	Unit	PGCB's requirements	Remarks
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	

SL. No.	Description	Unit	PGCB's requirements	Remarks
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	4	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs	Nos.	6	For Line VT & Bus VT
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	10 (programmable)	Should be increased as per the scheme design
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos. high speed trip output and 2 Nos. watchdog outputs)	Should be increased as per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	15 (programmable)	Should be increased as per the scheme design
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool.	

SL. No.	Description	Unit	PGCB's requirements	Remarks
			2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license	
14	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 based Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Impedance protection	
17.1	Tripping options		Single and/or three phases	
17.2	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Number of impedance protection zones	Nos.	5	
17.5	Shape of impedance zone		Mho/Quadrilateral	
17.6	Reverse looking element		Settable in all 5 zones	
17.7	Can resistance and reactance reaches be set independent of each other	Yes/No	Yes	
17.8	Arc forward and reverse reach setting independent of each other?	Yes/No	Yes	
17.9	Switch on to fault	Yes/No	Yes	
17.10	Power swing block	Yes/No	Yes	
17.11	Communication aided impedance protection		PUTT, POTT, CB Echo logic, Weak infeed echo logic, DTT, Zone-1 extension etc.	
17.12	Communication aided Directional Earth Fault	Yes/No	Yes	
17.13	Impedance zone operating time	Sec	Settable between 0s and 30s (or higher range) with step size of 0.01s	
17.14	Impedance setting range	Ohm	0.1/In to 600/In or higher with the step size of 0.001/In	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault	
19	Control functions		2 sets of Synchrocheck and 2 sets	1 set for Double

SL. No.	Description	Unit	PGCB's requirements	Remarks
			of 1P/3P auto-reclose for single and multi CB arrangements	busbar arrangement
20	Monitoring functions			
20.1	Fuse failure supervision, current circuit supervision	Yes/No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.3	Fault locator	Yes/No	Yes	
20.4	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

Line Differential Protection

Line Differential Protection (Usable as Main-1/Main-2 of Line feeders):

SL. No.	Description	Unit	PGCB's requirements	Remarks
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	8	4 for Double Busbar arrangement
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	

SL. No.	Description	Unit	PGCB's requirements	Remarks
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement	Nos.		
9.1	No of Inputs		6	For Line VT & Bus VT
9.2	Nominal voltage	V AC	110	
9.3	Minimum continuous withstand voltage	V AC	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	10 (programmable)	Should be increased as per the scheme design
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs)	Should be increased as per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	15 (programmable)	Should be increased as per the scheme design
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license	
15	GPS Time synchronization		Should be available	

SL. No.	Description	Unit	PGCB's requirements	Remarks
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
16.3	Protection communication		Should be suitable for multiplexed, routed switched or dedicated fiber optic communication	
16.4	Binary input transfer		Should be able to transfer at least 8Nos binary signals between the IEDs	
17	Main protection function		Line differential protection	
17.1	Tripping options		Single and/or three phases	
17.2	Number of parameter setting groups	Nos	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Differential characteristics		Restrained biased characteristics with charging current compensations	
17.5	Harmonics blocking		2 nd and 5 th harmonics	
17.6	CT summation		Internal CT summation facility should be available for 1 and ½ CB arrangement	
17.7	Emergency protection (Should be enabled in case of differential communication failure)		Impedance protection with at least 4 mho/quadrilateral zone setting options, PSB, SOTF, VTFF and all scheme communication features ¹	
17.8	Display options		There must be provision of displaying restraining and differential current on the HMI	
17.9	Tripping time		Instantaneous	
17.10	Protected distance		Should be able to protect at least 150km of line and further facility of extending protected line length in the relay should be provided	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault	
19	Control functions		2 sets of Synchrocheck and 2 sets of 1P/3P auto-reclose for single and multi CB arrangements	1 set for Double busbar arrangement

¹ PUTT, POTT, CB Echo logic, Weak infeed echo logic, DTT, Zone-1 extension etc.

SL. No.	Description	Unit	PGCB's requirements	Remarks
20	Monitoring functions			
20.1	Fuse failure supervision, current circuit supervision	Yes/No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.3	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

Transformer Differential Protection: NOT APPLICABLE

Transformer Differential Protection (Usable as Main-1/Main-2 of Transformer feeders):

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer			
2	Country of Origin (Place of Manufacturing)		Not applicable	
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	12	8 Nos for 2 winding Transformer
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
9	Voltage transformer requirement			
9.1	No of Inputs		6	For Line VT & Bus VT
9.2	Nominal voltage	V AC	110	
9.3	Minimum continuous withstand voltage	V AC	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	20 (programmable)	Should be increased as per the scheme design
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs)	Should be increased as per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	15 (programmable)	Should be increased as per the scheme design
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
15	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Transformer differential protection	
17.1	Application		For 3 winding and Auto-Transformers	For 2 winding transformer as per requirement
17.2	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Differential characteristics		Restrained biased characteristics with stabilization during magnetizing inrush and CT saturation	
17.5	Harmonics blocking		2 nd and 5 th harmonics	
17.6	CT ratio matching and vector group compensation		Internally done, Software based	
17.7	CT connection		CT connections from each voltage level should be connected individually without external summation	
17.8	Display options		There must be provision of displaying restraining and differential current on the HMI	
17.9	Tripping time		Instantaneous	
17.10	Restricted Earth Fault		High / low impedance type for protecting 3 winding Auto-transformers and 2 winding transformers	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault, Over-excitation protection, Thermal overload protection	
19	Control functions		2 Sets of Synchrocheck for single and multi CB arrangements	1 set for Double Busbar arrangement
20	Monitoring functions			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			and at least 24Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

Over current and Earth fault protection:

Over current and Earth fault protection (Usable as Back-up relay):

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	4	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs	Nos	4	
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	10 (programmable)	Should be increased as per the scheme design

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	10 (minimum 6 Nos high speed trip output and 2 Nos watchdog outputs)	Should be increased as per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	8 (programmable)	Should be increased as per the scheme design
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
15	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault protection with IEC and ANSI/IEEE	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			characteristics curves	
17.1	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.2	Minimum stages in each setting groups for Over-current	Nos	3	
17.3	Minimum stages in each setting groups for Earth fault	Nos	3	
17.4	Pre-configuration		For all basic functions	
17.5	Tripping time		Settable between 0s to 150s	
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	$0.1 \cdot I_n$ to at least $20 \cdot I_n$ (step size 0.01)	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	$0.5 \cdot I_n$ to at least $35 \cdot I_n$ (step size 0.1)	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	$0.01 \cdot I_n$ to at least $20 \cdot I_n$ (step size 0.01)	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	$0.5 \cdot I_n$ to at least $35 \cdot I_n$ (step size 0.1)	
17.10	TMS setting range for IDMT		0.025 to at least 1.5 (step size 0.025)	
18	Other protection functions		Comprehensive voltage protection functionality including over-voltage, under-voltage, negative sequence overvoltage, residual over-voltage, under-frequency, over-frequency, Rate of Change of Frequency (ROCOF) protection	
19	Control functions		2 Sets of Synchrocheck for single and multi CB arrangements if required by PSLD	1 set for Double Busbar arrangement
19	Monitoring functions			
19.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
19.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
20	Tripping and indication logics		Should be programmable	
21	Standards		Should conform IEC-60255 in all aspects	
22	Type test certificate		Should be provided	

Bay Control Unit (BCU) & Protection Unit (BCPU):

Bay Control & Protection Unit (BCPU):

SL. No.	Description	Unit	PGCB's requirements	Remarks
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50/60Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos	4	
8.2	Nominal current	A	Operable in 1A and 5A	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs	Nos	10	For Line voltage and Bus voltages; 6 Nos for Double Busbar arrangement
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos	10 (programmable)	Can be increased as per the scheme design
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos	10 (minimum 5 Nos fast operating trip output and 1 Nos watchdog outputs)	Can be increased as

SL. No.	Description	Unit	PGCB's requirements	Remarks
				per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos	08 (programmable)	Can be increased as per the scheme design
13	HMI		Front mounted, should be suitable to issue close & open commands to switching devices through visual animation, access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
15	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault protection with IEC and ANSI/IEEE characteristics curves	
17.1	Number of parameter setting groups	Nos	Minimum 4 (Independently settable)	
17.2	Minimum stages in each setting groups for Over-current	Nos	3	
17.3	Minimum stages in each setting groups for Earth fault	Nos	3	

SL. No.	Description	Unit	PGCB's requirements	Remarks
17.4	Pre-configuration		For all basic functions	
17.5	Tripping time		Settable between 0s to 150s	
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	$0.1 \times I_n$ to at least $20 \times I_n$ (step size 0.01)	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	$0.5 \times I_n$ to at least $35 \times I_n$ (step size 0.1)	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	$0.01 \times I_n$ to at least $20 \times I_n$ (step size 0.01)	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	$0.5 \times I_n$ to at least $35 \times I_n$ (step size 0.1)	
17.10	TMS setting range for IDMT		0.025 to at least 1.5 (step size 0.025)	
18	Other protection functions		Comprehensive voltage protection functionality including over-voltage, under-voltage, negative sequence overvoltage and residual over-voltage protection	
19	Control functions		i. Synchrocheck ii. Implementing interlocking logics iii. Execution of close and open command for switching devices coming from SAS and Device HMI	
20	Monitoring functions			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 10Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 16Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

Frequency Protection

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50/60Hz, $\pm 5\%$	
8	Voltage transformer requirement			
8.1	No of Inputs		3	
8.2	Nominal voltage	V AC	110	
8.3	Minimum continuous withstand voltage	V AC	220	
9	Language		English	
10	Binary input module			
10.1	Minimum number of inputs	Nos	5 (programmable)	
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos	8	
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
12	Number of LEDs	Nos	8 (programmable)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license	
15	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Frequency protection functions		Comprehensive frequency protection functionality including over-frequency, under-frequency, frequency rate of change with rate of change of rise and rate of change of fall freely.	
17.1	Number of parameter setting groups	Nos	Minimum 4 (Independently settable)	
17.2	Pre-configuration		For all basic functions	
17.3	Frequency setting range	Hz	40 to 60 or higher range (in step size of 0.01Hz)	
17.4	Time setting range of U/F and O/F	sec	0 to 100 or higher range (in step size of 0.01s)	
17.5	Setting range of Rate of Change of Frequency (ROCOF))	Hz/sec	0.1 to 10 or higher range (in step size of 0.01Hz/sec)	
17.5	Time setting range of ROCOF	sec	0 to 50 or higher range (in step size of 0.01s)	
18	Event records and oscillographic disturbance records		Event recorder should keep at least 10Nos previous records and disturbance recorder should handle at least 4Nos analogue channels and at least 8Nos binary channels	
19	Tripping and indication logics		Should be programmable	
20	Standards		Should conform IEC-60255 in all aspects	
21	Type test certificate		Should be provided	

Busbar Protection System:

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer		Insert	
2	Country of Origin (Place of Manufacturing)		Insert	
3	Relay Installation			
3.1	Operating architecture		Distributed	
3.2	Number of Central Unit	Nos	1	
3.3	Number of Bay Units	Nos	As mentioned in Substation Single Line Diagram; For Breaker Failure Protection of Tie CB in 1 and Half CB bus arrangement,	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			stand-alone relays will also be accepted.	
3.4	Minimum number of Bay Units supported by single Central Unit	Nos	30	
4	Central Unit Requirements			
4.1	Relay Type & model		Should be filled up by bidder	
4.2	Relay Software version		Should be filled up by bidder	
4.3	Relay Hardware version		Should be filled up by bidder	
4.4	Language		English	
4.5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
4.6	Relay auxiliary voltage	V DC	Minimum range of 48V to 250V; with protective fuse	
4.7	Maximum ripple		≤15%	
4.8	Operating frequency	Hz	50Hz, ±5%	
4.9	Binary Inputs of Central Unit			
	4.8.1	Minimum number of binary inputs	Nos.	12 (programmable)
	4.8.2	Minimum operating range	V DC	Substation nominal DC voltage ±15%
	4.8.3	Operating time	ms	<1
4.10	Binary Outputs of Central Unit			
	4.9.1	Minimum number of outputs	Nos.	9
	4.9.2	Operating time	ms	3
	4.9.3	Operating voltage	V	Upto 250 V AC/DC
	4.9.4	Continuous current capacity	A	8
	4.9.5	Short time current capacity	A	30A for at least 0.5s
	4.9.6	Binary output reset response		Programmable for latched and self reset
4.11	Number of LEDs	Nos.	20 (programmable)	
4.12	HMI		Front mounted, should be suitable to access all relevant measurements, alarms, tripping information and switching device information without external computer	
5	Bay Unit Requirements			
5.1	Relay Type & model		Should be filled up by bidder	
5.2	Relay Software version		Should be filled up by bidder	
5.3	Relay Hardware version		Should be filled up by bidder	
5.4	Language		English	
5.5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
5.6	Relay auxiliary voltage	V DC	Minimum range of 48V to 250V	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
5.7	Maximum ripple		≤15%	
5.8	Operating frequency	Hz	50Hz, ±5%	
5.9	Binary Inputs of Bay Unit			
	5.8.1	Minimum number of binary inputs	Nos.	12 (programmable)
	5.8.2	Minimum operating range	V DC	Substation nominal DC voltage ±15%
	5.8.3	Operating time	ms	<1
5.10	Binary Outputs of Bay Unit			
	5.9.1	Minimum number of outputs	Nos.	16
	5.9.2	Operating time	ms	3
	5.9.3	Operating voltage	V	Upto 250 V AC/DC
	5.9.4	Continuous current capacity	A	8
	5.9.5	Short time current capacity	A	30A for at least 0.5s
	5.9.6	Binary output reset response		Programmable for latched and self reset
5.11	CT requirements of Bay Unit			
	5.10.1	No of CT Inputs	Nos.	4
	5.10.2	Nominal current	A	Operable in 1A and 5A (User settable)
	5.10.3	Minimum continuous current capacity	A	4*Nominal current
	5.10.4	Thermal withstand capacity	A	100*Nominal current for at least 1s
	5.10.5	Burden per phase	VA	≤0.2
5.12	Number of LEDs	Nos.	8 (programmable)	
5.13	HMI		Front mounted, should be suitable to access all relevant measurements, alarms, tripping information and switching device information without external computer	
5.14	Test socket		Should be installed in the front side of the panel with each Bay Unit	
5.15	Supply of applicable test plug	Nos	2 Nos for each substation	
6	Communication interface & Software			
6.1	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
6.2	GPS Time synchronization		Should be available	
6.3	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base	

SL. No.	Description		Unit	PGCB's requirements	Bidder's Data
				Substation Automation System)	
6.4	Ethernet speed and connector			100Mbps, RJ45 plug connector/RS232 serial connector as front port	
6.5	Protection communication interface				
6.5.1	Type of communication			Optical fibre	
6.5.2	Number of cores per Bay Unit	Nos		2	
6.5.3	Core/sheath diameter			62.5/125µm (multi-mode)	
6.5.4	Maximum permissible attenuation	dB		5	
6.5.5	Minimum supported transmission length	m		1200	
7	Protection Functions				
7.1	Main protection function				
7.1.1	Required function			Highly reliable low-impedance based busbar differential protection	
7.1.2	Evaluation criteria			- Differential current with restrain feature - Directional current comparison method	
7.1.3	Evaluation method			Phase segregated	
7.1.4	Through-fault stability during CT saturation			Must be complied	
7.1.5	CT switching/Busbar selection			Must be done internally	
7.1.6	Minimum fault current pick-up setting	A		0.2 to 4 x I_N in step size of 0.01	
7.1.7	Differential restraining characteristics slope setting			0.5 to 0.8; in step size of 0.05	
7.1.8	Differential current alarms - Current setting - Time delay setting			5 to 50% of minimum pick-up in steps of 5% 2 to 10s in steps of 1s	
7.1.9	Isolator alarm time delay			0.5 to 90s	
7.1.10	Typical tripping time			20 to 30ms at $I_{Diff}/I_{Rest} \geq 5$	
7.1.11	Settable CT ratio per feeder			50 to 10,000/1A	
7.2	Check zone criterion			Should be available	
7.2.1	Minimum fault current pick-up setting	A		0.2 to 4 x I_N in step size of 0.01	
7.2.2	Differential restraining characteristics slope setting			0 to 0.8; in step size of 0.05	
7.2.3	Settable CT ratio per feeder			50 to 10,000/1A	
7.3	Additional protection function 1				
7.3.1	Required function			TEE-point differential protection (for 1 and half CB bus arrangement only)	Not applicable for Double busbar arrangement

SL. No.	Description		Unit	PGCB's requirements	Bidder's Data
	7.3.2	Evaluation criteria		- Differential current with restrain feature - Directional current comparison method	
	7.3.3	Evaluation method		Phase segregated	
	7.3.4	Through-fault stability during CT saturation		Must be complied	
	7.3.5	CT switching/selection		Must be done internally	
	7.3.6	Minimum fault current pick-up setting	A	0.2 to 4 x I_N in step size of 0.01	
	7.3.7	Differential restraining characteristics slope setting		0.5 to 0.8; in step size of 0.05	
	7.3.8	Differential current alarms - Current setting - Time delay setting		5 to 50% of minimum pick-up in steps of 5% 2 to 10s in steps of 1s	
	7.3.9	Isolator alarm time delay		0.5 to 90s	
	7.3.10	Typical tripping time		20 to 30ms at $I_{Diff}/I_{Rest} \geq 5$	
	7.3.11	Settable CT ratio per feeder		50 to 10,000/1A	
7.4	Additional protection function 2				
	7.4.1	Required function		Breaker failure protection	
	7.4.2	Current setting range		0.1 to 2 x I_N in step size of 0.1 x I_N	
	7.4.3	Measurement accuracy		$\pm 5\%$	
	7.4.4	Tripping logic		Should be available for minimum 2 (two) stages: re-trip and remote trip	
	7.4.5	Setting range of re-trip timer (t1)	ms	10 to 5,000ms in steps of 10ms	
	7.4.6	Setting range of remote trip timer (t2)	ms	10 to 5,000ms in steps of 10ms	
	7.4.7	Remote trip pulse duration	ms	100 to 2,000ms in steps on 10ms	
7.5	Additional protection function 3				
	7.5.1	Required function		End-fault protection	
	7.5.2	Current setting range		0.1 to 2 x I_N in step size of 0.1 x I_N	
	7.5.3	Timer setting range	ms	100 to 10,000ms in steps of 100ms	
7.6	Selective Tripping & Blocking options				
	7.6.1	Selective tripping		Should be provided based of statuses of switching devices	
	7.6.2	Selective blocking		Should be available for differential current alarm, switching object alarm, measurement abnormality, communication failure between Central Unit and Bay Unit	
	7.6.3	Forced blocking		Should be provided with selector switches installed in the panel for following options: BBP block, BFP block, EFP block, Output contacts	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			block, All functions block	
7.7	Pre-configuration		For all basic functions with respect to the complete Single Line Diagram of the substation	
8	Monitoring & Supervision functions			
8.1	Current measurement		For all feeders and all phases, Differential Current, Restraining current	
8.2	Switching object monitoring		Should be available	
8.3	Self supervision system		Should be available for Central Unit and Bay Units	
8.4	Event records		Event recorder should keep at least 100 events in each bay unit and at least 1000 events in Central Unit	
8.5	Time stamp of event records		Date and time with 1ms accuracy	
8.6	Disturbance records		Should be available with wave shapes of all current measurements and at least 32 binary inputs and outputs for each bay unit.	
8.7	Sampling frequency of disturbance record	Hz	At least 2400	
9	Tripping and indication logics		Should be programmable	
10	Standards		Should conform IEC-60255 in all aspects	
11	Type test certificate		Should be provided	
12	Environmental requirements			
12.1	Temperature			
12.1.1	Operation	°C	-10 to +55	
12.1.2	Storage and Transport	°C	-40 to +85	
12.2	Climate tests			
12.2.1	Cold		-25°C/16h	
12.2.2	Dry heat		+70°C/16h	
12.2.3	Damp heat		-25°C to +70°C, 1°C, 2 cycles	
12.2.4	Damp heat (long time)		+40°C, 93% relative humidity/4 days	
12.3	Insulation resistance tests		>100 MOhm @0.5kV	
12.4	Dielectric tests		2kV AC or 3kV DC/1 min 1kV AC or 1.4kV DC/1 min (across open contacts)	
12.5	Impulse test		1.2/50 μS/0.5 Joule, 5kV AC	

