

POWER GRID BANGLADESH PLC



Bidding Documents For Procurement of

**Design, Supply, Installation, Testing & Commissioning for
replacement of 2 (two) nos. 132/33kV Power Transformer
at Sreepur 230/132/33kV AIS Grid Substation.**

Volume 3 of 3

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OCB No.	:	POWERGRID/132kVTx/Sreepur/SS
Country	:	Peoples Republic of Bangladesh

Employer:



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1. Schedule A: Scope of Works

1.1 Description of Overall Project

The Government of the People's Republic of Bangladesh has prioritized the power sector development and has taken massive initiative to build a country-wide power network (transmission & distribution) targeting to reach electricity for all by 2021. As per Power System Master Plan (PSMP-2016), a transmission system capable of supplying 40000 MW electricity throughout the country is essential 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 throughout the country.

This project aims to increase the capacity of existing grid substations to ensure a quality and reliable power supply to meet the country's growing electricity demand.

1.2 Description of this Package

This turnkey package is for designing, manufacturing, factory testing, packing for export, shipping, delivery to site, complete erection and installation as well as including site testing, (pre)commissioning, training at site, quality assurance & warranty for a period of defect liability period (as mentioned in General/Special condition of Contract) after commissioning for all equipment's and all civil works.

The work covered by this Bid and Specification is outlined below-

Power Transformer				
Sl. No.	Name of the Substations	Installation of Power Transformer	Quantity	Installation Type
1.	Sripur 230/132/33KV	132/33kV, 80/120MVA 3-phase Power Transformer	2	Replacement

Required works shall be in accordance with this section and drawings. In this section being Scope of Works are listed herewith. The "Schedule of requirements" for equipment, materials and services, detailed technical specifications of equipment, materials and price schedule included in the bidder document shall be read in conjunction with the scope of work described herein. The drawings provided in the bidder document are being indicative only and hence the entire scope of work is not fully reflected in those drawings.

Even though miscellaneous works are not fully specified in this section, those works shall be deemed fully to be included in the scope of works. And also all details, accessories etc.

required for the complete installation and satisfactory operation of the works not specifically mentioned in this specification are deemed to be included in the Contract Price.

The Contractor is responsible for ensuring that all or any items of work required for the safe, efficient and satisfactory completion and functioning of the works.

The program 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 program chart detailing times required for the design, manufacture, testing, delivery and erection for the complete work.

The Works under this Bid Package for substation part in brief are:

Power Transformers:

Design supply, delivery, installation, testing and commissioning of two (2) nos. of 132/33 kV, 80/120MVA, 3-phase Power transformers with necessary switchgears and civil works. The above two (2) nos. of 132/33 kV, 80/120MVA, 3-phase power transformers with associated switchgears shall replace the existing power transformers and switchgears to enhance the capacity due to overload.

1.3 Requirement

1.3.1 132/33kV transformer replacement at Sreepur 230/132/33kV AIS Substation

For Sreepur substation, scheme of existing 132kV side is double bus scheme with U type bus system. Replacement of existing two sets of 132/33kV, 80/120MVA transformers (Trafo 1 & 2) with new two (2) sets of 132/33kV, 80/120MVA three phase power transformer and replacement/modification of necessary 132KV & 33kV switchgear equipment and civil works.

The equipment to be designed, supplied, installed, tested & commissioned as stipulated in bid specification and shown in bid drawings.

Item	Description
1A	Power Transformer (replacement)
1A1	Two (2) sets of 132/33kV, 80/120 MVA (ONAN/ONAF), three phase outdoor type power transformers with associated bushing CTs including all necessary connections, insulators & fittings, transformer rail (if required).
1A2	One (1) lot of connection, modification, testing & commissioning of existing Tap changer (RTCC) panel to integrate with the new replaced Transformer.
1B	33kV Air Insulated Switchgear (AIS) (replacement)
	The 33kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements and shall comprise the following:-