Self-Reset trip relays (as required for providing standard number of tripping and annunciation signals :

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		Insert	
2	Country of Origin		Insert	
3	Type, model		Should be filled up by bidder	
4	Reset mechanism		Self reset	
5	Maximum operating time	ms	10	
6	Maximum reset time	ms	20	
7	Rated voltage	V DC	100-125 or higher range	
8	Minimum threshold voltage	V DC	35% lower than the nominal voltage	
9	Minimum Rated capacity of relay contacts		AC 1250VA with maxima of 5A and 300V DC 1250W with maxima of 5A and 300V	
10	Minimum thermal capacity of relay contacts		AC 7500VA with maxima of 30A and 300V DC 7500W with maxima of 30A and 300V	
11	Number of Normally Open contacts	Nos	As required for standard scheme	
12	Number of Normally Close contacts	Nos	As required for standard scheme	
13	Standards		Should conform IEC-60255 in all aspects	

Hand Reset trip relays (as required for providing standard number of tripping and annunciation signals:

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		ABB/SIEMENS/ALSTOM/Schneider	
2	Country of Origin		France/UK/USA/Switzerland/Sweden/Germany	
3	Type, model		Should be filled up by bidder	
4	Reset mechanism		Hand reset	
5	Maximum operating time	ms	10	
6	Rated voltage	V DC	100-125 or higher range	
7	Minimum threshold voltage	V DC	35% lower than the nominal voltage	
8	Minimum Rated capacity of relay contacts		AC 1250VA with maxima of 5A and 300V DC 1250W with maxima of 5A and 300V	
9	Minimum thermal capacity of relay contacts		AC 7500VA with maxima of 30A and 300V DC 7500W with maxima of 30A and 300V	
10	Number of Normally Open contacts	Nos	As required for standard scheme	
11	Number of Normally Close contacts	Nos	As required for standard scheme	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
12	Standards		Should conform IEC-60255 in all aspects	

Trip circuit supervision relays (4 Nos for 2 feeders):

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		Insert	
2	Country of Origin		Insert	
3	Type, model		Should be filled up by bidder	
4	Supervision mode		Pre-close and post-close	
5	Maximum operating time	ms	70	
6	Rated voltage	V DC	100-125 or higher range	
7	Minimum threshold voltage	V DC	25% lower than the nominal voltage	
8	Thermal rating of the coil	%	120% of the rated voltage, continuous	
9	Maximum coil burden	W	20W at rated voltage	
10	Number of Normally Open contacts	Nos	As required for standard scheme	
11	Number of Normally Close contacts	Nos	As required for standard scheme	
12	Standards		Should conform IEC-60255 in all aspects	

Test Socket

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1.1	Manufacturer		Insert	
1.2	Country of origin		Sweden/Switzerland/UK/USA/Europe	
1.3	Type - Line main 1 and 2 - Line back-up and bus coupler - Transformer main 1 and 2 - Bay unit BBF Distance protection		Insert	
1.4	Standards		IEC	
1.5	Each protection device must have its own test socket		Yes	
1.6	Test socket must obtain safe online protection testing and maintaining, and performing whole tripping test with following AR		Yes	
1.7	Test socket should have enough contacts to: - Short-circuit current inputs from CT's - Isolate voltage inputs from VT's - Isolate trip circuit for each phase		Yes	

	separately - Isolate CB close command - Isolate signalling voltage - Inhibit breaker failure initialising - Inhibit sending of communication signal Allow functional testing of protection			
1.8	Socket should be designed for 4 mm banana plugs access		Yes	
2.2.1	Number of outputs	NO/NC	Min. 2/2	

Front Panel Annunciation for OHL & Power Transformers (Optional)

SL No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	Panel mounting		Yes	
2	Number of inputs		Min. 16	
3	Contact type		NO/NC	
4	Galvanic isolation		Yes	
5	Self-monitoring via front indication via relay contact		Yes	
6	Response delay time		Adjustable	
7	Bright LED technology		Yes	
8	Audible device output		Yes	
9	Lamp test button		Yes	
10	Acknowledgement button		Yes	
11	Horn acknowledgement button		Yes	

** Front panel annunciation must be parameterised, configured and delivered as per Engineer's requirements.

Front Panel Annunciation for Control Room (Optional)

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	Panel mounting		Yes	
2	Number of inputs		Min. 48	
3	Contact type		NO/NC	
4	Galvanic isolation		Yes	
5	Self-monitoring via front indication via relay contact		Yes	
6	Response delay time		Adjustable	
7	Bright LED technology		Yes	
8	Audible device output		Yes	
9	Lamp test button		Yes	
10	Acknowledgement button		Yes	
11	Horn acknowledgement button		Yes	

** Front panel annunciation must be parameterised, configured and delivered as per Engineer's requirements.

Overall Fault Clearance Times

SL No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	400 kV Busbar Faults:			
	Main protection relay operating time	ms	Insert	
3	Auxiliary and tripping relay time (where used)	ms	Insert	
4	Circuit breaker time	ms	Insert	
5	Total	ms	Insert	
2	230 kV Busbar Faults:			
	Main protection relay operating time	ms	Insert	
	Auxiliary and tripping relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
3	400/230/33 kV Transformer Faults:		Not Applicable	
	Main protection relay operating time	ms		
	Auxiliary and tripping relay time	ms		
	Circuit breaker time	ms		
	Total	ms		
4	400/132/33 kV Transformer Faults:		Not Applicable	
	Main protection relay operating time	ms		
	Auxiliary and tripping relay time	ms		
	Circuit breaker time	ms		
	Total	ms		
5	400 kV Line Faults:			
5.1	Fault Clearance at Kaliakoir:			
	Distance protection maximum operating time	ms	Insert	
	Permissive scheme time delay	ms	Insert	
	Auxiliary relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
5.2	Fault Clearance at Aminbazar			
	Distance protection maximum operating time	ms	Insert	
	Permissive scheme time delay	ms	Insert	
	Auxiliary relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
5.3	Fault Clearance at Gopalganj			
	Distance protection maximum operating time	ms	Insert	

	Permissive scheme time delay	ms	Insert	
	Auxiliary relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
6	230 kV Line Faults:			
6.1	Fault Clearance at Baghabari:			
	Distance protection maximum operating time	ms	Insert	
	Permissive scheme time delay	ms	Insert	
	Auxiliary relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
6.2	Fault Clearance at: Dhamrai			
	Distance protection maximum operating time	ms	Insert	
	Permissive scheme time delay	ms	Insert	
	Auxiliary relay time (where used)	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	

SCADA Server

SL No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14261	SCADA Server / Code number: 14261			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
1.5	Type of housing		Industrial 19" rack	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Dual power supply		Yes	
2.2	Processor type		Insert	
2.3	Processor clock	GHz	Insert	
2.4	Memory type		Insert	
2.5	Memory capacity	MB	Insert	
2.6	Video display adapter type		Insert	
2.7	Video display adapter memory		Insert	
2.8	Hard disc type		Insert	
2.9	Rotating hard disc	Yes/No	Insert	
2.10	Hard disc capacity	GB	Insert	
2.11	Number of hard discs	pcs.	Insert	
2.12	RAID controller type		Insert	
2.13	DVD RW type		Insert	
2.14	Serial interface RS232		Yes	
2.15	Number of serial interfaces		Min. 2	
2.16	Fast Ethernet network interface card type		Insert	
2.17	Number of fast Ethernet network interface cards	pcs.	4	
2.18	Fans	Yes/No	Insert	
2.19	Monitor 19"	pcs.	1	
2.19.1	Manufacturer		Insert	
2.19.2	Country of origin		Insert	
2.19.3	Type		TFT	
2.19.4	Standards		IEC	
2.19.5	Supply voltage			

SL No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.19.5.1	Rated auxiliary supply voltage	V a.c.	110 ±15 %	
2.19.5.2	Power consumption	W	Insert	
2.20	Vertical frequency	Hz	Insert	
2.21	Max. resolution		Insert	
	Overall compliance with the requirements (yes/no)			

** SCADA servers must be in hot-standby redundant configuration.

Operator Workstation

SL No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14262	Operator Workstation / Code number: 14262			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
1.5	Type of housing		Insert	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Processor type		Insert	
2.3	Processor clock	GHz	Insert	
2.4	Memory type		Insert	
2.5	Memory capacity	MB	Insert	
2.6	Video display adapter type		Dual head capability	
2.7	Video display adapter memory	MB	Insert	
2.8	Hard disc type		Insert	
2.9	Rotating hard disc	Yes/No	Insert	
2.10	Hard disc capacity	GB	Insert	
2.11	Number of hard discs	pcs.	Insert	
2.12	RAID controller type		Insert	
2.13	DVD RW type		Insert	
2.14	Sound card type		Insert	
2.15	Fast Ethernet network interface card type		Insert	

SL No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.16	Number of fast Ethernet network interface cards	pcs.	4	
2.17	Fans	Yes/No	Insert	
2.18	Monitor 24"	pcs.	2	
2.18.1	Manufacturer		Insert	
2.18.2	Country of origin		Insert	
2.18.3	Type		TFT	
2.18.4	Standards		IEC	
2.18.5	Supply voltage			
2.18.5.1	Rated auxiliary supply voltage	V a.c.	110 ±15 %	
2.18.5.2	Power consumption	W	Insert	
2.19	Visible diagonal	"	Insert	
2.20	Vertical frequency	Hz	Insert	
2.21	Max. resolution		Insert	
	Overall compliance with the requirements (yes/no)			

Printer

SL No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14263	Printer / Code number: 14263			
1.1	Manufacturer		Insert	
1.2	Model		Insert	
1.3	Country of origin		Insert	
1.4	Standards		IEC / ISO	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Type		Colour laser	
2.3	Format		A4	
2.4	Resolution	dpi	Insert	
2.5	Memory	MB	Insert	
2.6	Parallel port	Yes/No	Insert	
2.7	Fast Ethernet port		Yes	
2.8	USB port	Yes/No	Insert	
2.9	Minimum speed	Page/min	Insert	

	Overall compliance with the requirements (yes/no)	
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Monitoring Workstation

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14264	Monitoring Workstation / Code number: 14264			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
1.5	Type of housing		Insert	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Processor type		Insert	
2.3	Processor clock	GHz	Insert	
2.4	Memory type		Insert	
2.5	Memory capacity	MB	Insert	
2.6	Video display adapter type		Insert	
2.7	Video display adapter memory	MB	Insert	
2.8	Hard disc type		Insert	
2.9	Rotating hard disc	Yes/No	Insert	
2.10	Hard disc capacity	GB	Insert	
2.11	Number of hard discs	pcs.	Insert	
2.12	RAID controller type		Insert	
2.13	DVD RW type		Insert	
2.14	Sound card type		Insert	
2.15	Serial interface RS232		Yes	
2.16	Fast Ethernet network interface card type		Insert	
2.17	Number of fast Ethernet network interface cards	pcs.	1	
2.18	Fans	Yes/No	Insert	
2.19	Monitor 24"	pcs.	1	
2.19.1	Manufacturer		Insert	
2.19.2	Country of origin		Insert	
2.19.3	Type		TFT	
2.19.4	Standards		IEC	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.19.5	Supply voltage			
2.19.5.1	Rated auxiliary supply voltage	V a.c.	110 ±15 %	
2.19.5.2	Power consumption	W	Insert	
2.20	Vertical frequency	Hz	Insert	
2.21	Max. resolution		Insert	
	Overall compliance with the requirements (yes/no)			

Time Synchronization Device

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14271	Time Synchronization Device / Code number: 14271			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Rack mounting case		Insert	
2.3	Synch. Pulse output, 1 min	Yes/No	Insert	
2.4	Fast Ethernet port / FO		Yes	
2.5	Serial port		Yes	
2.6	Protocol		NTP	
	Overall compliance with the requirements (yes/no)			

Ethernet Switch Process LAN

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14273	Ethernet Switch-Process LAN / Code number: 14273			
1.1	Terminal Type		Insert	
1.2	Terminal version (software version)		Insert	
1.3	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Dual power supply		Yes	
2.2	Ethernet ports			
2.2.1	Number of ports		Min. 6xRJ45 or Min. 6xFO for IED connections AND 2xFO (1 GB) for process LAN	
2.2.1	Type of ports		RJ45 or FO and Fibre Optical (1 GB)	
2.3	Immunity to EMI and heavy electrical surges		Insert	
2.4	Temperature range			
2.4.1	Operation		0..50°C	
2.4.2	Storage		-20..+70°C	
2.5	Switching method an layer		Store & Forward Layer 3 (IEC 61850), RSTP (802.1w); eRSTP™ or RSTP (802.1D-2004) network fault recovery	
2.6	Switching latency		≤ 5µs	
2.7	Switching bandwidth		≤ 1.6 Gbps	
2.8	Failsafe output relay		Potential-free	
2.9	Cyber security features			
2.9.1	Multi-level passwords		Yes	
2.9.2	SSH/SSL encryption		Yes	
2.9.3	Enable/disable ports, MAC based port security		Yes	
2.9.4	Port based network access control		Yes	
2.10	System features			
2.10.1	Automatic learning negotiation and crossover detection			
2.10.2	Port configuration, status, statistics, mirroring, security			
2.10.3	Network fault recovery		≤ 5 ms	
2.11	Type Test Reports		To be included with bid	
2.12	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

Technical characteristics of optical ports of process LAN Ethernet switches must comply with appropriate characteristics of fibre optic cables for protection and control (see Code No. 14296).

thernet Switch Control Room

No.	Description	Minimum Requirements	Guaranteed
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		Unit	Data	
14274	Ethernet Switch-Control Room / Code number: 14274			
1.1	Terminal Type		Insert	
1.2	Terminal version (software version)		Insert	
1.3	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Dual power supply		Yes	
2.2	Ethernet ports			
2.2.1	Number of ports		Min. 16	
2.2.1	Type of ports		RJ45	
2.3	Immunity to EMI and heavy electrical surges		Insert	
2.4	Temperature range			
2.4.1	Operation		0..50°C	
2.4.2	Storage		-20..+70°C	
2.5	Switching method an layer		Store & Forward Layer 3 (IEC 61850), RSTP (802.1w); eRSTP™ or RSTP (802.1D-2004) network fault recovery	
2.6	Switching latency		≤ 5µs	
2.7	Switching bandwidth		≤ 1.6 Gbps	
2.8	Failsafe output relay		Potential-free	
2.9	Cyber security features			
2.9.1	Multi-level passwords		Yes	
2.9.2	SSH/SSL encryption		Yes	
2.9.3	Enable/disable ports, MAC based port security		Yes	
2.9.4	Port based network access control		Yes	
2.10	System features			
2.10.1	Automatic learning negotiation and crossover detection			
2.10.2	Port configuration, status, statistics, mirroring, security			
2.10.3	Network fault recovery		≤ 5 ms	
2.11	Type Test Reports		To be included with bid	
2.12	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

Protection Monitoring Software

No.	Description	Minimum Requirements	Guaranteed
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		Unit	Data	
14281	Protection Monitoring Software / Code number: 14281			
1.1	Protection Monitoring Software			
1.1.1	Communication with protection terminals		Yes	
1.1.2	Protection terminal configuration		Yes	
1.1.3	Protection terminal parameter setting		Yes	
1.1.4	Disturbance data collecting		Yes	
1.1.5	Disturbance data analysing		Yes	
1.1.6	Other software:		Insert	
	Overall compliance with the requirements (yes/no)			

SCADA Software

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14282	SCADA Software / Code number: 14282			
1.1	Basic SCADA server software			
1.1	Basic SCADA server software	pcs.	2	
1.1.1	Communication with 2 higher level control centres		Yes	
1.1.2	Real-time database management		Yes	
1.1.3	Data processing		Yes	
1.1.4	Data acquisition		Yes	
1.1.5	Alarm and event processing		Yes	
1.1.6	Data archiving		Yes	
1.1.7	Report generation and printing		Yes	
1.1.8	Redundancy management		Yes	
1.2	Operator workstation software	pcs.	2	
1.3	Communication software	pcs.	2	
1.3.1	Communication with 2 higher level control centres		Yes	
1.4	Application libraries	pcs.	1, optional	
1.5	Software tools	pcs.	1	
1.5.1	Database creating, maintaining and viewing		Yes	
1.5.2	User interface definition		Yes	
1.5.3	Report definition		Yes	
1.5.4	System configuration		Yes	
1.5.5	Historical data maintaining		Yes	
1.5.6	Database and historical data export/import		Yes	
1.5.7	Analysis and diagnostic tools		Yes	
1.5.8	Training simulator		Yes	
1.5.9	Other software tools according to Contractor's concept:		Insert	
	Overall compliance with the requirements (yes/no)			

Fibre Optic Cables & Terminal Equipment

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14298	Fibre Optic Cables & Terminal Equipment			
1.1	Sufficient quantity of adequate glass fibre optic cables for overall Protection & Control & Monitoring & Metering system should be foreseen and included in the bid.		Yes	
1.2	Below proposed quantities shall be verified according to specific Bidder's design.		Yes	
1.3	Final quantities must be estimated and delivered as per Single Line Diagram and Substation layouts.		Yes	
1.4	At least 20% spare in cable length, as well as in number of fibres in cable, should be foreseen.		Yes	
1.5	Fibre optic ducted cables shall be foreseen.		Yes	
1.6	Type of fibre optic		Multimode	
1.7	Number of fibres in cable		Min. 4	
1.8	Operational Wave length		Insert	
1.9	Attenuation factor maximum		Insert	
1.10	Band-width minimum		Insert	
1.11	Manufacturer		Insert	
2	Characteristics			
2.1	Fibre optic terminations. Overall quantities of specific fibre optic terminations should be closely related to number of fibres in each cable (each fibre, used or spare, should be properly terminated). At least 20% spare terminations for each proposed type should be foreseen.		Yes	
2.1.1	Plug connectors type		Insert	
2.1.2	Connection technology		Insert	
2.1.3	Plug pin type		Insert	
2.1.4	Manufacturer		Insert	
2.2	Optical distributor with connectors Overall quantity of Optical Distributor with Connectors should be closely related to number of relay houses. Optical Distributor with Connectors should be foreseen for both cable ends. At least 10% spare Optical Distributors with Connectors should be foreseen.		Yes	
2.2.1	Fibre optic cable gland		To accept metal-free optical cable	
2.2.3	Patch-cord connection		Yes	
2.2.4	Type of optical connectors		Insert	
2.2.5	Manufacturer		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.3	Patch-cord with optical connectors Overall quantity of fibre optic patch-cord cables should be closely related to number of protection and control devices (terminals) in each particular relay house. At least 20% spare patch-cord cables should be foreseen.		Yes	
Overall compliance with the requirements (yes/no)				

The quantities and specifications of the optical distributor with connectors and patch-cord with optical connectors predicted according to the optical ring configuration for control and according to the configuration of busbar protection.