- 1B1** Six (6) nos. of single-phase, 4-core, 33kV, 31.5kA/1sec, 50Hz, 170kVp BIL, outdoor, post type current transformer.
- 1C** **Flexible conductor, clamps & connectors for busbar, jackbus, jumper, equipment connections**
- 1C1** (i) One (1) lot of flexible conductors of suitable capacity for replacement of existing jackbus, jumper, equipment connections required for connecting 33KV side of new replaced transformers to the 33KV bus.
- (ii) One (1) lot of clamps & connectors of suitable capacity for replacement of existing clamps & connectors at 132kV side of transformer, if required, and 33kV incomer bay of new replaced transformers.
- 1D** **Insulator & fittings (33KV)**
- 1D1** One (1) lot of fittings including all necessary accessories required for connecting replaced transformers 33KV side to the 33KV bus.
- 1E** **Steel structures**
- 1E1** One (1) lot of 33KV CT (3 phase) support steel structures including nuts & bolts with all necessary fitting & fixing accessories required for completing renovation portion of the switchyard.
- 1F** **Control, Protection, SAS & Metering**
- All control & protection equipment and metering panels for 132kV and 33kV side of transformer bay and those shall be installed in the existing control room building.
- The sequence of the panels shall mirror the actual switchyard layout. Space shall be provided adjacent to the panel suites for each voltage level to accommodate sufficient panels for the future circuits.
- The equipment to be supplied, installed and commissioned is shown on Bid Drawings comprising the following:
- 132kV Circuit**
- 1F1** One (1) lot of connection, modification, testing & commissioning of existing control and protection panel to integrate with 132kV side of new replaced Transformer.
- 33kV Circuit**
- 1F2** One (1) lot of connection, modification, testing & commissioning of existing control and protection panel to integrate with 33kV side of new replaced Transformer.
- 1G** **Multicore Cables**
- Multicore, XLPE, LV Power & Control Cable for control, protection, metering & power circuits
- 1G1** (i) One (1) lot of LV Control Cable

(ii) One (1) lot of LV Power Cable

1H Earthing & lightning protection

1H1 One (1) lot of modification of existing earthing system for renovation portion

1I Temporary Arrangement, Dismantling, Transporting and Handing Over

1I1 Dismantling (clamps-connectors, bushings, radiators, conservator etc.) of one (01) set of existing 132/33kV, 80/120MVA transformer at Sreepur 230/132/33kV AIS Substation. Transporting (including transport insurance) & handing over (after re-assembling of dismantled parts) of one (01) set of transformer to Rupsi 132/33kV GIS substation. Removal of one (01) set of existing 132/33kV, 80/120MVA transformer from existing location at Sreepur 230/132/33kV AIS Substation and shifting of that transformer to new location/foundation pad inside Sreepur 230/132/33kV AIS Substation as per instruction of the grid in-charge. Dismantling, removal, transporting, shifting and re-assembling of dismantled parts of the transformers shall have to be implemented under the supervision and instruction of an expert from a reputed 132kV or higher voltage rating transformer manufacturer. Transformers shall be tested before and after transportation/shifting in the presence of RTS division of Power Grid Bangladesh to verify mechanical and electrical integrity of the transformers due to transportation/shifting. All the necessary nut-bolts, gaskets, blanking cover plates, packing materials etc. shall be provided by the contractor and price of these items are deemed to be included in the contract price.

Dismantling of existing 33KV CT and support structure of replaced transformer bays and handing over to the store. Temporary connection arrangement of 01 (one) existing transformer during transformer foundation modification.

2H Civil Works

2H1 Complete design, supply and construction of one (1) lot of modification of existing 02 (two) nos. of 132kV power transformer foundation for new replaced transformer & 33KV CT foundations.

1.4 Detailed Description of the Scope of Supply for Telecommunication System (Not applicable)

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

- 1) Deleted
- 2) Deleted
- 3) Deleted
- 4) Deleted
- 5) Deleted

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 characteristics shall be define during the Design stage and there will be subject of the Employer's approval.

1.4.1 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

1.4.2 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).

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

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

- **SDH Telecommunication System**

1.4.3 Scope of Work and Supply

The scope of work and supply of the telecommunication system:

- One (1) optical fibre cable from the gantry of each of 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 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 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 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 or GE MSE-5010 (OSN-1500B) type to ensure fully integration with existing multiplexers.
- Depending of the length of each 230 kV and/or 132 kV one or two optical boosters may be required.