The technical characteristics of fibre optic cables for protection and control have influence on optical ports characteristics of process LAN Ethernet switches.

Special Control Equipment and Tools

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14299	Special Control Equipment and Tools / Code number: 14299			
1.1	Special Control Equipment and Tools			
1.1.1	Special equipment and tools for setting, repairing, handling and maintaining of control system	set	1	
1.1.2	Software needed for configuration, setting, commissioning, testing, communication, interfacing with substation system	set	1	
1.1.3	Laptop brand-name computer	pcs.	2	
1.1.4	Test plugs, including all necessary accessories (transport case, cables, plugs, etc.)	set	2	
	Overall compliance with the requirements (yes/no)			

Fibre Optic Multiplexer Equipment

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	General:			
1.1	Manufacturer		Insert	
1.2	Model No.		Insert	
1.3	Type		Insert	
1.4	Type of multiplexer		SDH: ADM	
1.5	Complying to ITU-T rec.		Yes	
1.6	Transmission Capacity	Mbit/s	STM-4: 620	
1.7	Access capacity on 64 Kbit/s	channels	Minimum 200	
1.8	Access capacity on 2 Mbit/s	channels	Minimum 40	
1.9	Redundant central processor		Shall be available	
1.10	Digital cross connect function		Fully non-blocking	
2	Available aggregates:			
2.1	Optical aggregates (ITU-T G.957)		L-1.1, L-1.2	
3	Available trunk interfaces:			
3.1	HDB3, 2 Mbit/s interfaces per module	No.	Minimum 8	
3.2	Complying to ITU-T rec.		G.703, transparent G.704, selectable	
3.3	HDSL, 2Mbit/s interface: - no of copper wires - Capacity on 2Mbit/s or on 1Mbit/s - Capacity selectable	No. of channels channels / pair of wire	4 or 2 30 or 15 30 / 2 pairs 30 / 1 pair 15 / 1 pair	
4	Available user interfaces			
4.1	Voice interfaces for trunk lines:			
4.1.1	1 + 1 com path protection, available for all		yes	
4.1.2	Analogue, 4wire with E&M: - Input level - Output level	dBr dBr	+7.5 ... -16.0 +7.0 ... -16.5	
4.1.3	Analogue, 2wire with E&M: - Input level - Output level	dBr dBr	+6.5 ... -12.5 -1.0 ... -20.0	
4.1.4	Digital, 2Mbit/s CAS or PRI		yes	
4.2	Voice interfaces for remote subscriber:			
4.2.1	2wire, subscriber side	dBr	-5 ... +4 / -7.5 ... -1	
4.2.2	2wire, PABX side	dBr	-5 ... +4 / -7.5 ... -3	
4.3	Integrated teleprotection			
4.3.1	Interface for Commands:			
4.3.1.1	Number of independent commands	No.	4	
4.3.1.2	Transmission time max.	ms	6	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.3.1.3	Signal voltage	V _{peak}	250	
4.3.1.4	1 + 1 com path protection		yes	
4.3.2	Interface(s) for Differential Protection:			
4.3.2.1	Electrical interface: G.703	Kbit/s	64	
4.3.2.2	Optical Interface	Kbit/s	Minimum 64	
4.4	Data: channels per module			
4.4.1	1 + 1 com path protection, available for all		yes	
4.4.2	V.24/V.28 (RS-232): up to 38.4kbit/s	No.	4	
4.4.3	V.11/X.24 (RS-422): 64kbit/s	No.	4	
4.4.4	V.35: 64kbit/s	No.	4	
4.4.5	V.36 (RS-449): 64kbit/s	No.	2	
4.4.6	G.703: 64kbit/s	No.	8	
4.4.7	Ethernet: • 10/100 BaseT • WAN capacity • Protocols	No. Mbit/s -	4 Min: 2x 2Mbit/s Min.: IP	
4.5	Integrated alarm gathering module:			
4.5.1	Number of external alarms per module	No.	Min. 20	
4.5.2	Auxiliary power supply for ext. contacts		Yes	
4.6	Network Management System			
4.6.1	Type/Name of configuration tool			
4.6.2	For fault / configuration management		Yes / yes	
4.6.3	For local / remote operation		Yes / yes	
4.6.4	Data communication network (DCN)		Ethernet / IP or Ethernet / OSI	
4.7	Ambient Conditions:			
4.7.1	Storage: ETS 300 019-1-1, class 1.2	°C / % hum	-5 ... + 55 / class 1.2	
4.7.2	Transport: ETS 300 019-1-2, class 2.2	°C / % hum	-5 ... + 70 / class 2.2	
4.7.3	Operation: ETS 300 019-1-3, class 3.1E	°C / % hum	-5 ... +45 / class 3.1E	
4.8	Power Supply			
4.8.1	Operation	V DC	48 / 60 (-15/+20%)	
4.8.2	Fully redundant power supply		yes	
	Overall compliance with the requirements (yes/no)			

Bidders shall provide all necessary information, which deemed to be necessary to complete the project in all respects.

Digital Fault and Disturbance Recorder (DFDR)

SL	ITEM	UNITS	PGCB'S REQUIREMENT
(A)	GENERAL		
1.	Manufacture's name and address		To be mentioned
2.	Type		To be mentioned
3.	Power supply	VDC	110
4.	-Power supply for printer	VAC	240
(B)	ANALOGUE INPUTS		
1.	Number of channel		As per required number of signals for particular feeders
	- Expandability		As required for future feeders
2.	Nominal current	Amp	1A/5A
3.	Nominal voltage	Vac/Vdc	
	-Current	mA/Amp	
4.	Frequency response		
5.	Cut –off frequency		
	(a) Bandwidth	dB	
	(b) Attenuation at	dB	
	(C) Auto adjusted anti-aliasing filters for chosen sampling rate	Yes/No	Yes
	(d) Simultaneously programmable sampling rate for all feeders/inputs		3 distinct programmable Sampling rates and generate 3 simultaneously distinct records
	-Locally Changeable	Yes/No	Yes
	- Remotely Changeable	Yes/No	Yes
	(e) Possible sampling rates		3 different sampling rates:
		Samples/sec	Slow. 1Hz-500Hz
		Samples/sec	Fast: 0.5kHz-6kHz
		Samples/sec	Continuous (variable rate)
6.	DC coupled inputs	Yes/No	Yes, all Analog inputs should be capable of connecting AC or DC inputs as per site requirement without changing any hardware .
7.	Resolution	bits	16 bits
8.	Accuracy	%	Min 0.5
9.	Burden		
	1.Current Circuit at IN	VA	
	2.Voltage Circuit	VA	
10.	Over load		
	1.Current	% In	100% In continuously, Min 600% in for 1sec
	2.Voltage Circuit	% Vn	2Vn and max. 350Vn
(C)	DIGITAL INPUTS		
1.	Number of channel		As per required number of signals for particular feeders
	-Expandability(without and time skew)		As required for future feeders

SL	ITEM	UNITS	PGCB'S REQUIREMENT
2.	Selectable input level	Vdc	N/O or N/C. 24,48,110 and220 VDC
3.	Type		Potential or potential free contract
4.	Resolution	ms	
(D)	MEMORY		
1.	Size	MB	64 MB or Higher
2.	Type		SolidState
3.	Pre-fault time (fast scanning rate)	sec	0.1-2 user programmable
4.	Post-fault (fast scanning rate)	sec	0.1-2 user programmable
5.	Pre and Post fault time (slow scanning rate)	sec	min. 180 user programmable
6.	In-Build Flash disk (auto-maintained)	GB	min. 4 GB
(E)	SENSORS/ TRIGGERING CRITERIA		
	All sensors/triggers are preferable Programmable and Virtually recordable	Yes/No	Yes
1.	Logical combination sensor	Yes/No	Yes
2.	Three phase over or under Voltage/ Current	Yes/No	Yes
3.	Mono phase over or under Voltage/ Current	Yes/No	Yes
4.	*du/dt,dp/dt,dq/dt, [Single/3 Phases], df/dt, etc.	Yes/No	Yes
5.	RMS [Voltage/Current]	Yes/No	Yes
6.	Zero Sequence	Yes/No	Yes
7.	Negative, Positive Sequence	Yes/No	Yes
8.	Frequency	Yes/No	Yes
9.	DC Step	Yes/No	Yes
10.	Pending/Swing	Yes/No	Yes
11.	Digital level and edge	Yes/No	Yes
12.	Sensor Trigger	Yes/No	Yes
13.	Event Trigger	Yes/No	Yes
14.	Manual Trigger	Yes/No	Yes
15.	Remote Trigger	Yes/No	Yes
(F)	CLOCK SYSTEM		
1.	Internal Clock	Yes/No	Yes
2.	Accuracy		
3.	External Synchronization	Yes/No	Yes
4.	Time resolution between 2 synchronized pulse		
(G)	OUTPUT ALARM RELAY CONTACT		
1.	Max. operation Voltage DC/AC	Vac/Vdc	250 Vac or above, 60 Vdc or above
2.	Make and carry for 0.5 sec	A	Min. 8A
3.	Carry continuously	A	Min. 5A
4.	Break (DC)-resistive	W	
(H)	INTERFACE FOR DATA COMMUNICATION		
1.	Full definition compression	Yes/No	Yes
2.	Maximum transmission rat	Bits/Sec	
3.	Standard serial port (EIA-232-D)	Yes/No	Yes
4.	Printer Port	Yes/No	Yes
5.	Dedicated serial port for modem	Yes/No	Yes
(I)	PRINTER DATA		
1.	Printer amplitude (scaling peak to peak)		
2.	Time Scale (mm/s)		
3.	Printer resolution	mm	

SL	ITEM	UNITS	PGCB'S REQUIREMENT
4.	Auto printing	Yes/No	Yes
(J)	Fault Priority transmission	Yes/No	Yes
(K)	Fault location (distance calculation)	Yes/No	Yes
(L)	Test certificate from internationally recognized Laboratories	Yes/No	Yes
(M)	COMMUNICATION AND REMOTE ANALYZING UNIT		
1.	Processor Pentium	(MHz), Yes/No	Yes, at least 450MHz Pentium
2.	Co-Processor Pentium	Yes/No	Yes
3.	Main memory capacity	(Mb), Yes/No	Yes, at least 64Mb
4.	Color graphics board S-VGA	Yes/No	Yes
5.	Screen S-VGA	Yes/No	Yes
6.	Hard disk unit	Yes/No	Yes, at least 40GB
7.	Printer	Yes/No	Yes
8.	Modem	Yes/No	Yes

***Note:** du/dt =Change of voltage, dp/dt =change of active power, dq/dt = change of reactive power, df/dt = Change of frequency.

Substation Automation System

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	General			
1.1	Standards			
	Test Cab: Damp heat, steady state Test Db: Damp heat, cycle (12h + 12h cycle) Digital I/O, Analogue I/O dielectric Tests Digital I/O, Surge withstand test Radio interference test Transient fast burst test Static Discharge Electromagnetic fields		IEC 60068-2-78 IEC 60068-2-30 IEC 60255-27 IEC 61000-4-5 IEC 60870-3/Class 2 IEC 61000-4-4 IEC 61000-4-2 IEC 61000-4-3	
1.2	Number of years of proven field experience of offered system. (Note: proof of experience should be furnished. The components used in the offered system and those with field experience should be the same)	Year	5	
1.3	Design life of substation Automation System	Year	15	
1.4	Manufacturers quality assurance system		ISO 9001/9002 or equivalent	
1.5	Dimensions of cubicle - Width - Depth - Height - Floor load	mm mm mm N/m2	Insert Insert Insert Max 600	
1.6	Temperature range (min/max)	°C	0/50	
1.7	Relative humidity	%	93	
1.8	Intelligent Electronic Devices (IED's)			
	-serial communication interface included?	Yes/No	Yes	
	-Protection & Control IED's connected same bus?	Yes/No	Yes	
	- self monitoring	Yes/No	Yes	
	- display of measured values	Yes/No	Yes	
	-remote parameterization	Yes/No	Yes	
	-disturbance record upload and analysis	Yes/No	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.9	Availability Calculation shall be furnished for each equipment as well as for the entire system.	Yes/No	Yes	
1.10	The main part of the system, HMI, Gateway, IED shall be furnished with dual communication port against any failure.	Yes/No	Yes	
1.11	SNTP server shall provide GPS time-sync information to all communication (HMI, Gateway, IED) and the system shall be synchronized.	Hz	Yes	
1.12	Ethernet switch shall have dual system topology not to lose entire system with single switching system failure.	V	Yes	
2.	Station Level Equipment:			
2.1	Station Controller		Industrial PC	
2.2	MTBF (Mean time between Failures)	Hours	50000	
2.3	Station computer shall have dual connection to Ethernet switch as redundant (hot, standby)	Yes/No	Yes	
2.4	Hot standby take over time	Seconds	Yes	
2.5	Dual Wide Monitor each HMI (over 25")	Yes/No	Yes	
2.6	Single wide screen	Yes/No	Yes	
2.7	Number of years of proven field experience of offered software	years	5	
2.8	Operating System		Windows	
2.9	i) All standard picture as per spec included in HMI ii) Process Status Display & Command Procedures iii) Event processing as per spec iv) Alarm processing as per spec v) Reports as per spec vi) Trend Display as per spec vii) Graphical fault information receiving function viii) Disturbance & Fault recording and analysis with graphical format ix) User Authority levels as per spec x) System supervision & monitoring as per spec xi) Automatic sequence control as per spec	Yes/No	Yes	
3	Gateway to National Load dispatch Center			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2	Number of years of proven field experience of offered unit Insulation tests Fast disturbance tests Industrial environment Industrial grade hardware with no moving parts (PC based gateway is not accepted) Design life of offered equipment Redundant communication channel Redundant CPU Redundant DC/DC Supply	%	5Yrs IEC 60255-27 IEC 61000-4-4, Class 4 EN61000-6-4 Yes 15 Yrs Yes Yes Yes 50000Hrs Yes	
3.	Station Bus:			
3.1	Physical Medium		Glass fibre optic	
3.2	Each communication devices shall have dual connection, hot and standby.	Yes/No	Yes	
4.	Inter-bay Bus: Physical Medium		Glass fibre optic	
5	Printer server: MTBF	Hours	200000	
6	Hard Copy colour Printer: MTBF	Hours	180000	
7	Master Clock – GPS (Global Positioning System) Receiver: MTBF	Hours	150000	
8	Bay control Unit - HV			
8.1	Number of years of proven field experience of offered unit		5	
8.2	Separate Bay controller unit provided for each bay & feeder	Yes/No	Yes	
8.3	Type of bay controller offered HV/MV		HV	
8.4	Select Before Operate with Open Execute & Close	Yes/No	Yes	
8.5	Single bit dependence	Yes/No	Yes	
8.6	Interlocking, bay & Station wide	Yes/No	Yes	
8.7	Synchro check function - Maximum Voltage difference - Maximum Frequency difference Maximum Phase difference	Specify Range	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
8.8	Double command blocking	Yes/No	Yes	
8.9	Independent settable parameter groups	No	4	
8.10	Local Display Unit	Yes/No	Yes	
8.11	Sequence of event recorder - Events Time resolution	Nos msec	256 1	
8.12	Disturbance recording file transfer function	Yes/No	Yes	
8.13	Comtrade file generation function of Disturbance Recorder	Yes/No	Yes	
8.14	IED shall have dual connection to Ethernet switch (hot & standby)	Yes/No	Yes	
8.15	Comprehensive self-supervision	Yes/No	Yes	
8.16	Battery free backup of events and disturbance records	Yes/No	Yes	
8.17	Insulation tests	Standard	IEC 60255-27	
8.18	Fast disturbance tests	Standard	IEC 61000-4-4, Class 4	
8.19	Temperature range: IED's - Operation Transport and storage	°C °C	-10 to +50 -10 to +50	
8.20	Relative humidity: - Operating max./min - Transport and storage	% %	93 93	
9	Back up control mimic –HV (400kV)			
9.1	Control functionality: Control of breaker as well as all isolators/earthing switch (Control functionality should not be affected if bay controller fails)	Yes/No	Yes	
9.2	Key-Locked	Yes/No	Yes	
9.3	- Interlock override function	Yes/No	Yes	
9.4	Separate backup control mimic provided for each bay & feeder	Yes/No	Yes	
10	Bay control Unit - MV			
10.1	Number of years of proven field experience of offered unit		5	
10.2	Separate Bay controller unit provided for each bay & feeder	Yes/No	Yes	
10.3	Type of bay controller offered HV/MV		HV	
10.4	Select Before Operate with Open Execute & Close	Yes/No	Yes	
10.5	Single bit dependence	Yes/No	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.6	- Interlocking, bay & Station wide	Yes/No	Yes	
10.7	Synchro check function - Maximum Voltage difference - Maximum Frequency difference - Maximum Phase difference	Specify Range	Insert	
10.8	Double command blocking	Yes/No	Yes	
10.9	Independent settable parameter groups	No	4	
10.10	Local Display Unit	Yes/No	Yes	
10.11	Sequence of event recorder - Events Time resolution	Nos msec	256 1	
10.12	Disturbance recording file transfer function	Yes/No	Yes	
10.13	Comtrade file generation function of Disturbance Recorder	Yes/No	Yes	
10.14	IED shall have dual connection to Ethernet switch (hot & standby)	Yes/No	Yes	
10.15	Comprehensive self-supervision	Yes/No	Yes	
10.16	Battery free backup of events and disturbance records	Yes/No	Yes	
10.17	Insulation tests	Standard	IEC 60255-27	
10.18	Fast disturbance tests	Standard	IEC 61000-4-4, Class 4	
10.19	Temperature range: IED's - Operation Transport and storage	°C °C	-10 to +50 -10 to +50	
10.20	Relative humidity: - Operating max./min - Transport and storage	% %	93 93	
11	Back up control mimic –HV (400kV)			
11.1	Control functionality: Control of breaker as well as all isolators/earthing switch (Control functionality should not be affected if bay controller fails)	Yes/No	Yes	
11.2	Key-Locked	Yes/No	Yes	
11.3	Interlock override function	Yes/No	Yes	
11.4	Separate backup control mimic provided for each bay & feeder	Yes/No	Yes	
12	Bay control Unit - LV			
12.1	Number of years of proven field experience of offered unit		5	
12.2	Separate Bay controller unit provided for each bay & feeder	Yes/No	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
12.3	Type of bay controller offered HV/MV		HV	
12.4	Select Before Operate with Open Execute & Close	Yes/No	Yes	
12.5	Single bit dependence	Yes/No	Yes	
12.6	Interlocking, bay & Station wide	Yes/No	Yes	
12.7	Synchro check function - Maximum Voltage difference - Maximum Frequency difference - Maximum Phase difference	Specify Range	Insert	
12.8	Double command blocking	Yes/No	Yes	
12.9	Independent settable parameter groups	No	4	
12.10	Local Display Unit	Yes/No	Yes	
12.11	Sequence of event recorder - Events Time resolution	Nos msec	256 1	
12.12	Disturbance recording file transfer function	Yes/No	Yes	
12.13	Comtrade file generation function of Disturbance Recorder	Yes/No	Yes	
12.14	IED shall have dual connection to Ethernet switch (hot & standby)	Yes/No	Yes	
12.15	Comprehensive self-supervision	Yes/No	Yes	
12.16	Battery free backup of events and disturbance records	Yes/No	Yes	
12.17	Insulation tests	Standard	IEC 60255-27	
12.18	Fast disturbance tests	Standard	IEC 61000-4-4, Class 4	
12.19	Temperature range: IED's - Operation Transport and storage	°C °C	-10 to +50 -10 to +50	
12.20	Relative humidity: - Operating max./min Transport and storage	% %	93 93	
13	Back up control mimic –HV (400kV)		DELETED	
14	System Performance:			
14.1	Exchange of display (First reaction)	second	< 1	
14.2	Presentation of a binary change in the process display	second	< 0.5	
14.3	Presentation of an analogue change in the process display	second	< 1	
14.4	From order to process output	second	< 0.5	
14.5	From order to updated of display	second	< 1.5	