1.4.4 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.

1.5 Detailed Description of the Scope of Supply for SCADA, Control & Monitoring System (Not applicable)

1.5.1 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.

1.5.2 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 230kv 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-terra control 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.

1.5.3 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 BCPU) 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 analysed systems of the future substation. The estimated signals are shown in the tables and include but not limited to:

Signalling:

- 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)

1.5.4 Scope of Work and Supply at New Substations (N

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 synchronisation 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:

- 230 kV transmission line bays,
- 230/132 kV power transformer
- 230 kV busbars
- 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, if required) 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.

1.5.5 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.

1.5.6 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.

1.6 Terminal Points (Not applicable)

1.6.1 Transmission Line Circuit Connections

The slack spans including overhead earth wires between the 230 kV and 132 kV 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.

1.6.2 Communication and SCADA Equipment

The voice communication, tele-protection signalling 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.

1.7 Training and Inspection (Deleted)

2. Schedule B: Bid Prices & Schedules

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 refer to volume-1 for Schedule B: Schedules of Rates and Prices.

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 the scope of work under this project is 720 Days. Construction Schedule exceeding 720 Days shall be rejected.

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

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

Should a manufacturer be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to substitute an acceptable manufacturer 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 manufacturers for each item concerned.

Manufacturers

The following Manufacturers are proposed for carrying out the facilities:

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
1	Power Transformer				
1.1	Power transformer 132/33 kV				
i.	Complete				
ii.	Tap Changer				
iii.	Bushing: HV/LV/TV/NV				
iv.	Core				
v.	Copper Winding				
vi.	Winding Insulation Material				
vii.	Oil				
viii.	Tank				
ix.	Radiator				
x.	Fan				

Design, Supply, Installation, Testing & Commissioning for replacement of 2 (two) nos. 132/33kV Power Transformer at Sreepur 230/132/33kV AIS Grid Substation.

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
xi.	Motor				
xii.	Temperature Indicator				
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				
4.2	132kV AIS				
4.2.1	~~132 kV~~ breakers				
i.	Mechanism				
ii.	Upper Chamber				
iii.	Motor				
4.2.2	~~132 kV~~ connectors				
i.	Mechanism				
ii.	Female Contact				
iii.	Motor				
4.2.3	Current transformers 132 kV				
i.	Core				
ii.	Winding				

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
iii.	Insulator				
4.2.4.	~~ge transformers 132 kV~~				
i. —					
ii. —	ng				
iii. —	tor				
4.2.5	~~arresters 132 kV~~				
i. —	Resistor Block				
ii. —	ng				
iii. —	Counter				
5.	33 kV Equipment				
5.1	Circuit breakers 33 kV	N/A			
5.2	Disconnectors 33 kV				
5.3	Current transformers 33 kV				
5.4	Voltage transformers 33 kV	N/A			
5.5	Surge arresters 33 kV				
6.	Control, Protection, and Metering Equipment (Not Applicable)				
6.1	Control & monitoring equipment				
6.2	Relay protection equipment				
6.3	Control & protection panels				
6.4	Metering equipment				
6.5	Metering panels				
6.6	Auxiliary Switches				
6.7	Auxiliary Relays				
6.8	Trip Relays				
6.9	TCS Relays				
6.10	Relay Test Block				
6.11	Humidity Sensor				
7.	Substation Automation System (Not Applicable)				

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
7.1	Bay Control Unit				
7.2	Industrial Server				
7.3	Server Processor				
7.4	Firewall				
7.5	Gateway Server				
7.6	GPS system				
7.7	Ethernet Switch				
7.8	Modem				
7.9	LCD Monitor				
7.10	Monitor & Keyboard				
7.11	Printer				
7.12	55" LCD Monitor				
7.13	Cables (FO, EC,CC)				
8.	Digital Fault & Disturbance Recorder (Not Applicable)				
8.1	Control Card				
8.2	Data Acquisition material				
8.3	Panel				
8.4	Processor				
8.5	Copper cable				
8.6	Fiber optic Cable				
8.7	Engineering PC				
9.	Telecommunication Equipment (Not Applicable)				
9.1	Communication equipment				
9.2	Multiplexer				
9.3	Fiber Optic cable				
9.4	PLC Communication				
9.5	Complete				
9.6	Panel				
9.7	Line matching Unit				
9.8	Surge arrester				
9.9	Wave Trap				

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
10	XLPE Cable & Cable Termination Kit (Not Applicable)				
10.1	400kV				
10.2	230kV				
10.3	132kV				
10.4	33kV				
10.5	Cable Sealing End				
11	Auxiliary Power Supply Equipment (Not Applicable)				
11.1	Battery				
11.2	Charger				
11.3	DC Distribution Panel				
11.4	AC Distribution Panel				
12	Conductors, Insulators & Fittings				
12.1.	Conductors				
i.	Tubular Conductor				
ii.	Flexible Conductor				
iii.	Fittings & Clamps				
12.2.	Insulators				
i.	Post Insulator				
ii.	Disk Insulator				
iii.	Fittings& Clamps				
13	Earthing & Lightning				
13.1	Copper Conductor				
13.2	Earthing Wire				
14	Multicore LV Auxiliary Power and Control Cables				
14.1	LV Cables				
14.2	Cable Trays				
Name of Bidder:					

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
Signature of Bidder:					

5. Schedule E: Technical Particulars and Guarantees

5.1 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.

5.2 Technical Data Schedule

Please find hereafter the technical data schedules.

Part-1: HV AIS Switchgear

5.2.1.1 String Insulator

	Description	Unit	Requirements	Guaranteed
1	Rated voltage	kV	400/230/132	
2	Type		Anti-FOG	
3	Size of insulators units	mmxmm	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	

5.2.2 AIS Switchgear 33 kV

5.2.2.1 Current Transformer 33 kV

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	Current Transformer-General			
1.1	Manufacturer		<i>insert</i>	
1.2	Country of Manufacturing		Insert	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		<i>insert</i>	
1.5	Country of Origin		Insert	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor	
1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earthing		Effectively earthed	
1.12	Service Condition: Seismic Condition	g	0.1	
2.	Current Transformer-Characteristics			
2.1	Nominal System Voltage	kV _{rms}	33	
2.2	Highest voltage for equipment, U _m	kV _{rms}	36	
2.3	Rated lightning impulse withstand voltage	kV _{peak}	170	
2.4	Rated Short duration power frequency voltage	kV _{rms}	70	
2.5	Rated frequency	Hz	50	
2.6	Rated short-time thermal current, I _{th} , 1s	kA	31.5	
2.7	Rated dynamic current, I _{dyn}	kA	80	
2.8.1	Rated primary current	A	2500	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Electrical dissipation factor at power frequency test voltage		<i>insert</i>	
2.10	Capacitance	pF		
2.11	Maximum Allowable winding temperature	°C	<i>insert</i>	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.12	Normal current density of primary winding		<i>insert</i>	
2.13	Rated continuous thermal current (40°C): - Core-I - Core-II - Core-III - Core-IV	% In % In % In % In	150 150 120 120	
2.14	Rated Transformer ratio: - Core-I - Core-II - Core-III - Core-IV	A/A A/A A/A A/A	2500/1 2500/1 2500/1 2500/1	
2.15	Accuracy Class: - Core-I - Core-II - Core-III - Core-IV		0.2s 0.2s 5P 5P	
2.16	Rated Burden: - Core-I - Core-II - Core-III - Core-IV	VA VA VA VA	15 15 30 30	
2.17	Rated Knee Point Voltage, V_k (Min) at highest ratio - Core-I - Core-II - Core-III - Core-IV	V	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.18	Max. magnetizing current guaranteed at knee point voltage, I_{Exc} at V_k at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.19	Max. magnetizing current guaranteed at half of knee point voltage, I_{Exc} at $V_k/2$ at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.20	Max. magnetizing current guaranteed at quarter of knee point voltage, I_{Exc} at $V_k/4$ at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.21	Rated Accuracy limit Factor, ISF/ALF: - Core-I - Core-II - Core-III - Core-IV		≤ 5 ≤ 5 20 20	
2.22	Max. resistance of primary winding at 75 °C, R_{CT} for each rating:	Ohms	<i>insert</i>	
2.23	Max. resistance of secondary winding at 75 °C, R_{CT} for each rating: - Core-I - Core-II - Core-III - Core-IV	Ohms	<i>insert</i>	
3.	Current Transformers-Design & Constructions			
3.1	External Insulator material		Porcelain/Cast resin	
3.2	Internal Insulating medium		Oil paper/Cast resin	
3.3	Type of cast resin (if applicable)		<i>Insert</i>	
3.4	Type including Brand		<i>Insert</i>	
3.5	Quantity of insulating oil		<i>Insert</i>	
3.6	Porcelain Breaking Strength	kN	<i>Insert</i>	
3.7	Minimum creepage distance	mm/kV	≥ 31	
3.8	In case of resin type, production process type		vacuum	
3.9	Partial discharge level; test voltage U_m test voltage $1.2 U_m/\sqrt{3}$	pC pC	≤ 10 (non-solid)/50 (solid) ≤ 5 (non-solid)/20 (solid)	
3.10	Min. LV enclosure protection		IP55	
3.11	Insulation Class		Class A/Class E	
3.12	Insulation test tapping data		Yes/No.	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.13.1	MV terminals : Shape		Flat	
3.13.2	MV terminals: Position		Horizontal	
3.13.3	MV terminals: Material Suitable for		Al terminal	
3.13.4	MV terminals: Adjustable holes		Yes	
3.13.5	MV terminals: Admissible Static Load	KN	<i>insert</i>	
3.13.6	MV terminals: Admissible Dynamic Load	KN	<i>insert</i>	
3.13.7	MV terminals: Cantilever test Load	KN	<i>insert</i>	
3.14	Total weight	kg	<i>insert</i>	
3.15	Total Height	mm	<i>insert</i>	
3.16	Ten delta test terminal provided		Yes	
3.17	Pressure relieving device		Yes	
3.18	Oil level gauge		Yes	
4.	Reliability Data			
4.1	Mean Time to Failure in yrs		<i>insert</i>	
4.2	Expected Operating Life in Yrs		<i>insert</i>	
4.3	Mean time to repair in Hrs		<i>insert</i>	
4.4	Mean time between preventive maintenance in Yrs		<i>insert</i>	
4.5	Mean Time to (perform) preventive maintenance in Hrs		<i>insert</i>	
4.0	Overall compliance with the requirements (yes/no)		Yes/No.	