Power Line Carrier Equipment

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.1	Wave Trap		Refer to 5.1.1.13	
1.2	HF Coupling Unit			
1.	Manufacturer/model		Insert	
2.	Type		Insert	
3.	Working temperature range	°C	Insert	
4.	Available bandwidth		Insert	
5.	Tuning range		Insert	
6.	Composite loss over tuning range		Insert	
7.	Line side impedance range for phase/phase coupling		Insert	
8.	Equipment side impedance		Insert	
9.	Drain coil current carrying - continuous - for 1 second - for 3 seconds	A	Insert	
10.	Isolation transformer voltage withstand for 1 minute	V	Insert	
11.	Main arrestor voltage	V	Insert	
12.	Earth switch interlock with door		Insert	
13.	Compatibility with IEC Recommendation 481		Insert	
1.3	High Frequency Cable			
1.	Manufacturer		Insert	
2.	Type		Insert	
3.	Coaxial or quad		Insert	
4.	Surge impedance		Insert	
5.	Voltage withstand: between conductors between cores and armouring	V	Insert Insert	
	Attenuation per km: • at 50 kHz at 400 kHz		Insert	
1.4	Digital PLC Terminal			
1.	Manufacturer/model		Insert	
2.	Type		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.	Compliance with relevant parts of IEC62488-1		Insert	
4.	DC voltage working range		Insert	
5.	Service conditions (temperature and RH)		Insert	
6.	Power consumption		Insert	
7.	Design life		Insert	
8.	Carrier frequency range		Insert	
9.	Gross bandwidth		Insert	
10.	Teleprotection equipment mounted within the PLC units		Insert	
11.	Technical description of the equipment		Insert	
12.	Type of coupling (phase/phase or inter circuit)		Insert	
13.	Return loss within the carrier frequency band		Insert	
14.	Transmission rate of the digital signal		Insert	
15.	Output impedance		Insert	
16.	Dynamic range of receiver for digital signal		Insert	
17.	Means of RF frequency selection		Insert	
18.	Frequency spacing for parallel connections - between two digital PLCs - between a digital and an analogue PLC		Insert	
19.	Output power (before hybrid at coaxial cable)		Insert	
20.	Channel terminal power at output to coupling equipment		Insert	
21.	Type of digital modulation available/proposed		Insert	
22.	Calculations to justify operation of the PLC over the transmission lines		Insert	
23.	Any limitations in paralleling of terminals (to digital or analogue PLCs)		Insert	
24.	Required minimum SNR for minimum BER		Insert	
25.	Switching off of parallel PLCs, not to cause interference with working PLCs		Insert	
26.	Spurious emissions		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.5	Digital PLC Terminal (Terminal)			
27.	Maximum transmitting level for parasitic signals: • 0-4 kHz from the band limits • 4-8 kHz from the band limits >8 kHz from the band limits		Insert	
28.	Voltage withstand		Insert	
29.	Capacity options available for various services equipped within the digital bit stream		Insert	
30.	Capacity allocation proposed for this project		Insert	
31.	Speech channel 2W/4W interface		Insert	
32.	Speech channel impedance/levels		Insert	
33.	“Long line” telephone facility		Insert	
34.	Speech channel interfaces available (E&M etc.)		Insert	
35.	Service telephone		Insert	
36.	Type of speech codec		Insert	
37.	Compatibility with analogue speech bands		Insert	
38.	Method of telephone signalling		Insert	
39.	Frequency response of speech channel (Ref 800 Hz)		Insert	
40.	Data channel interface		Insert	
41.	Synchronous/asynchronous data channel availability		Insert	
42.	Data signalling transmission rates which can be accommodated		Insert	
43.	FSK Interface		Insert	
44.	VFT signal levels (2W and 4W)		Insert	
45.	Frequency response of VFT channel (Ref 3 kHz)		Insert	
46.	Test facilities		Insert	
47.	Alarm facilities		Insert	
48.	Equipment technical description		Insert	
49.	Terminal MTBF	Hours	Insert	
50.	Single or duplicated PSU		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.6	Teleprotection Equipment			
1.	Manufacturer/model		Insert	
2.	Type		Insert	
3.	DC voltage working range		Insert	
4.	Service conditions (temperature and RH)		Insert	
5.	Power consumption		Insert	
6.	Configured for analogue or digital communications media		Insert	
7.	Design life		Insert	
8.	Suitable for direct, permissive, blocking signalling		Insert	
9.	Single/duplication of teleprotection signals		Insert	
10.	VFT channel allocation and bandwidth		Insert	
11.	Frequency or coded signalling		Insert	
12.	Use of guard channel		Insert	
13.	Signal transmission time		Insert	
14.	Modem programmability		Insert	
15.	Means of monitoring communications channel		Insert	
16.	Transmission of "trip/send" signal at increased level		Insert	
17.	No. of signals per terminal		Insert	
18.	Facility to hold on output signal		Insert	
19.	Trip extension facility/time		Insert	
20.	Minimum/maximum input pulse and corresponding output		Insert	
21.	No. of receive output contracts		Insert	
22.	Provision of counters		Insert	
23.	Voltage withstand		Insert	
24.	Transmitter level output range		Insert	
25.	Receiver sensitivity range		Insert	
26.	Receiver alarm level or BER referred to nominal		Insert	
27.	Minimum alarm contact closure time		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
28.	No. of alarm contacts		Insert	
29.	19"/ETSI rack mounting practice		Insert	
30.	Information to be submitted with the Tender (a) Technical description (b) MTBF calculations (c) Performance graphs/details		Insert	
1.7	PAX Telephone Equipment and Subscriber Equipment			
(a)	Exchange equipment			
1.	Type reference		Insert	
2.	Manufacturer		Insert	
3.	Dimensions of cubicle		Insert	
4.	Rack width		Insert	
5.	Literature reference for typical layout of cubicle		Insert	
6.	Operating temperature range		Insert	
7.	Operating relative humidity		Insert	
8.	Power requirements		Insert	
9.	Mean time between failures		Insert	
10.	Maximum number of local extensions		Insert	
11.	Maximum number of remote extensions		Insert	
12.	Maximum number of trunk lines		Insert	
13.	Maximum number of connecting circuits		Insert	
14.	Method of signalling • Local extensions 2W • Remote extension 4W • Trunk lines 4W		Insert	
15.	Frequency of audible tones • Dial tone • Busy tone • Ringing tone Ringing current		Insert	
16.	Ring voltage		Insert	
17.	Type of processor		Insert	
18.	Type of memory		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
(b)	Subscriber telephone			
1.	Type reference		Insert	
2.	Manufacturer		Insert	
3.	Type of dial (rotary/pushbutton)		Insert	
4.	Operating voltage		Insert	
5.	Outdoor bell		Insert	
6.	Type reference		Insert	
7.	Manufacturer		Insert	
8.	Operating voltage		Insert	

Clamp Connector

TECHNICAL DATASHEET

SL	Item	Unit	Required	Offered
1.	Name of Clamp		Insert	
2.	EKD No.		Insert	
3.	Type/Model designation Vendor		Insert	
4.	Type designation Employer		Insert	
5.	Applicable Standard		Insert	
6.	Material composition		Insert	
	Main body		Al Alloy 6061	
	Bolt		SS or Al	
	Nut		SS or Al	
	Washer			
	Other hardware			
7.	Rated Voltage	kV	As per scope of work	
8.	Highest Voltage	kV	As per scope of work	
9.	Frequency	Hz	50	
10.	Ampacity	A	Not less than connecting conductor	
11.	Ambient temperature	⁰ C	40 or 45 (as per section- 01)	
12.	Temperate Rise	⁰ C	30	
13.	Short time current	kA	As per spec	
14.	Duration	s	3s	
15.	Contact resistance	$\mu\Omega$	Insert	
16.	Corona Inception Voltage	kVrms	Insert	
17.	Corona Extinction Voltage	kVrms	Insert	
18.	Noise	dB	Insert	
19.	RIV at $1.1 U_m/\sqrt{3}$	μV	Insert	
20.	Tensile Strength -rated	kN	Insert	
21.	95% UTS	kN	Insert	
22.	75% UTS	kN	Insert	
23.	60% UTS	kN	Insert	
24.	Size of Nut-Bolt		Insert	
25.	Tightening Torque-Recommended		Insert	
26.	Grease		Insert	
27.	Recommended cleaning brush		Insert	
28.	Type Tests		As per spec	
29.	Sample test		As per spec	
30.	Routine Test		As per spec	
31.	Drawings		As per spec	

ALLOY PROPERTIES -FOR ACCC

SL	Item	Unit	Required	Offered
1.	Name of Camp			
2.	EKD No.			
3.	Type/Model designation Vendor			
4.	Type designation Employer			
5.	Applicable Standard			
6.	Material Properties			
	Mechanical			
	Elongation at break	%	11	
	Fatigue strength	MPa		
	Elastic Modulus	GPa	69	
	Shear Modulus	GPa		
	Poisons ratio		0.33	
	Tensile Strength: Ultimate	MPa	100	
	Tensile Strength: Yield (Proof)	MPa	92	
7.	Thermal			
	Latent Heat of Fusion	J/g	400	
	Maximum Temperature: Mechanical	⁰ C	180	
	Melting Completion (Liquidus)	⁰ C	660	
	Melting Onset (Solidus)	⁰ C	640	
	Specific Heat Capacity	J/kg-K	≤900	
	Thermal Conductivity	W/m-K	≤220	
	Thermal Expansion	μm/m-K	≤24	
8.	Electrical			
	Electrical Conductivity: Equal Volume	% IACS		
	Electrical Conductivity: Equal Weight (Specific)	% IACS		
9.	Density	g/cm ³		
10.	Embodied Energy	MJ/kg		

ALLOY COMPOSITION- FOR ACCC

SL	Item	Unit	Required	Offered
1.	Name of Camp			
2.	EKD No.			
3.	Type/Model designation Vendor			
4.	Type designation Employer			
5.	Applicable Standard			
6.	Commercial Name/Grade			
7.	Material composition			
i.	Aluminium (Al)	%	≥ 99 to 99.95	

ii.	Silicon (Si)	%	0 to 1.0	
iii.	Iron (Fe)	%	0 to 1.0	
iv.	Copper (Cu)	%	0.05 to 0.2	
v.	Zinc (Zn)	%	0 to 0.10	
vi.	Manganese (Mn)	%	0 to 0.050	
vii.	Residuals	%	0 to 0.15	
8.				

Alloy 6061-T63

SL	Component	Percentage in Alloy-Required	Percentage in Alloy-Offered
1.	Aluminum, Al	<= 97.6 %	
2.	Boron, B	<= 0.06 %	
3.	Chromium, Cr	<= 0.03 %	
4.	Copper, Cu	<= 0.10 %	
5.	Iron, Fe	<= 0.50 %	
6.	Magnesium, Mg	0.35 - 0.80 %	
7.	Manganese, Mn	<= 0.03 %	
8.	Other, each	<= 0.03 %	
9.	Other, total	<= 0.10 %	
10.	Silicon, Si	0.30 - 0.70 %	
11.	Zinc, Zn	<= 0.10 %	

List of Clamp-Connector for AIS Substation

SL	Clamp	Reference ID no.
1.	Tension Clamp-Single conductor-ACSR	Insert
2.	Tension Clamp-Double conductor-ACSR	Insert
3.	Tension Clamp-Triple conductor-ACSR	Insert
4.	Tension Clamp-Quad conductor-ACSR	Insert
5.	Tension Clamp-Single conductor-TACSR	Insert
6.	Tension Clamp-Double conductor-TACSR	Insert
7.	Jumper Connection-ACSR-Single Conductor	Insert
8.	Jumper Connection-ACSR-Twin Conductor	Insert
9.	Jumper Connection-ACSR-Triple Conductor	Insert
10.	Jumper Connection-ACSR-Quad Conductor	Insert
11.	Suspension Clamp-Single conductor-TACSR	Insert
12.	Suspension Clamp-Double conductor-TACSR	Insert
13.	Shield Wire Connector	Insert

14.	T-Clamp	Insert
15.	CB connector Horizontal	Insert
16.	CB connector Vertical	Insert
17.	DS connector Horizontal	Insert
18.	DS connector Vertical	Insert
19.	ES connector-Rigid BUS	Insert
20.	ES connector-Strain BUS	Insert
21.	CT connector Horizontal	Insert
22.	CT connector Vertical	Insert
23.	VT connector Horizontal	Insert
24.	VT connector Vertical	Insert
25.	LA connector Horizontal	Insert
26.	LA connector Vertical	Insert
27.	Earth-Wire Connector	Insert
28.	Tr. Bushing Connector Horizontal	Insert
29.	Tr. Bushing Connector Vertical	Insert
30.	PI Connector	Insert
31.	BPI Connector -Fixed	Insert
32.	BPI Connector -pinned	Insert
33.	AL tube end clamp	Insert
34.	AL tube expansion joint clamp	Insert
35.	AL tube to Flexible conductor connector	Insert

Note; The above list is general only. Detailed list (including other than listed here) shall be provided by the contractor during execution as per site requirement.

Table: List of Clamp-Connector for GIS Substation

SL	Clamp	Reference ID no.
1.	Tension Clamp-Single conductor-ACSR	Insert
2.	Tension Clamp-Double conductor-ACSR	Insert
3.	Tension Clamp-Triple conductor-ACSR	Insert
4.	Tension Clamp-Quad conductor-ACSR	Insert
5.	Tension Clamp-Single conductor-TACSR	Insert
6.	Tension Clamp-Double conductor-TACSR	Insert
7.	Jumper Connection-ACSR-Single Conductor	Insert
8.	Jumper Connection-ACSR-Twin Conductor	Insert
9.	Jumper Connection-ACSR-Triple Conductor	Insert
10.	Jumper Connection-ACSR-Quad Conductor	Insert
11.	Suspension Clamp-Single conductor-TACSR	Insert

12.	Suspension Clamp-Double conductor-TACSR	Insert
13.	Shield Wire Connector	Insert
14.	T-Clamp	Insert
15.	AIS CB connector Horizontal (if any)	Insert
16.	AIS CB connector Vertical (if any)	Insert
17.	AIS DS connector Horizontal (if any)	Insert
18.	AIS DS connector Vertical (if any)	Insert
19.	AIS ES connector-Rigid BUS (if any)	Insert
20.	AIS ES connector-Strain BUS (if any)	Insert
21.	AIS CT connector Horizontal (if any)	Insert
22.	AIS CT connector Vertical (if any)	Insert
23.	AIS CVT connector Horizontal (if any)	Insert
24.	AIS CVT connector Vertical (if any)	Insert
25.	AIS LA connector Horizontal	Insert
26.	AIS LA connector Vertical	Insert
27.	Earth-Wire Connector	Insert
28.	Tr. Bushing Connector Horizontal	Insert
29.	Tr. Bushing Connector Vertical	Insert
30.	PI Connector	Insert
31.	BPI Connector -Fixed	Insert
32.	BPI Connector -pinned	Insert
33.	AL tube end clamp	Insert
34.	AL tube expansion joint clamp	Insert
35.	AL tube to Flexible conductor connector	Insert
36.	GIS Bushing Connector	Insert

Note; The above list is general only. Detailed list (including other than listed here) shall be provided by the contractor during execution as per site requirement.