Note:

- 1) The oil immersed Type CT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture from the environment. Following accessories / fittings shall, but not restricted to, be supplied along with the Current Transformers.
 - Pressure release device
 - Oil level indicator
 - Lifting lugs
 - The CT shall be so constructed that it can be easily transported to the site within the allowable transport limitations even in horizontal position, if the transport limitations so demand.
- 2) The pressure relief device shall be designed to relieve any internal abnormal pressures before the likelihood of fracture of any external component of the transformer. The relief device shall be positioned near the top and oriented to prevent the possibility of injury or damage to persons or other equipment.

5.2.3 Transformers**5.2.3.1 132/33 kV 80/120 MVA ONAN/ONAF Power transformer**

Guaranteed Technical Particulars (GTP) for Auto/Power Transformer**Note:**

1. The GTP shall be provided by the respective Vendor in their letterhead pad mentioning contractor/supplier Name, Users' name as PGCB and Consultant Name (if any) as per provision of contract between PGCB & Contractor. GTP must have Revision No. & date of submission. Responsible personnel of Manufacturer (Prepared by, checked by & Approved by, as appropriate) shall sign the GTP. The Project Manager/Design & Quality Control Personnel of Contractor shall also sign the GTP before submission to PGCB.
2. The items that require detail design of the offered transformer, may be kept unfilled mentioning "TBA" [To be announced] during detailed design. All other data shall be filled during bidding.