Others

No	Description	Unit	Minimum Requirements	Guaranteed
1	Structural Steel			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Minimum yield strength	kg/mm ²	Insert	
	Ultimate tensile strength	kg/mm ²	Insert	
2	Copper Conductors for Earthing system			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Conductor material		Insert	
	Size of conductors (Solid copper rods)	mm ²	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	Size of conductors (Flat copper bars) (Width×Thickness×Bundles)	mm	Insert	
	Rated current	A	Insert	
	Short time withstand current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
3	High Voltage Bus Work			
3.1	Switchyard Conductor			
3.1.1	Copper Tubular Conductors for Busbar			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Inner diameter	mm	Insert	
	Outer diameter	mm	Insert	
	Rated continuous current (site rating)	A rms	Insert	
	Temperature rise at rated current	°C	Insert	
	Rated short time current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
	Weight	kg/m	Insert	
	Moment of inertia	kg-m ²	Insert	
3.1.2	Aluminium Tubular Conductors for Busbar			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Inner diameter	mm	Insert	
	Outer diameter	mm	Insert	
	Rated continuous current (site rating)	A rms	Insert	
	Temperature rise at rated current	°C	Insert	
	Rated short time current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
	Weight	kg/m	Insert	
	Moment of inertia	kg-m ²	Insert	
	Temperature rise at rated current	°C	Insert	
	Rated short time current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
	Rated ultimate tensile strength	kN	Insert	
	Mass, nominal	kg/m	Insert	
	No. of conductors per bundle		Insert	
	Bundle configuration		Insert	
	Bundle spacing			
3.1.3	Flexible Bus Conductor			
	Type and standard specification		Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	Manufacturer and country		Insert	
	Conductor type		Insert	
	Conductor size		Insert	
	Standing - No. of Al wires Dia. Of each wire	mm	Insert	
	Overall conductor dia.	mm	Insert	
	Cross-sectional area	mm ²	Insert	
	Rated continuous current (site rating)	A rms	Insert	
	Temperature rise at rated current	°C	Insert	
	Rated short time current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
	Rated ultimate tensile strength	kN	Insert	
	Mass, nominal	kg/m	Insert	
	No. of conductors per bundle		Insert	
	Bundle configuration		Insert	
	Bundle spacing		Insert	
3.1.4	Shield Wire			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Dia. of galvanized steel wire	mm	Insert	
	Stranding - No. of Al wires Dia. Of each wire	mm	Insert	
	Grade of wire		Insert	
	Weight of wire	kg/km	Insert	
	Minimum breaking strength of wire	kN	Insert	
3.2	Insulators			
3.2.1	Station Post Type (for rigid Busbar)			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Insulator unit, length/height	mm	Insert	
	No. of units in each insulator		Insert	
	Power frequency flashover voltage - Dry - Wet	kV kV	Insert	
	Impulse flashover voltage - Positive - Negative	kV kV	Insert	
	Power frequency withstand voltage - 1 min. dry	kV	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	- 10 sec. wet	kV		
	Power frequency puncture voltage	kV	Insert	
	Switching impulse withstand voltage, wet	kV pk	Insert	
	Lightning impulse withstand voltage	kV pk	Insert	
	Radio interference voltage - Test voltage to ground Max. RIV at 1.1xUr//3 line to ground voltage, when tested as per IEC 60694	kV rms micro V	Insert	
	Leakage distance	mm	Insert	
	Mechanical values, failing load (min.) - Cantilever strength - Tensile strength - Torsional strength - Compressional strength - Combined electrical and mechanical strength Impact strength	N N N-m N N N-m	Insert	
3.2.2	String Type		Insert	
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Insulator unit, length	mm	Insert	
	No. of units in each insulator		Insert	
	No. of insulator strings per conductor (at each end)		Insert	
	Dia. of disc	mm	Insert	
	Disc spacing	mm	Insert	
	Power frequency flashover voltage - Dry - Wet	kV kV	Insert	
	Impulse flashover voltage - Positive - Negative	kV kV	Insert	
	Power frequency withstand voltage - 1 min. dry - 10 sec. wet	kV kV	Insert	
	Power frequency puncture voltage	kV	Insert	
	Switching impulse withstand voltage, wet	kV pk	Insert	
	Lightning impulse withstand voltage	kV pk	Insert	
	Dry arcing distance	mm	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	Radio interference voltage - Test voltage to ground Max. RIV at $1.1 \times U_r / \sqrt{3}$ line to ground voltage, when tested as per IEC 60694	kV rms micro V	Insert	
	Leakage distance	mm	Insert	
	Mechanical values, failing load (min.) - Tensile strength - Torsional strength - Compressional strength - Combined electrical and mechanical strength Impact strength	N N-m N N N-m	Insert	

Technical information

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
1	Contractor's quality control system		
1.1	Copy of the QA system accreditation certificates		
1.2	Quality system manual with typical procedures and quality control sheets		
1.3	Environmental management manual		
1.4	Occupational health and safety manual		
2	Standards		
2.1	Copy of technical standards proposed for use instead of a relevant IEC or other international standard, with list of differences from relevant international standard, if any		
3	Substation arrangement		
3.1	Substation Single Line Diagrams		
3.2	Substation Layout drawing		
3.2	Cross-section drawing		
4	Circuit breakers		
4.1	Manufacturer's authorization letter		
4.2	Manufacturer's quality assurance certificates		
4.3	Technical data sheet		
4.4	Drawing		
4.5	List of performed type tests		
4.6	Type test certificates		
4.7	Descriptive catalogue		
4.8	Reference list for the last five years for the offered type		
4.9	List of mandatory special tools		
4.10	List of mandatory spare parts		
4.11	List of recommended spare parts		
4.12	Training plan and program		
5	Disconnectors		
5.1	Manufacturer's authorization letter		
5.2	Manufacturer's quality assurance certificates		
5.3	Technical data sheet		
5.4	Drawing		
5.5	List of performed type tests		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
5.6	Type test certificates		
5.7	Descriptive catalogue		
5.8	Reference list for the last five years for the offered type		
5.9	List of mandatory special tools		
5.10	List of mandatory spare parts		
5.11	List of recommended spare parts		
5.12	Training plan and program		
6	Current transformers		
6.1	Manufacturer's authorization letter		
6.2	Manufacturer's quality assurance certificates		
6.3	Technical data sheet		
6.4	Drawing		
6.5	List of performed type tests		
6.6	Type test certificates		
6.7	Descriptive catalogue		
6.8	Reference list for the last five years for the offered type		
7	Voltage transformers		
7.1	Manufacturer's authorization letter		
7.2	Manufacturer's quality assurance certificates		
7.3	Technical data sheet		
7.4	Drawing		
7.5	List of performed type tests		
7.6	Type test certificates		
7.7	Descriptive catalogue		
7.8	Reference list for the last five years for the offered type		
8	Surge arresters		
8.1	Manufacturer's authorization letter		
8.2	Manufacturer's quality assurance certificates		
8.3	Technical data sheet		
8.4	Drawing		
8.5	List of performed type tests		
8.6	Type test certificates		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
8.7	Descriptive catalogue		
8.8	Reference list for the last five years for the offered type		
9	Control system		
9.1	Manufacturer's authorization letter		
9.2	Manufacturer's quality assurance certificates		
9.3	Technical data sheet		
9.4	Drawing		
9.5	List of performed type tests		
9.6	Type test certificates		
9.7	Descriptive catalogue		
9.8	Reference list for the last five years for the offered type		
9.9	List of mandatory special tools		
9.10	List of mandatory spare parts		
9.11	List of recommended spare parts		
9.12	Training plan and program		
10	Relay Protection System		
10.1	Manufacturer's authorization letter		
10.2	Manufacturer's quality assurance certificates		
10.3	Technical data sheet		
10.4	Drawing, system topology, block diagrams		
10.5	General description of hardware		
10.6	General description of software		
10.7	Descriptive catalogue		
10.8	Reference list for the last five years for the offered type		
10.9	List of mandatory special tools		
10.10	List of mandatory spare parts		
10.11	List of recommended spare parts		
10.12	Training plan and program		
11	Metering System		
11.1	Manufacturer's authorization letter		
11.2	Manufacturer's quality assurance certificates		
11.3	Technical data sheet		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
11.4	Drawing		
11.5	General description of hardware		
11.6	General description of software		
11.7	Descriptive catalogue		
11.8	Reference list for the last five years for the offered type		
11.9	List of mandatory special tools		
11.10	List of mandatory spare parts		
11.11	List of recommended spare parts		
12	Communication System		
12.1	Manufacturer's authorization letter		
12.2	Manufacturer's quality assurance certificates		
12.3	Technical data sheet		
12.4	Drawing, system topology		
12.5	General description of hardware		
12.6	General description of software		
12.7	Descriptive catalogue		
12.8	Reference list for the last five years for the offered type		
12.9	List of mandatory special tools		
12.10	List of mandatory spare parts		
12.11	List of recommended spare parts		
	Overall compliance with the requirements (yes/no)		

Drawings and Other Technical Information to be provided

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
1	Contractor's quality control system		
1.1	Copy of the QA system accreditation certificates		
1.2	Quality system manual with typical procedures and quality control sheets		
1.3	Environmental management manual		
1.4	Occupational health and safety manual		
2	Standards		
2.1	Copy of technical standards proposed for use instead of a relevant IEC or other international standard, with list of differences from relevant international standard, if any		
3	Substation arrangement		
3.1	Substation Single Line Diagrams		
3.2	Substation Layout drawing		
4	Gas Insulated Substation & Equipment		
4.1	Manufacturer's authorization letter		
4.2	Manufacturer's QA certificates		
4.3	Technical data sheet		
4.4	List of performed type tests		
4.5	Type test certificates		
4.6	Reference list for the last ten years for the offered type		
5	Circuit breakers		
5.1	Manufacturer's authorization letter		
5.2	Manufacturer's QA certificates		
5.3	Technical data sheet		
5.4	List of performed type tests		
5.5	Type test certificates		
4.6	Reference list for the last ten years for the offered type		
6	Disconnectors		
6.1	Manufacturer's authorization letter		
6.2	Manufacturer's QA certificates		
6.3	Technical data sheet		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
6.4	List of performed type tests		
6.5	Type test certificates		
6.6	Reference list for the last five ten for the offered type		
7	Current transformers		
7.1	Manufacturer's authorization letter		
7.2	Manufacturer's QA certificates		
7.3	Technical data sheet		
7.4	List of performed type tests		
7.5	Type test certificates		
7.6	Reference list for the last ten years for the offered type		
8	Voltage transformers		
8.1	Manufacturer's authorization letter		
8.2	Manufacturer's QA certificates		
8.3	Technical data sheet		
8.4	List of performed type tests		
8.5	Type test certificates		
8.6	Reference list for the last ten years for the offered type		
9	Surge arresters		
9.1	Manufacturer's authorization letter		
9.2	Manufacturer's QA certificates		
9.3	Technical data sheet		
9.4	List of performed type tests		
9.5	Type test certificates		
9.6	Reference list for the last ten years for the offered type		
10	Control system		
10.1	Manufacturer's authorization letter		
10.2	Manufacturer's QA certificates		
10.3	Technical data sheet		
10.4	List of performed type tests		
10.5	Type test certificates		
10.6	Reference list for the last ten years for the offered type		
11	Relay Protection System		
11.1	Manufacturer's authorization letter		
11.2	Manufacturer's QA certificates		
11.3	Technical data sheet		
11.4	List of performed type tests		
11.5	Type test certificates		
11.6	Reference list for the last five years for the offered type		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
12	Metering System		
12.1	Manufacturer's authorization letter		
12.2	Manufacturer's QA certificates		
12.3	Technical data sheet		
12.4	List of performed type tests		
12.5	Type test certificates		
12.6	Reference list for the last ten years for the offered type		
13	Communication System		
13.1	Manufacturer's authorization letter		
13.2	Manufacturer's QA certificates		
13.3	Technical data sheet		
13.4	List of performed type tests		
13.5	Type test certificates		
13.6	Reference list for the last ten years for the offered type		

6. Schedule F: Subcontractors

The following form shall be filled and attached to the bid.

Bidders are free to propose/list more than one Subcontractor for each item.

Quoted rates and prices shall be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

In case that more than one Subcontractor has been proposed, the **Contractor** have right to choose one or more of them, or can ask for replacement

Should a Subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to substitute an acceptable Subcontractor without any change to the bid price.

Prior to signing the Contract, the corresponding Appendix to the Contract Agreement shall be completed, listing the approved Subcontractor for each item concerned.

If the Bidder will carry out any of the works and services, they shall put own name in the form

Subcontractors

The following Subcontractors are proposed for carrying out the facilities:

Item	Works and Service	Subcontractor's Name and Address	Nationality
11.1	Design		
11.2	Civil works		
11.3	Electrical works / installation, testing and commissioning		
11.4	NLDC		
Name of Bidder:			
Signature of Bidder:			

7. **Schedule G: Proposed Alternative Standards to Which Equipment Shall Be Provided**

The bidder shall list below all the alternative engineering and design Standards, which he proposes to use in his design, manufacture and testing of equipment to be supplied. Should these standards differ from the specified standard in any respect, the bidder shall detail the differences between the proposed and specified standard.

Compliance with any standard equal or superior to those specified will be considered acceptable.

In the absence of any listed alternative standard, it is deemed that the standards specified in the Tender documents are fully complied with.

Specified Standard	Alternative Standard	
	Number	Title

8. Schedule H: Proposed Contract & Site Organization

Personnel

The data on their experience should be supplied using the Form below for each candidate. The Bidder must demonstrate that he has the personnel for the key positions that meet the following requirements:

No.	Position	Total Work Experience (years)	Work Experience In Similar Projects (years)	Work Experience In Similar Projects in Oversea Area
1	Contractor's Representative Project Director / Project Manager	15	12	10
2	Substation Design Engineer	12	8	05
3	Site Manager	10	5	05
4	HV Electrical Engineer	10	5	05
5	Protection Engineer	10	5	05
6	Control Engineer	10	5	05
7	Substation Civil Engineer	10	5	05
8	Health & Safety (Accident Prevention) Officer*	8	5	03
9	Environmental Specialist*	8	5	03
10	Social/ Land Acquisition / Compensation Specialist*	8	5	03

*Workforce Management / Health & Safety (Accident Prevention) Officer, Environmental Specialist and Social /Community Liaison and Land Acquisition / Compensation Specialist shall be responsible inter alia for development of site - and works-specific CESMMP, including all sub-plans as indicated in Volume II (ERQ), Annex 1 and for the implementation of these plans, including monitoring and related reporting within the standard progress reporting of the project.

- ☐ All three specialists shall be full time position, during on-site construction.
- All three specialist shall be familiar with the application of the World Bank Group's General EHS Guidelines and the Sector EHS Guidelines for Electric Power Transmission and Distribution and with the other international standards as set out in Volume II (ERQ), Annex 1
- CV's of the three specialists have to be provided with the bidding documents, including evidence for each expert for having worked with application of the required standards.
- Each of the three specialists for E&S Management should be provided with appropriate assistance in terms of additional support staff of appropriate qualification to ensure due implementation of the CESMMP.
- The numbers of support staff for each of the specialists/the final team set up for E&S Management of the Construction Phase shall be provided as part of the bidding document.

The Bidder shall provide details of the proposed personnel and their experience records in the relevant information forms included in Section 4 (Bidding Forms) of Volume 1 of the Bidding Document and below.

Bidders should provide the names of suitably qualified personnel to meet the requirements specified in Section 3 (Evaluation and Qualification Criteria) of Volume 1 of 3 of the Bidding Document. The data on their experience should be supplied using the Form below for each candidate.

♦ **Form PER – 1: Proposed Personnel**

1.	Title of position*
	Name
2.	Title of position*
	Name
3.	Title of position*
	Name
4.	Title of position*
	Name

*As listed in Section 3 (Evaluation and Qualification Criteria).

♦ **Form PER – 2: Resume of Proposed Personnel**

Position		
Personnel information	Name	Date of birth
	Professional qualifications	
Present employment	Name of employer	
	Address of employer	
	Telephone	Contact (manager / personnel officer)
	Fax	E-mail
	Job title	Years with present employer

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

[illegible]

9. **Schedule I: Drawings and Documents to Be Submitted With Bid and After Contract**

9.1 **Drawing and Documents to be Submitted with BID**

The following drawings/documents shall be submitted with the Tender:

1. Typical single line, layout & sectional drawings of substation showing details of construction and dimensions.
2. Outline drawings of all switchgear equipment:-
 - (a) Showing installed components, dimensions and weights;
 - (b) Showing transport dimensions and weights;
3. Outline drawings of all power transformers, auxiliary transformers and Shunt Reactor (if any):-
 - (a) Showing installed components, dimensions and weights;
 - (b) Showing transport dimensions and weights;
4. Typical drawing of transformer remote control panel.
5. Following type test certificates of the equipment of similar or higher specifications (higher voltage & higher capacity) required by the bid shall be submitted as per relevant IEC.