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	General			
1.1	Manufacturer		Insert	
1.2	Type		Power transformer three phase, oil immersed, with on-load tap changer, outdoor	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60044	
			IEC 60076	
			IEC 60137	
			IEC 60214	
			IEC 60354	
			IEC 60529	
			IEC 60815	
			IEC 60947	
			NEMA TR-1	
			CENELEC EN 50216	
1.6	Quality control		ISO 9001	
1.7	No. of Windings		Two	
1.8	Tertiary winding function		NA	
1.9	Thermal insulation class		A	
2	Ratings and properties			
2.1	Rating			
2.1.1	Voltage ratio (No Load)	kV/kV	132/33	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1.2	Rated Power HV-LV (ONAN / ONAF)	MVA	80/120	
2.1.3	Rated Power TV	MVA	NA	
2.1.4	Rated Ampacity (120 MVA)			
	HV	A		
	LV	A		
	TV	A	NA	
2.1.5	Percent Impedance			
	At 120MVA base, HV-LV (For Joydevpur S/S)	%	Tap 1:13.289 (±5%) Tap 9:12.612 (±5%) Tap 17:12.451 (±5%)	
	At 120MVA base, HV-LV (For Sreepur S/S)	%	12 (±10%)	
	At 70MVA base, HV-TV	%	NA	
	At 70MVA base, LV-TV	%	NA	
2.1.6	Percent Zero-Sequence Impedance			
	At 120MVA base, HV-LV	%	[not less than 90% of Z+]	
	At 70MVA base, HV-TV	%	NA	
	At 70MVA base, LV-TV	%	NA	
2.1.7	X/R ratio		[Insert]	
2.1.8	Rated Frequency	Hz	50	
2.1.9	Corresponding minimum Designed Frequency	Hz	48	
2.1.10	Induced Voltage			
	HV	kVrms	[Insert]	
	RV	kVrms	[Insert]	
	LV	kVrms	[Insert]	
	TV	kVrms	[Insert]	
2.1.11	Insulation level			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1.11.1	High voltage (HV)		LI 650 AC 275	
2.1.11.2	Low voltage (LV)		LI 170 AC 70	
2.1.11.3	Tertiary Voltage (TV)		NA	
2.1.11.4	Neutral Voltage (NV)		LI 170 AC 70	
2.1.11.5	Method of Neutral Earthing		Solidly Grounded -Yes	
2.1.11.6	The highest system voltage for equipment (effective value)			
	High voltage (HV)	kV	145	
	Low voltage (LV)	kV	36	
	Tertiary Voltage (TV)	kV	NA	
	Neutral Voltage (NV)	kV	36	
2.2	Guaranteed Loss & Evaluation of Loss			
2.2.1	~~Loading pattern in three winding~~		Simultaneous	
2.2.2	No Load Loss			
2.2.2.1	No-load losses with tap changer in nominal (principal) tap position at rated voltage and at rated frequency	kW	[Insert]	
2.2.2.2	No-load losses with tap changer in nominal (principal) tap position at 110 % rated voltage and at rated frequency	kW	[Insert]	
2.2.2.3	No-load losses with tap changer in nominal (principal) tap position at 90 % rated voltage and at rated frequency	kW	[Insert]	
2.2.2.4	Average of the above & No-Load Loss for Loss capitalization (N) [This value will be evaluated]	kW	[Insert]	
2.2.2.5	Loss Capitalization Unit	Tk/kW	600000	
2.2.2.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
2.2.3	On-load losses at 75°C			
2.2.3.1	On-load losses at 75°C and rated frequency, with tap	kW	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	changer in nominal tap position at rated tapping current (ONAF) of that tap position			
2.2.3.2	On-load losses at 75°C and rated frequency, with tap changer in plus (+) extreme tap position at rated tapping current (ONAF) of that tap position	kW	[Insert]	
2.2.3.3	On-load losses at 75°C and rated frequency, with tap changer in minus (-) extreme tap position at rated tapping current (ONAF) of that tap position	kW	[Insert]	
2.2.3.4	Average of the above & On-load Loss for Loss capitalization (L) [This value will be evaluated]	kW	[Insert]	
2.2.3.5	Loss Capitalization Unit	Tk/kW	300000	
2.2.3.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
2.2.4	Load Loss due to Ancillary Equipment (M) [fans, pumps, heaters, etc.]	kW		
2.2.4.1	Capitalized valued of ancillary equipment load	Tk/kW	300000	
2.2.4.2	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