The type test certificates of the equipment of similar or higher specifications (voltage & capacity) required by the bid shall be submitted as per relevant IEC and shall be from any independent testing laboratory except Power transformer, GIS, Shunt Reactor, circuit breaker and Lightning Arrester. For 400kV system, the short circuit capacity shall be 63kA for evaluation. For 230kV system, the short circuit capacity shall be 50kA for evaluation

Type test certificates of Power Transformer, Shunt Reactor, GIS, Circuit breaker and Lightning Arrester shall be issued by any independent STL member testing laboratories 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 STL members' laboratories.

i. **Power Transformer (Not Applicable)**

- a. Temperature rise test.
- b. Dielectric tests (Induced over voltage test, Lightning impulse voltage withstand test, Separate source voltage withstand test).
- c. Partial Discharge test
- d. Measurement of sound-level

- e. Short circuit withstand test (special test)

For Short circuit withstand test, the rating of Transformer shall be 380kV, 400MVA, single/three phase or higher rating. And for other test, the rating of Transformer shall be 380kV, 750MVA, 3-phase or higher rating. The transformer must be a Grid transformer. Type test for generator step-up transformer shall not be acceptable.

ii. Shunt Reactor: (Not Applicable)

- a. Temperature rise test.
- b. Dielectric tests (Induced over voltage test, Lightning impulse voltage withstand test, Separate source voltage withstand test).
- c. Partial Discharge test
- d. Measurement of sound-level
- e. Short circuit withstand test (special test)

iii. Circuit Breaker (AIS)

- a. Dielectric tests (LI, SI & Power Frequency)
- b. Temperature-rise tests
- c. Short time withstand current and peak withstand current tests
- d. Electromagnetic Compatibility tests
- e. Short circuit Current making & breaking tests
- f. Capacitive current switching tests
- g. Reactor Switching test
- h. Mechanical operation tests.
- i. Out of phase making & breaking test.

iv. Disconnecter (AIS)

- a. Lightning Impulse voltage withstand dry test.
- b. Switching Impulse voltage withstand dry test.
- c. Power frequency voltage withstand dry test.
- d. Short time withstand current test.
- e. Temperature rise test

Note: The Post Insulator (PI) of Disconnecter (DS) shall preferably be from DS main part (Contact blade) manufacturer. However, if PI manufacturer is different from DS main part manufacturer, the supply record of DS must include the name of PI manufacturer and the type test of DS must be submitted with the same type PI that will be supplied under this project; that is, the complete DS assembly, including PI, to be supplied under this project must be type tested.

v. Current Transformer (AIS)

- a. Short time current withstand test.
- b. Impulse voltages (Lightning& Switching Impulse) withstand tests for current transformers for service in exposed installation.
- c. Power frequency voltage withstand test.
- d. Temperature rise test.
- e. Measurement of Errors
- f. Partial Discharge Measurement test

vi. Voltage Transformer (AIS)

- a. Temperature rise test.
- b. Impulse voltages (Lightning& Switching Impulse) withstand tests for voltage transformers for service in exposed installation.
- c. Short circuit test
- d. Short time over voltage/Power frequency voltage withstand test.
- e. Partial Discharge Measurement test

vii. 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 withstand test.
- d. Residual voltage test.
- e. Pressure relief test.
- f. Artificial pollution test.

viii. Wave Trap

- a. Impulse voltage test
- b. Power frequency voltage test
- c. Temperature rise test
- d. Radio interference test
- e. Short time current withstand test
- f. Measurement of tapping loss & tapping loss based on the blocking resistance

ix. Insulator Units

Type test certificates shall be from an independent and reputed testing laboratory for insulator units and shall include the following tests performed on all offered types of insulators as per IEC.

- Dry lightning impulse voltage withstand test;
- Wet power frequency voltage withstand test;
- Electro-mechanical failing load test;
- Thermal mechanical performance test;
- Impulse voltage puncture test;
- Power arc test.

For each equipment, the Bidder shall provide the List of performed Type tests as following

Equipment					
No.	Type test	Name of Type test laboratory	Number of Type test report	Date of report	Number of pages

6. Quality Assurance Certificate ISO9001/9002 Certification (or equivalent) and Quality Assurance Programme & Typical Quality Plan for the work from the manufacturers of the following equipment:

- (i) Switchgears (CB, DS/ES) &
- (ii) Instrument Transformer (CT, PT)
- (iii) Relays & substation Automation System
- (iv) Fibre Optic Multiplexer Equipment for protection and communication
- (v) Surge Arrester
- (vi) Wave Trap
- (vii) DFDR
- (viii) Insulator

9.2 Drawings and Documents to be Submitted after Contract

Technical Drawings/Documents

General:

The Contractor shall prepare necessary technical documents for the equipment including detailed engineering drawings, design calculations and specifications showing full details of the civil works, equipment and materials to be used as well as all arrangement necessary for the installation works.

Prior to manufacturing, the contractor shall submit technical documents and drawings to the Employer for approval.

The Employer will review and send to the Contractor his comments on the documents within 4 weeks from receiving them, the commented drawings/ documents will be marked by "Approved", "Approved with Conditions", "Not Approved" or "Not Subject for Approved".

Any comments given by the Employer shall be taken into account before commencement of civil works, manufacturing process at factories and if any modification or change is directed by the Employer, the documents shall be revised and resubmitted for approval after making necessary revisions (Within 14 days).

Approval of the documents shall in no way relieve the Contractor from any of his contractual obligations.

All costs and expenses for preparation and submission of the documents shall be borne by the Contractor including those for revision and submission of the documents.

The Technical documents shall have the followings features:

a) Units:

International System of Units (SI) shall be applied to all works.

b) Language:

English shall be the formal language, hence all documents, correspondences, drawings, reports, schedules, instructions, name plates, rating plates, caution plates and notices shall be written in English.

c) Symbols, Marks and Abbreviations:

All symbols, marks and abbreviations, etc., used on any documents shall be clearly explained by a legend on the same document or on separate sheets.

The abbreviations and marks used for an individual device shall be identical throughout whole documentation so as to avoid confusion and misunderstanding.

d) Sizes and Identifications of Documents:

The size of the drawings shall be standardized as follows:

- A1 (594 mm x 841 mm)
- A2 (420 mm x 594 mm)
- A3 (297 mm x 420 mm)
- A4 (210 mm x 297 mm)

Design calculations, specifications, lists, instruction manuals and other documents shall preferably be prepared and submitted in A4 size.

All documents shall have a uniform title block at the bottom right hand corner, inclusive of the origin of the documents. The title block shall show the drawing title with main ratings such as capacity or voltage etc., drawing number, revision number or letter, date to have been prepared, name of the Contractor and/or manufacturer and the signature of the Contractor's authorized representative. Project title block will be informed from Engineer after contract. A spare blank space shall be provided above the title block of each document for the Employer comments.

Typical Technical Documents required to be submitted to the Employer:

The Bidder/Contractor shall submit the following technical documents and drawings:

A) With the Bid: (Refer to also Item 10.1 above)

The following drawings shall be submitted with the Bid:

- a) General arrangement of substation.

This drawing shall give the principal dimensions and approximate positions of the circuit breakers, isolating switches, etc.

- b) General arrangement and overall dimension drawings of the switchgear.
- c) Single line diagram of the main connections with secondary circuit of protection and metering etc.
- d) General arrangement for transformers.
- e) General arrangement of control and indicating panels.
- f) General arrangement of relay panels
- g) Drawings for MV switchgear & auxiliary buildings and guard house including floor plan, section, elevation and dimensions.
- h) Catalogues, literature and reference list of proposed Switchgear equipment, protection relays and SAS.
- i) Quality Management System Manual and ISO Certificate of the equipment manufacturer for 400kV & 230kV GIS, Auto Transformer, Shunt Reactor, 33kV Switchgear, Protection relays, Battery and Battery charger, Communication equipment and SAS.
- j) Type testing certificates and procedures for similar switchgear, transformer, shunt reactor, circuit breaker, cable, etc.
- k) Routine testing certificates and procedures for all equipment.

B) After Contract Award Stage:

The followings are minimum requirement. Additional documents/drawings shall be submitted to the Employer, when required by the Employer.

- a) Master List of Drawings and Documents (Master Document List):

After contract signing, the Contractor shall create and submit a master list of drawings and documents to the Employer for approval, for the purpose of monitoring and smooth processing of document approval, which shall contain document title and number, date to be submitted, re-submission date, approval date etc. underneath each column of relevant document classification or category.

- i) Single Line diagram (SLD) for main circuits and secondary circuits.
- ii) Layout drawings of the substation showing buildings/rooms, equipment arrangement, overall dimensions of equipment bays, cable routes or connections between equipment, internal/access roads and phase-phase and phase-earth clearances where applicable.
- iii) Outline drawings of switchgear bays, circuit breakers, disconnecting switches, earthing switches and other main plant showing overall dimensions and weights, including details for shipping.
- iv) General arrangement for transformers and shunt reactors.
- v) Bushings or cable termination details for switchgears and transformers/reactors.

vi) Descriptive information and drawings for transformers, dealing with tank, core and winding arrangements including type of coils, insulation, use of grading, on-load tap-changing equipment and location of all ancillary devices, these drawings shall show masses crane lift necessary for un-tanking and size of lifting lugs.

vii) Typical drawings of protection equipment, relay panels, and associated equipment enclosures.

viii) SAS system configuration and related drawings

ix) AC/DC system and panels arrangement drawing

x) Telecommunication equipment system diagram & panel arrangement

xi) Detailed schematic diagram for all equipment

xii) Interconnection/Wiring Diagrams, Cables route & Cable schedule between panels/equipment

xiii) Civil Engineering/design drawings

xiv) Details of Building services equipment and system arrangement/calculations

xv) Others, when required

- The contractor shall include any other drawings, catalogues, descriptions and photographs necessary to present a clear picture of the type and class of equipment to be provided under the contract.

- Project Implementation Schedule/Program shall be submitted to the Employer for approval within one month after signing the contract, showing the detailed program time schedule in bar/Gantt chart or equivalent for design, manufacturing, civil works, factory testing, delivery to substations, installation, site tests/commissioning and energization.

- The project organization chart including site organization shall also be submitted to the Employer for approval within one month after signing the contract.

b) Subcontractors & manufacturers:

Summary list of the final selected subcontractors/manufacturers shall be submitted for Approval showing materials/equipment, place of manufacturing and testing etc.

The Employer has the right to request the Contractor to submit detailed subcontract (Suborder) documents if required.

c) Specifications:

The Contractor shall prepare specifications for all major equipment/materials, installation, and commissioning for the Employer approval.

The specification shall contain the type, ratings, design, construction, materials, dimensions, corrosion protection and other necessary performance of the equipment.

d) Calculation sheets:

The Contractor shall submit all design calculation sheets for approval required for the substations systems and equipment in accordance with related IEC standards or equivalents, but not limited to:

i) 230/33kV/LV cable sizing calculation

ii) CT/VT ratings and sizing calculation (Burden, Class, Knee point voltage, Secondary resistance etc)

iii) Batteries and Battery Charger capacity

iv) Auxiliary Transformer capacity calculation

v) Earthing system, conductor sizing and safety of personnel and equipment calculations

vi) Detailed civil structural design calculations.

vii) Protective Relay settings calculations and recommendations

viii) Insulation coordination study

e) Lists:

The following lists shall be submitted for approval:

- Cable Lists
- List of site installation equipment
- List of Test Equipment and Special Tools.
- List of Spare Parts
- f) Factory Test Time Schedules
- g) Factory Test Procedures
- h) Factory Test Reports with witness signature
- i) Site test time schedule and Procedures
- j) Site Test /Commissioning Report
- k) Operation and maintenance Instruction Manuals and installation manual.
- l) Red marked As-Built Drawings
- m) As-Built Drawings
- n) Monthly Project progress report
- o) Weekly and Daily site report

Required Numbers of Drawings/Documents:

Numbers of the documents to be submitted to Engineer shall be as follows:

- a) During the Design/ Manufacturing stage:
 - Documents for approval : 6 copies.
 - Reference documents : 6 copies
- b) Before energizing stage:
 - Red mark corrected drawings : 4 copies.
- c) After commissioning test:
 - Complete sets of bound prints of As-built drawings : 4 copies.
- 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.

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.

10. Schedule J: Departures from The Specification

Bidders are to list all departures from the requirements of the specification in this schedule.

All departures whether they be commercial, financial, technical or of a contractual nature are to be included and shall be submitted with the Technical proposal

Any item that does not have a departure listed in this schedule will be deemed to be in full accordance with the requirements of the specification.

No other document or detail accompanying the tender will be considered in evaluating departures. Bidders are not permitted to offer any alternative to this schedule.

Item	Volume	Clause	Detail of Departure from Specification
			NOT APPLICABLE

11. Schedule K: Coefficient and Indices for Price Adjustment

(Not Applicable)

Price schedule

of

**Design, Supply, Installation, Testing & Commissioning
of 400kV AIS Bay extension at Kaliakoir 400/230kV
Substation (Package-2, Lot-1)**

Schedule B1: Plant & Equipment supplied from abroad						
Section-I Extension of Two (02) 400kV AIS Bays at Existing 400kV Kaliakoir Substation						
Item No.	Description of Equipment Requirement	Unit	Quantity	Code	Foreign Currency (in USD)	
					Unit Price	Total Price
					CIP (2)	CIP (3) = (1) x (2)
1A1	400 kV Air Insulated Switchgear, equipment connection and steel structures					
1A1.1	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, live tank type, single pole operated , SF6 gas circuit breakers with spring-stored energy operating mechanism with PIR, CSD as phase switching mechanism with support structure	Set	4			
1A1.2	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors with motor/manual operated	Set	2			
1A1.3	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors without earthing switch.	Set	8			
1A1.4	Single-phase, 6-core, 400kV, 63kA/1sec, 4000-2000/1A, 50Hz, 1425kVp BIL, post type current transformer.	No	18			
1A1.5	Single-phase, 3-core, 400kV, 50Hz, 1425kVp BIL, capacitor type voltage transformer.	No	6			
1A1.6	390kV rated voltage, 312kV(rms) continuous operating voltage at 50°C 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.	No	6			
1A1.7	Wave Trap, single phase, 420kV, 4000A, 1mH, 63kA/1s	No	2			
1A1.8	Post type support insulators for 400kV busbar and switchgear	lot	1			
1A1.9	Rigid tubular bus and/ or flexible conductors, insulators, fittings including all necessary clamps and connectors as required for completing extension of 400kV AIS Switchyard					
i)	Rigid Tubular Bus	lot	1			
ii)	Flexible Conductor for jumper, equipment connections	lot	1			
iii)	Insulator	lot	1			
iv)	Fittings, Clamp & Connectos with Nut-Bolts	lot	1			
1A1.10	Steel Structures for gantry and equipment supports					
a)	Gantry Column including nut & bolts					
i)	For Main Bus	Deleted				
ii)	For Jack-Bus	No.	8			
b)	Gantry beam at Jack-Bus height including nut & bolts	No.	8			
c)	Equipment support structures including nut & bolts					
i)	DS with ES	set	2			
ii)	DS without ES	set	8			
iii)	Bus ES	Deleted				
iv)	CT	No	18			
v)	CVT/IVT	No	6			
vi)	LA	No	6			
vii)	Wave Trap	No	2			
viii)	PI	lot	1			
d)	Cable tray including fitting, fixing accessories	lot	1			
e)	All other necessary material and equipment required for completing 400 kV switchgear.	lot	1			
1A2	420kV Gas Insulated Switchgear	Not Applicable				
1B	245 kV AIS & GIS	Not Applicable				
1C	132 kV AIS & GIS	Not Applicable				
1D	33kV AIS & GIS	Not Applicable				
1E	Power Transformer & Earthing/Auxiliary Transformer	Not Applicable				
1F	Control, Protection, SAS and Metering					
	420kV Circuits					
1F.1	Control, Monitoring, Protection & Substation Automation Facility including event recording function for 400KV overhead line circuits bays					
	Each Comprising	set	2			
a)	One (01) set Control Mimic panel with all accessories including monitoring					
b)	Two (02) sets of Protection main relays, Main-1 & Main-2 with TTB					
c)	One (01) set of Auxiliary relays (TCS, Lockout etc)					
d)	One (01) set Complete Protection Panel including Auxiliary Relay Switches, wiring, lighting, heater, humidity sensor and other					
1F.2	Modification / Extension of Busbar Protection					
	Each Comprising					
a)	One (01) set of Complete Protection Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	set	2			
b)	Two (02) sets of Protection main relay (BB-1 & BB-2 for each bus) (if required)					
i)	One (01) lot of Bay unit with HMI					
ii)	One (01) lot of Central unit with HMI including software modification					
c)	One (01) lot of Selector Switch for Enabling/Disabling BBP,BFP, all function (if required)					
1F.3	Tarif metering					
a)	Energy Meters (Main & Check)	set	4			
b)	Metering Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	lot	1			
1F.4	Substation Automation System					
	Each Comprising					
i.	BCU	Lot	1			
a)	for 400kV Circuits as per protection SLD					

Item No.	Description of Equipment Requirement	Unit	Quantity	Code	Foreign Currency (in USD)	
					Unit Price	Total Price
			CIP		CIP	
			(1)		(2)	(3) = (1) x (2)
	ii. ~~One (01) of Industrial Server PC -Deleted.~~					
	iii. 1 lot of Ethernet Switch for SAS					
	iv. 1 set of GPS system (if required)					
	v. One (01) lot of Renovation/Modification/Extension of Alarm Unit (if required)					
	vi. One (01) set of LCD Monitor, 55" or Large (Deleted)					
	vii. Two (02) sets of Printer, A4 Laser (One black & White, Other Color) (if required)					
	viii. One (01) set of Engineering PC for SAS & SCADA (if required)					
	ix. One (01) lot of Cable (Fiber Optic, Ethernet, Copper etc.)					
	x. One (01) of complete Panel including wiring, lighting,heater,humidity controller & other accessories					
	xi. One (01) lot of other Accessories (if any)					
1G	Digital Fault & Disturbance Recorder (Modification/Extension)					
1G.1	Each Comprising					
	i. ~~One (01) set of DFDR processor-Deleted~~	Lot	1			
	ii. Digital & Analog data acquisition channel					
	a) for 400kV Circuits as per protection SLD					
	iii. One (01) set of Ethernet Switch					
	iv One (01) set of GPS system (if required)					
	v. One (01) lot of Complete Panel including wiring, lighting, heater, humidity sensor & other accessories (if required)					
	vi. One (01) set of Engineering PC (if required)					
	vii. One (01) lot of Other Accessories (if any)					
1H	SCADA system for Telecontrol and Telemetering					
1H.1	Modification/Extension of SCADA hardware & software					
	Each Comprising					
	a) Equipment at Substation for modification / extension of SCADA system	Lot	1			
	i. One (01) set of Gateway (server, engineering software) (if required)					
	ii. One set of Ethernet Switch					
	iii. One set of Hardware Firewall					
	iv. Additional 33kV Feeder BCU - N/A					
	v. Complete Panel including wiring, lighting,heater, humidity controller & other accessories (if required)					
	vi. one lot Cables					
	vii. one lot Other Accessories					
	b Integration work with Master & Backup NLDC including Engineering & Commissioning	Refer to Schedule B4				
1I	Extension of Fibre Optic Multiplexer Equipment and PLC Equipment for Communication and Protection					
1I.1	One (01) complete lot of equipment for extension of existing fibre optic multiplexer equipment at local and remote end Substation for protection & communication, for required part of substation, shall be designed, supplied, delivered, installed, tested and commissioned and integrated into the existing system, under this contract. Fibre optic multiplexer equipment is to be provided for - 21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC) Distance relay carrier signal (main and back-up) SCADA data from switchgear and control system through SAS Hot-line telephone system	Lot	1			
1I.2	A lot of underground optical fibre (48 cores) cables from terminal box at gantry structure to MDF (Main distribution Frame) shall be designed, supplied, delivered, installed, tested and commissioned, including supply and installation of MDF and digital cables	Lot	1			
1I.3	A complete lot of PLC equipment for extension of existing PLCC system at Kaliakoir Substation including line matching unit and necessary cables & other accessories for completing PLC communication.	Lot	1			
1I.4	Installation,testing & commissioning	refer to schedule B4				
1J	Power Cable	Deleted				
1K	Multicore Cables					
1K.1	Multicore Cables for control, protection, metering & power circuits					
	i) LV Control Cable	lot	1			
	ii) LV Power Cable	lot	1			
1L	Earthing and Lightning Protection					
1L.1	_Extension of Earthing system for 400kV Switchyard	lot	1			
1L.2	Extension of Lightning Protection System for 400kV Switchyard	lot	1			
1M	Batteries, chargers & DC distribution					
1M.1	110V Ni-cad Batteries with chargers & distribution board					
	a) Extension of 110V DC Distribution panel, MCC type and board/New DCDB panel (if required)	Lot	1			
	b) 110V Ni-cad Batteries with chargers	lot	1			

Item No.	Description of Equipment Requirement		Unit	Quantity	Code	Foreign Currency (in USD)	
						Unit Price	Total Price
						CIP	CIP
						(1)	(2)
						(3) = (1) x (2)	
	i.	110V Battery Banks, not less than 400Ah	set	1			
	ii.	Charger, not less than 150A	set	1			
a)	iii.	Insulation Monitoring system for complete DC system(if required)	lot	1			
1M.2	48V Ni-cad Batteries with chargers & distribution board						
	i)	Extension of 48V DC Distribution panel and board/New DCDB panel (if	Lot	1			
1N	LVAC Distribution						
1N.1	Extension of AC 415V or 240V distribution panels (MCC type)		lot	1			
1N.2	Tariff metering at LV side(Main & Check)		Deleted				
1O	Civil Works, Building and Foundation						
1O.1	Complete civil items required for outdoor works including boundary wall, gantry foundation, necessary land development.		Refer to Schedule B4				
1O.2	Complete civil works for new Switchyard Panel Room (SPR) & repair, modification works of other control houses for the extension work.		Refer to Schedule B4				
1O.3	Testing of Foundation		Refer to Schedule B4				
1P	Lighting, small power, air conditioning and Ventilation						
1P.1	Extension of Lighting, small power and emergency DC lighting for new SPR and Local control houses.		lot	1			
1P.2	Complete design, supply, installation and commissioning of equipment to provide Air Conditioning system (cassette type), Ventilation system for new SPR.		lot	1			
1P.3	Extension of Lighting for outside building for security, roadway, switchyard and emergency DC lighting.		lot	1			
1P.4	Fire Fighting system for SPR		lot	1			
	Sub-Total Price of section-I (carried to Schedule-5: Grand Summary)						
Section-II	Mandatory Spares, Erection & Test Equipment						
	Mandatory Spares						
2.1	420kV Switchgear						
2.1.2	420kV Air Insulated Switchgear						
2.1.2.1	Complete SF6 gas, livetank type 420kV Circuit Breaker (single-pole operation type) suitable for Reactor switching		set	1			
2.1.2.2	Complete SF6 gas, livetank type 420kV Circuit Breaker (gang operation type)		Deleted				
2.1.2.3	Complete 420kV disconnect switch (with & without ES)		set	1			
2.1.2.4	Complete 420kV Current Transformer		Nos.	1			
2.1.2.5	Complete 420kV capacitive VoltageTransformer		Nos.	1			
2.1.2.6	390kV Surge arrester		Nos.	1			
2.1.2.7	Closing coils for CB (Offered Type)		Nos.	1			
2.1.2.8	Tripping coils for CB (Offered Type)		Nos.	2			
2.1.2.9	Motor for 420kV circuit breaker operating mechanism		Nos.	1			
2.1.2.10	Motor for disconnect drive		Nos.	1			
2.1.2.11	SF6 gas (45 kg) cylinder		Nos.	1			
2.1.2.12	Contactors, relays, selector switches, push buttons, counters, heaters, humidity sensors etc., in motor drive mechanism and control cubicle, one of each type		set	1			
2.2	245kV Switchgear						
2.2.1	245kV Gas Insulated Switchgear		Deleted				
2.2.2	245kV Air Insulated Switchgear		Deleted				
2.3	Protection and Control						
2.3.1	Each type of protection relay for 400KV Extension of Kaiakoir Substation (Bidder to list)		set	1			
2.3.2	Deleted						
2.3.3	Deleted						
2.3.4	Deleted						
2.3.5	Deleted		set	1			
2.3.6	Tripping relays		sets	1			
2.3.7	Each type of Auxiliary relays (Bidder to list)		sets	1			
2.3.8	Each type of Trip circuit supervision relays (Bidder to list)		sets	1			
2.3.9	Bay Control Unit		set	1			
2.3.10	Each type of Switch (if applicable)		set	1			
2.3.11	Each type of MCB		lot	1			
2.3.12	Each type of Lamps		sets	1			
2.3.13	Gateway Terminal		NA				
2.3.14	Ethernet Switches		nos.	1			
2.3.15	Optical connectors (one for each)		lot	1			
2.3.16	Relay Test Block & socket		No.	1			
2.3.17	Heater		No.	1			
2.3.18	Humidity Sensors		No.	1			
2.3.19	Humidity stat and thermostat		No.	1			
2.3.20	Ammeter		No.	Deleted			
2.3.21	Voltmeter		No.	Deleted			
2.3.22	Annunciator bulbs		No.	1			
2.3.23	Bulbs for discrepancy switches		No.	1			
2.3.24	Multifunction Meter		No.	1			
2.4	DC & Charger Equipment						
2.4.1	Each type of Printed Circuit Board for Charger		Deleted				

Item No.	Description of Equipment Requirement	Unit	Quantity	Code	Foreign Currency (in USD)	
					Unit Price	Total Price
					CIP (1)	CIP (2)
2.4.2	Contactors, relays, selector switches, push buttons, counters, heaters, etc., one of each type	Deleted				
2.4.3	Miniature circuit breaker of each type and rating (Bidder to list all types)	lot	1			
2.5	LVAC Equipment					
2.5.1	Miniature circuit breaker of each type and rating (Bidder to list all types)	lot	1			
2.5.2	3-phase LVAC board incoming MCCB	No.	Deleted			
2.5.3	3-phase outgoing MCCBs	No.	1			
2.5.4	1-phase sets outgoing MCBs	No.	1			
2.5.5	Contactors, relays, selector switches, push buttons, counters, heaters, etc., one of each type	lot	1			
2.6	Power, Control and Auxiliary Cables	Deleted				
2.6.1	Power Cables (230kV) (for Dhamrai Substation)	meter				
2.6.2	Power Cables (36kV)	Deleted				
2.6.3	Control Cables, each type, 100m (for Kaliakoir & Baghabari Substaion)	lot				
2.6.4	LV Power cables, 100m of each type (for Kaliakoir & Baghabari	lot				
2.7	Transformers and Shunt Reactor	Deleted				
2.8	Miscellaneous					
2.8.1	SF6 evacuation and filling plant	Deleted				
2.8.2	XLPE termination kits					
2.8.3	All types of control valves for SF6 gas	Deleted				
2.8.4	Rubber gaskets "O" rings and seals for SF6 gas	Deleted				
2.8.5	Post Type Insulator					
i)	For 420kV	No.	2			
ii)	For 245kV	No.	Deleted			
iii)	For 145kV	No.	Deleted			
2.8.6	Disc Insulator					
i)	Each type of set of Disc Insulator	set	2			
2.8.7	Conductor					
i)	Each type of Bus Conductor	m	Delete			
ii)	Each size of Rigid Tubular Conductor	m	Delete			
2.8.8	Clamp and Fitting					
i)	Each type of Clamps and Fittings	set	2			
2.9	Test O&M EQUIPMENT	Deleted				
	Sub-Total Price of section-II (carried to Schedule-5: Grand Summary)					

Name of Bidder	
Signature of Bidder	

1 Specify currencies in accordance with ITB 19.1 of the BDS.

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

3 Definition of route km: Route km is the transmission line distance between two terminal points in plan view. Route km is exclusive sag and other electrical clearances, elevation differences etc. The Contractor shall incorporate all such extra costs in his unit rate.

4. Due to decrease or increase of any quantity mentioned above in unit "sets, nos., m, m², m³, liter, kg " during execution stage, the payment shall be at actual ba

5. Detail design of GIS, Control building & SPR shall be finalized during execution stage, payment shall be at actual area size (sqmm) of the approved building

Country of Origin Declaration Form

Item	Description	Code	Country

Schedule B2: Plant & Equipment supplied from within Employer's Country					
Section-I	Extension of Two (02) 400kV AIS Bays at Existing 400kV Kaliakoir Substation				
Item No.	Description of Equipment Requirement	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
			(1)	(2)	(3) = (1) x (2)
1A1	400 kV Air Insulated Switchgear, equipment connection and steel structures				
1A1.1	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, live tank type, single pole operated , SF6 gas circuit breakers with spring-stored energy operating mechanism with PIR, CSD as phase switching mechanism with support structure	Set	4		
1A1.2	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors with motor/manual operated earthing switch.	Set	2		
1A1.3	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors without earthing switch.	Set	8		
1A1.4	Single-phase, 6-core, 400kV, 63kA/1sec, 4000-2000/1A, 50Hz, 1425kVp BIL, post type current transformer.	No	18		
1A1.5	Single-phase, 3-core, 400kV, 50Hz, 1425kVp BIL, capacitor type voltage transformer.	No	6		
1A1.6	390kV rated voltage, 312kV(rms) continuous operating voltage at 50°c 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.	No	6		
1A1.7	Wave Trap, single phase, 420kV, 4000A, 1mH, 63kA/1s	No	2		
1A1.8	Post type support insulators for 400kV busbar and switchgear	lot	1		
1A1.9	Rigid tubular bus and/ or flexible conductors, insulators, fittings including all necessary clamps and connectors as required for completing extension of 400kV AIS Switchyard				
i)	Rigid Tubular Bus	lot	1		
ii)	Flexible Conductor for jumper, equipment connections	lot	1		
iii)	Insulator	lot	1		
iv)	Fittings, Clamp & Connectos with Nut-Bolts	lot	1		
1A1.10	Steel Structures for gantry and equipment supports				
a)	Gantry Column including nut & bolts				
i)	For Main Bus	Deleted			
ii)	For Jack-Bus	No.	8		
b)	Gantry beam at Jack-Bus height including nut & bolts	No.	8		
c)	Equipment support structures including nut & bolts				
i)	DS with ES	set	2		
ii)	DS without ES	set	8		
iii)	Bus ES	Deleted			
iv)	CT	No	18		
v)	CVT/IVT	No	6		
vi)	LA	No	6		
vii)	Wave Trap	No	2		
viii)	PI	lot	1		
d)	Cable tray including fitting, fixing accessories	lot	1		
e)	All other necessary material and equipment required for completing 400 kV switchgear.	lot	1		
1A2	420kV Gas Insulated Switchgear	Not Applicable			
1B	245 kV AIS & GIS	Not Applicable			
1C	132 kV AIS & GIS	Not Applicable			
1D	33kV AIS & GIS	Not Applicable			
1E	Power Transformer & Earthing/Auxiliary Transformer	Not Applicable			
1F	Control, Protection, SAS and Metering				
	420kV Circuits				
1F.1	Control, Monitoring, Protection & Substation Automation Facility including event recording function for 400KV overhead line circuits bays				
	Each Comprising	set	2		
a)	One (01) set Control Mimic panel with all accessories including monitoring				
b)	Two (02) sets of Protection main relays, Main-1 & Main-2 with TTB				
c)	One (01) set of Auxiliary relays (TCS, Lockout etc)				
d)	One (01) set Complete Protection Panel including Auxiliary Relay Switches, wiring, lighting, heater, humidity sensor and other accessories				
1F.2	Modification / Extension of Busbar Protection				
	Each Comprising				
a	One (01) set of Complete Protection Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	set	2		
b	Two (02) sets of Protection main relay (BB-1 & BB-2 for each bus) (if required)				
i	One (01) lot of Bay unit with HMI				
ii	One (01) lot of Central unit with HMI including software modification				
c	One (01) lot of Selector Switch for Enabling/Disabling BBP, BFP, all function (if required)				

Item No.	Description of Equipment Requirement	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
				(1)	(2)
				(3) = (1) x (2)	
1F.3	Tarif metering				
	a Energy Meters (Main & Check)	set	4		
	b Metering Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	lot	1		
1F.4	Substation Automation System				
	Each Comprising				
	i. BCU	Lot	1		
	a) for 400kV Circuits as per protection SLD				
	ii. One (01) of Industrial Server PC -Deleted.				
	iii. 1 lot of Ethernet Switch for SAS				
	iv. 1 set of GPS system (if required)				
	v. One (01) lot of Renovation/Modification/Extension of Alarm Unit (if required)				
	vi. One (01) set of LCD Monitor, 55" or Large (Deleted)				
	vii. Two (02) sets of Printer, A4 Laser (One black & White, Other Color) (if required)				
	viii. One (01) set of Engineering PC for SAS & SCADA (if required)				
	ix. One (01) lot of Cable (Fiber Optic, Ethernet, Copper etc.)				
	x. One (01) of complete Panel including wiring, lighting, heater, humidity controller & other accessories				
	xi. One (01) lot of other Accessories (if any)				
1G	Digital Fault & Disturbance Recorder (Modification/Extension)				
1G.1	Each Comprising				
	i. One (01) set of DFDR processor-Deleted	Lot	1		
	ii. Digital & Analog data acquisition channel				
	a) for 400kV Circuits as per protection SLD				
	iii. One (01) set of Ethernet Switch				
	iv. One (01) set of GPS system (if required)				
	v. One (01) lot of Complete Panel including wiring, lighting, heater, humidity sensor & other accessories (if required)				
	vi. One (01) set of Engineering PC (if required)				
	vii. One (01) lot of Other Accessories (if any)				
1H	SCADA system for Telecontrol and Telemetry				
1H.1	Modification/Extension of SCADA hardware & software				
	Each Comprising				
	a) Equipment at Substation for modification / extension of SCADA system	Lot	1		
	i. One (01) set of Gateway (server, engineering software) (if required)				
	ii. One set of Ethernet Switch				
	iii. One set of Hardware Firewall				
	iv. Additional 33kV Feeder BCU - N/A				
	v. Complete Panel including wiring, lighting, heater, humidity controller & other accessories (if required)				
	vi. one lot Cables				
	vii. one lot Other Accessories				
	b Integration work with Master & Backup NLDC including Engineering & Commissioning	Refer to Schedule B4			
1I	Extension of Fibre Optic Multiplexer Equipment and PLC Equipment for Communication and Protection				
1I.1	One (01) complete lot of equipment for extension of existing fibre optic multiplexer equipment at local and remote end Substation for protection & communication, for required part of substation, shall be designed, supplied, delivered, installed, tested and commissioned and integrated into the existing system, under this contract. Fibre optic multiplexer equipment is to be provided for - 21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC) Distance relay carrier signal (main and back-up) SCADA data from switchgear and control system through SAS Hot-line telephone system	Lot	1		
1I.2	A lot of underground optical fibre (48 cores) cables from terminal box at gantry structure to MDF (Main distribution Frame) shall be designed, supplied, delivered, installed, tested and commissioned, including supply and installation of MDF and digital cables	Lot	1		
1I.3	A complete lot of PLC equipment for extension of existing PLCC system at Kaliakoir Substation including line matching unit and necessary cables & other accessories for completing PLC communication.	Lot	1		
1I.4	Installation, testing & commissioning	refer to schedule B4			
1J	Power Cable	Deleted			
1K	Multicore Cables				
1K.1	Multicore Cables for control, protection, metering & power circuits				
	i) LV Control Cable	lot	1		
	ii) LV Power Cable	lot	1		

Item No.	Description of Equipment Requirement	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
			(1)	(2)	(3) = (1) x (2)
1L	Earthing and Lightning Protection				
1L.1	_Extension of Earthing system for 400kV Switchyard	lot	1		
1L.2	_Extension of Lightning Protection System for 400kV Switchyard	lot	1		
1M	Batteries, chargers & DC distribution				
1M.1	110V Ni-cad Batteries with chargers & distribution board				
	a) Extension of 110V DC Distribution panel, MCC type and board/New DCDB panel (if required)	Lot	1		
	b) 110V Ni-cad Batteries with chargers	lot	1		
	i. 110V Battery Banks, not less than 400Ah	set	1		
	ii. Charger, not less than 150A	set	1		
	a) iii. Insulation Monitoring system for complete DC system(if required)	lot	1		
1M.2	48V Ni-cad Batteries with chargers & distribution board				
	i) Extension of 48V DC Distribution panel and board/New DCDB panel (if required)	Lot	1		
1N	LVAC Distribution				
1N.1	_Extension of AC 415V or 240V distribution panels (MCC type)	lot	1		
1N.2	_Tariff metering at LV side(Main & Check)	Deleted			
1O	Civil Works, Building and Foundation				
1O.1	Complete civil items required for outdoor works including boundary wall, gantry foundation, necessary land development.	Refer to Schedule B4			
1O.2	Complete civil works for new Switchyard Panel Room (SPR) & repair, modification works of other control houses for the extension work.	Refer to Schedule B4			
1O.3	Testing of Foundation	Refer to Schedule B4			
1P	Lighting, small power, air conditioning and Ventilation				
1P.1	Extension of Lighting, small power and emergency DC lighting for new SPR and Local control houses.	lot	1		
1P.2	Complete design, supply, installation and commissioning of equipment to provide Air Conditioning system (cassette type), Ventilation system for new SPR.	lot	1		
1P.3	Extension of Lighting for outside building for security, roadway, switchyard and emergency DC lighting.	lot	1		
1P.4	Fire Fighting system for SPR	lot	1		
	Sub-Total Price of section-I (carried to Schedule-5: Grand Summary)				

Section-II	Mandatory Spares, Erection & Test Equipment				
	Mandatory Spares				
2.1	420kV Switchgear				
2.1.2	420kV Air Insulated Switchgear				
2.1.2.1	Complete SF6 gas, livetank type 420kV Circuit Breaker (single-pole operation type)	set	1		
2.1.2.2	Complete SF6 gas, livetank type 420kV Circuit Breaker (gang operation type)	Deleted			
2.1.2.3	Complete 420kV disconnect switch (with & without ES)	set	1		
2.1.2.4	Complete 420kV Current Transformer	Nos.	1		
2.1.2.5	Complete 420kV capacitive VoltageTransformer	Nos.	1		
2.1.2.6	390kV Surge arrester	Nos.	1		
2.1.2.7	Closing coils for CB (Offered Type)	Nos.	1		
2.1.2.8	Tripping coils for CB (Offered Type)	Nos.	2		
2.1.2.9	Motor for 420kV circuit breaker operating mechanism	Nos.	1		
2.1.2.10	Motor for disconnect drive	Nos.	1		
2.1.2.11	SF6 gas (45 kg) cylinder	Nos.	1		
2.1.2.12	Contactors, relays, selector switches, push buttons, counters, heaters, humidity sensors	set	1		
2.2	245kV Switchgear				
2.2.1	245kV Gas Insulated Switchgear	Deleted			
2.2.2	245kV Air Insulated Switchgear	Deleted			
2.3	Protection and Control				
2.3.1	Each type of protection relay for 400KV Extension of Kaiakoir Substation (Bidder to list)	set	1		
2.3.2	Deleted				
2.3.3	Deleted				
2.3.4	Deleted				
2.3.5	Deleted	set	1		
2.3.6	Tripping relays	sets	1		
2.3.7	Each type of Auxiliary relays (Bidder to list)	sets	1		
2.3.8	Each type of Trip circuit supervision relays (Bidder to list)	sets	1		
2.3.9	Bay Control Unit	set	1		
2.3.10	Each type of Switch (if applicable)	set	1		

Item No.	Description of Equipment Requirement	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
			(1)	(2)	(3) = (1) x (2)
2.3.11	Each type of MCB	lot	1		
2.3.12	Each type of Lamps	sets	1		
2.3.13	Gateway Terminal	NA			
2.3.14	Ethernet Switches	nos.	1		
2.3.15	Optical connectors (one for each)	lot	1		
2.3.16	Relay Test Block & socket	No.	1		
2.3.17	Heater	No.	1		
2.3.18	Humidity Sensors	No.	1		
2.3.19	Humidity stat and thermostat	No.	1		
2.3.20	Ammeter	No.	Deleted		
2.3.21	Voltmeter	No.	Deleted		
2.3.22	Annunciator bulbs	No.	1		
2.3.23	Bulbs for discrepancy switches	No.	1		
2.3.24	Multifunction Meter	No.	1		
2.4	DC & Charger Equipment				
2.4.1	Each type of Printed Circuit Board for Charger	Deleted			
2.4.2	Contactors, relays, selector switches, push buttons, counters, heaters, etc.,	Deleted			
2.4.3	Miniature circuit breaker of each type and rating	lot	1		
2.5	LVAC Equipment				
2.5.1	Miniature circuit breaker of each type and rating	lot	1		
2.5.2	3-phase LVAC board incoming MCCB	No.	Deleted		
2.5.3	3-phase outgoing MCCBs	No.	1		
2.5.4	1-phase sets outgoing MCBs	No.	1		
2.5.5	Contactors, relays, selector switches, push buttons, counters, heaters, etc.,	lot	1		
2.6	Power, Control and Auxiliary Cables	Deleted			
2.6.1	Power Cables (230kV) (for Dhamrai Substation)	meter			
2.6.2	Power Cables (36kV)	Deleted			
2.6.3	Control Cables, each type, 100m (for Kaliakoir & Baghabari Substaion)	lot			
2.6.4	LV Power cables, 100m of each type (for Kaliakoir & Baghabari	lot			
2.7	Transformers and Shunt Reactor	Deleted			
2.8	Miscellaneous				
2.8.1	SF6 evacuation and filling plant	Deleted			
2.8.2	XLPE termination kits				
2.8.3	All types of control valves for SF6 gas	Deleted			
2.8.4	Rubber gaskets "O" rings and seals for SF6 gas	Deleted			
2.8.5	Post Type Insulator				
i)	For 420kV	No.	2		
ii)	For 245kV	No.	Deleted		
iii)	For 145kV	No.	Deleted		
2.8.6	Disc Insulator				
i)	Each type of set of Disc Insulator	set	2		
2.8.7	Conductor				
i)	Each type of Bus Conductor	m	Delete		
ii)	Each size of Rigid Tubular Conductor	m	Delete		
2.8.8	Clamp and Fitting				
i)	Each type of Clamps and Fittings	set	2		
2.9	Test O&M EQUIPMENT	Deleted			
Sub-Total Price of section-II (carried to Schedule-5: Grand Summary)					

Name of Bidder	
Signature of Bidder	

1 Specify currencies in accordance with ITB 19.1 of the BDS.

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

3 Definition of route km: Route km is the transmission line distance between two terminal points in plan view. Route km is exclusive sag and other elec clearances, elevation differences etc. The Contractor shall incorporate all such extra costs in his unit rate.

4. Due to decrease or increase of any quantity mentioned above in unit "sets, nos., m, m², m³, liter, kg " during execution stage, the payment shall be €

Country of Origin Declaration Form

Item	Description	Code	Country

Schedule B3: Design Services

Section-I	Extension of Two (02) 400kV AIS Bays at Existing 400kV Kaliakoir Substation				
Item No	Description of Required Services	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
				foreign portion	foreign portion
				(1)	(2)
1	Design and engineering services of the substation, local and foreign part	Lump sum	1		
2	LA rating, PIR rating, Breaker Selection analysis for bay extension in Kaliakoir 400kV Substation	Lump sum	1		
3	Relay Co-ordination study for bay extension in the Substation with software demonstration	Lump sum	1		
Sub-Total Price of section-I (carried to Schedule-5: Grand Summary)					

Name of Bidder	
Signature of Bidder	

1. Specify currencies in accordance with ITB 19.1 of the BDS.
2. Bidder shall quote the amount considering clause 14.1 of section 8(Special Conditions of Contract), Volume 1 of 3 of the bidding document. The amount quoted by bidder is subject to arithmetic correction by Employer as required.

Schedule B4: Installation and Other Services

01. Extension of Two (02) 400kV AIS Bays at Existing 400kV Kaliakoir Substation					
Item No.	Description of Equipment Requirement	Unit	Quantity	Foreign Currency (in USD)	
				Unit Price	Total Price
			(1)	(2)	(3) = (1) x (2)
1A1	400 kV Air Insulated Switchgear, equipment connection and steel structures				
1A1.1	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, live tank type, single pole operated , SF6 gas circuit breakers with spring-stored energy operating mechanism with PIR, CSD as phase switching mechanism with support structures	Set	4		
1A1.2	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors with motor/manual operated earthing switch.	Set	2		
1A1.3	420kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, horizontal double break, post type, motor operated disconnectors without earthing switch.	Set	8		
1A1.4	Single-phase, 6-core, 400kV, 63kA/1sec, 4000-2000/1A, 50Hz, 1425kVp BIL, post type current transformer.	No	18		
1A1.5	Single-phase, 3-core, 400kV, 50Hz, 1425kVp BIL, capacitor type voltage	No	6		
1A1.6	390kV rated voltage, 312kV(rms) continuous operating voltage at 50°C 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.	No	6		
1A1.7	Wave Trap, single phase, 420kV, 4000A, 1mH, 63kA/1s	No	2		
1A1.8	Post type support insulators for 400kV busbar and switchgear	lot	1		
1A1.9	Rigid tubular bus and/ or flexible conductors, insulators, fittings including all necessary clamps and connectors as required for completing extension of 400kV AIS Switchyard				
i)	Rigid Tubular Bus	lot	1		
ii)	Flexible Conductor for jumper, equipment connections	lot	1		
iii)	Insulator	lot	1		
iv)	Fittings, Clamp & Connectos with Nut-Bolts	lot	1		
1A1.10	Steel Structures for gantry and equipment supports				
a)	Gantry Column including nut & bolts				
i)	For Main Bus	Deleted			
ii)	For Jack-Bus	No.	8		
b)	Gantry beam at Jack-Bus height including nut & bolts	No.	8		
c)	Equipment support structures including nut & bolts				
i)	DS with ES	set	2		
ii)	DS without ES	set	8		
iii)	Bus ES	Deleted			
iv)	CT	No	18		
v)	CVT/IVT	No	6		
vi)	LA	No	6		
vii)	Wave Trap	No	2		
viii)	PI	lot	1		
d)	Cable tray including fitting, fixing accessories	lot	1		
e)	All other necessary material and equipment required for completing 400 kV switchgear	lot	1		
1A2	420kV Gas Insulated Switchgear	Not Applicable			
1B	245 kV AIS &GIS	Not Applicable			
1C	132 kV AIS &GIS	Not Applicable			
1D	33kV AIS &GIS	Not Applicable			
1E	Power Transformer & Earthing/Auxiliary Transformer	Not Applicable			
1F	Control, Protection, SAS and Metering				
	420kV Circuits				
1F.1	Control, Monitoring, Protection & Substation Automation Facility including event recording function for 400KV overhead line circuits bays				
	Each Comprising	set	2		
a)	One (01) set Control Mimic panel with all accessories including monitoring				
b)	Two (02) sets of Protection main relays, Main-1 & Main-2 with TTB				
c)	One (01) set of Auxiliary relays (TCS, Lockout etc)				
d)	One (01) set Complete Protection Panel including Auxiliary Relay Switches, wiring, lighting, heater, humidity sensor and other accessories				
1F.2	Modification / Extension of Busbar Protection				
	Each Comprising				
a)	One (01) set of Complete Protection Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	set	2		
b)	Two (02) sets of Protection main relay (BB-1 & BB-2 for each bus) (if required)				
i)	One (01) lot of Bay unit with HMI				
ii)	One (01) lot of Central unit with HMI including software modification				
c)	One (01) lot of Selector Switch for Enabling/Disabling BBP,BFP, all function (if required)				
1F.3	Tarif metering				
a)	Energy Meters (Main & Check)	set	4		
b)	Metering Panel including wiring, lighting, heater, humidity controller & other accessories (if required)	lot	1		
1F.4	Substation Automation System				
	Each Comprising				

	i. BCU	Lot	1		
	a) for 400kV Circuits as per protection SLD				
	ii. One (01) of Industrial Server PC -Deleted.				
	iii. 1 lot of Ethernet Switch for SAS				
	iv. 1 set of GPS system (if required)				
	v. One (01) lot of Renovation/Modification/Extension of Alarm Unit (if required)				
	vi. One (01) set of LCD Monitor, 55" or Large (Deleted)				
	vii. Two (02) sets of Printer, A4 Laser (One black & White, Other Color) (if required)				
	viii. One (01) set of Engineering PC for SAS & SCADA (if required)				
	ix. One (01) lot of Cable (Fiber Optic, Ethernet, Copper etc.)				
	x. One (01) of complete Panel including wiring, lighting,heater,humidity controller & other accessories				
	xi. One (01) lot of other Accessories (if any)				
1G	Digital Fault & Disturbance Recorder (Modification/Extension)				
1G.1	Each Comprising				
	i. One (01) set of DFDR processor-Deleted	Lot	1		
	ii. Digital & Analog data acquisition channel				
	a) for 400kV Circuits as per protection SLD				
	iii. One (01) set of Ethernet Switch				
	iv. One (01) set of GPS system (if required)				
	v. One (01) lot of Complete Panel including wiring, lighting, heater, humidity sensor & other accessories (if required)				
	vi. One (01) set of Engineering PC (if required)				
	vii. One (01) lot of Other Accessories (if any)				
1H	SCADA system for Telecontrol and Telemetry				
1H.1	Modification/Extension of SCADA hardware & software				
	Each Comprising				
	a) Equipment at Substation for modification / extension of SCADA system	Lot	1		
	i. One (01) set of Gateway (server, engineering software) (if required)				
	ii. One set of Ethernet Switch				
	iii. One set of Hardware Firewall				
	iv. Additional 33kV Feeder BCU - N/A				
	v. Complete Panel including wiring, lighting,heater, humidity controller & other accessories (if required)				
	vi. one lot Cables				
	vii. one lot Other Accessories				
	b. Integration work with Master & Backup NLDC including Engineering & Commissioning	Refer to Schedule B4			
1I	Extension of Fibre Optic Multiplexer Equipment and PLC Equipment for Communication and Protection				
1I.1	One (01) complete lot of equipment for extension of existing fibre optic multiplexer equipment at local and remote end Substation for protection & communication, for required part of substation, shall be designed, supplied, delivered, installed, tested and commissioned and integrated into the existing system, under this contract. Fibre optic multiplexer equipment is to be provided for - 21 (or 87 with built-in 21) relay for each transmission line protection (through fibre cores or backup PLC) Distance relay carrier signal (main and back-up) SCADA data from switchgear and control system through SAS Hot-line telephone system	Lot	1		
1I.2	A lot of underground optical fibre (48 cores) cables from terminal box at gantry structure to MDF (Main distribution Frame) shall be designed, supplied, delivered, installed, tested and commissioned, including supply and installation of MDF and				
1I.3	A complete lot of PLC equipment for extension of existing PLCC system at Kaliakoir Substation including line matching unit and necessary cables & other accessories for completing PLC communication.				
1I.4	Installation,testing & commissioning				
1J	Power Cable	Deleted			
1K	Multicore Cables				
1K.1	Multicore Cables for control, protection, metering & power circuits				
	i) LV Control Cable	lot	1		
	ii) LV Power Cable	lot	1		
1L	Earthing and Lightning Protection				
1L.1	_Extension of Earthing system for 400kV Switchyard	lot	1		
1L.2	_Extension of Lightning Protection System for 400kV Switchyard	lot	1		
1M	Batteries, chargers & DC distribution				
1M.1	110V Ni-cad Batteries with chargers & distribution board				
	a) Extension of 110V DC Distribution panel, MCC type and board/New DCDB panel (if required)	Lot	1		
	b) 110V Ni-cad Batteries with chargers				
	i. 110V Battery Banks, not less than 400Ah	set	1		
	ii. Charger, not less than 150A	set	1		
	a) iii. Insulation Monitoring system for complete DC system(if required)	lot	1		
1M.2	48V Ni-cad Batteries with chargers & distribution board				
	i) Extension of 48V DC Distribution panel and board/New DCDB panel (if required)	Lot	1		
1N	LVAC Distribution				

1N.1	_ Extension of AC 1515V or 240V distribution panels (MCC type)	lot	1
1N.2	_ Tariff metering at LV side(Main & Check)	Deleted	
1O	Civil Works, Building and Foundation		
1O.1	Complete civil items required for outdoor works including boundary wall, necessary land development and slope protection		
i	Outdoor gantry foundation 400kV switchyard	No.	8
ii	Outdoor equipment foundation 400kV switchyard		
a)	CB	set	4
b)	DS with ES	set	2
c)	DS without ES	set	8
d)	BUS ES	Deleted	
e)	CT	No.	18
f)	CVT	No.	6
g)	LA	No.	6
h)	WaveTrap	No.	2
i)	PI	lot	1
iii	Indoor equipment foundation 400kV switchyard	Deleted	
iv	Outdoor gantry foundation 230kV switchyard	Deleted	
v	Outdoor equipment foundation 230kV switchyard	Deleted	
vi	Indoor equipment foundation 132kV switchyard	Deleted	
vii	Outdoor gantry foundation 33kV switchyard including 33kV Bus	Deleted	
viii	Outdoor equipment foundation 33kV switchyard	Deleted	
ix	Transformer foundation including oilpit & carriage way	Deleted	
x	Blast wall with foundation	Deleted	
xi	Property Line Demarkation	Deleted	
xii	Security Boundary Wall for overall plan	Deleted	
xiii	Substation Main gate	Deleted	
xiv	_Chainlink Fencing including three (3) personal gates	Deleted	
xv	Approach road (6m width)	Deleted	
xvi	Box Culvert	Deleted	
xvii	Internal road		
a)	8m wide road	m	10
b)	6m wide road	m	20
c)	4.5m wide road	m	100
d)	2.5m wide road	m	200
xviii	Surface drain	Deleted	
xix	Cable Trench / Tunnel with soakpit for		
a)	LV power & control cable	m	500
b)	HV Power cable	m	0
xx	_Whole scope area with necessary land development, surface finishing with drainage system	lot	1
xxi	Gravelling in switchyard area	sqm	15000
xxii	Septic tank, sowak way	Deleted	
xxiii	Pump house including deep tubewell, motor, pump, water reservoir, water pipe	Deleted	
xxiv	Guard house	Deleted	
xxv	sentry post	no	1
xxvi	car port	Deleted	
1O.2	Complete civil works for Control Room, Operation & Panel Room		
a)	Modification works for Control Room	Lot	1
b)	Complete civil works for 1 No. 400kV Panel Room with battery		
i)	Foundation works	lot	1
ii)	Super structures	lot	1
iii)	All finish works	lot	1
1O.3	Testing of Foundation		
i)	_ Compression Test	No.	1
ii)	_ Uplift Test	No.	1
1P	Lighting, small power, air conditioning and Ventilation		
1P.1	Extension of Lighting, small power and emergency DC lighting for new SPR and other control houses.	lot	1
1P.2	Complete design, supply, installation and commissioning of equipment to provide Air Conditioning system (cassette type), Ventilation system for new SPR.	lot	1
1P.3	Extension of Lighting for outside building for security, roadway, switchyard and emergency DC lighting.	lot	1
1P.4	Fire Fighting system for SPR	lot	1
	Sub-Total Price of section-I (carried to Schedule-5: Grand Summary)		
	Name of Bidder		
	Signature of Bidder		

1. The bidder shall not keep price for this item blank and shall not write included. The prices are fixed for the mentioned items, but the Payments will be made from the quoted amount on the basis of percentage of test and inspection completed for an item upon submission of relevant documents. The Contractor may need to submit justification and price breakup in support of the quoted price against these items during the contract execution.

2. Due to decrease or increase of any quantity mentioned above in unit "sets, nos., m, m², m³, liter, kg" during execution stage, the payment shall be at actual.

3. Detail design of GIS, Control building & SPR shall be finalized during execution stage, payment shall be at actual area size (sqmm) of the approved building.

Schedules of Rates and Prices**Schedule 5: Grand Summary**

Schedule No	Description	Total Price	
		Foreign Currency (in.....)	Local Currency (in BDT)
Section-I:			
Schedule No. 1:	Plant & Equipment Supplied from Abroad		
Schedule No. 2:	Plant & Equipment Supplied from within the Employer's Country		
Schedule No. 3:	Design Services		
Schedule No. 4:	Installation and Other Services		
Total of Section-I			
Section-2: Mandatory Spares, Erection & Test Equipment			
Schedule No. 1:	Plant & Equipment Supplied from Abroad		
Schedule No. 2:	Plant & Equipment Supplied from within the Employer's Country		
Total of Section-2			
GRAND TOTAL (Schedule No.1 to Schedule No.4 (to Letter of Price Bid)			

Name of Bidder

Signature of Bidder

Schedule B6: Recommended Spare Parts

No	Description	Unit	Quantity	Foreign Currency (in.....)		Local Currency (in BDT)	
			(1)	Unit Price EXW (2)	Total Price EXW (3)=(1)x(2)	Unit Price EXW (4)	Total Price EXW (5)=(1)x(4)

Name of Bidder	
Signature of Bidder	

1. Specify currencies in accordance with ITB 19.1 of the BDS.