2.2.5	Per Phase loss			
	HV	kW	[Insert]	
	LV	kW	[Insert]	
	TV	kW	NA	
3	Design & Construction			
3.1	Cooling system			
3.1.1	Oil Flow through Windings/ windings group			
	Guided Oil Flow inside transformer	Yes/No.	Yes	
	Pattern of Oil Flow through	Axial/Zig-Zag	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Duct			
3.1.2	Pressure drop inside transformer			
	Radial Locations with respect to core		[Insert]	
	Axial Locations with respect to core		[Insert]	
3.1.3	Radiators & Coolers			
3.1.3.1	Radiator Location Attached to Tank or Separate		A	
3.1.3.2	HV side			
	No. of Radiator Bank	No.	[Insert]	
	No. of Fins/Plates in each Radiator	No.	[Insert]	
	No. of Cooler Fans	No.	[Insert]	
	No. of group of Cooler Fan	No.	[Insert]	
	Spare Fans in each group	No.	[Insert]	
	No. of Blower/Motor Driving a Fan	No.	01	
	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
	No. of Pipes collecting Hot Oil	No.	[Insert] (spare , n+1,shall be considered)	
	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
3.1.3.3	LV side			
	No. of Radiator Bank	No.	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	No. of Fins/Plates in each Radiator	No.	[Insert]	
	No. of Cooler Fans	No.	[Insert]	
	No. of group of Cooler Fan	No.	[Insert]	
	Spare Fans in each group	No.	[Insert]	
	No. of Blower/Motor Driving a Fan	No.	01	
	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
	No. of Pipes collecting Hot Oil	No.	[Insert] (spare n+1, shall be considered)	
	No. of Pipes collecting Cold Oil	No.	[Insert] (spare, n+1, shall be considered)	
3.1.4	Oil Flow rate			
3.1.4.1	Oil Flow rate inside Transformer during ONAN Cooling			
	Highest Flow rate (Approx.)	m/s	[Insert]	
	Location at Transformer		[Insert]	
	Lowest Flow rate (Approx.)	m/s	[Insert]	
	Location at Transformer		[Insert]	
	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
3.1.4.2	Oil Flow rate inside Transformer during ONAF Cooling			
	Highest Flow rate (Approx.)	m/s	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Location at Transformer		[Insert]	
	Lowest Flow rate (Approx.)	m/s	[Insert]	
	Location at Transformer		[Insert]	
	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
3.1.5	Predicted Hot Spot Location			
	HV Side		Insert	
	LV side		Insert	
	TV side		NA	
3.1.6	Temperature Difference (D-Temp) between Inlet & Outlet of Radiator banks --- Design value	0C	[Insert]	
3.2	Temperature rise			
3.2.1	Average Oil Temperature rise	0C	60	
3.2.2	Top Oil			
	At ONAN	0C		
	At ONAF/OFAF/ODAF (as per schedule of requirement)	0C		
3.2.3	Average Winding Temperature rise	0C	65	
3.2.3.1	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	0C	[Insert]	
3.2.4	Maximum hot spot temperature rises in core at rated power	0C	[Insert]	
3.2.4.1	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	0C	130	
3.2.4.2	Surface Temperature (Amb. Temp. + Top oil rise + Core surface temp.)	0C	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.5	Temperature gradient at specified rating			
3.2.6	Temperature rise of metallic parts			
	Tank walls	°C	[Insert]	
	Tie plate	°C	[Insert]	
	Top clamp	°C	[Insert]	
	Bottom clamp	°C	[Insert]	
3.3	Core Construction			
3.3.1	Type of Transformer Core (Shell or Core)		Core	
3.3.2	No. of Core Limb		03	
3.3.3	Core Material		CRGO Si steel	
3.3.3.1	Grade Designation		Insert	
3.3.3.2	Core Graining Method		Laser-beam or plasma jet irradiation	
3.3.3.3	Thickness of Sheet	mm	[Insert]	
3.3.3.4	Specific Loss at 1.7T,50Hz	W/kg	[Insert]	
3.3.3.5	Insulation material & Class		[Insert]	
3.3.4	Safe Working Temperature of Core	°C	[Insert]	
3.3.5	Whether step lap construction adopted		Yes	
3.3.6	Whether boltless construction adopted		Yes	
3.3.7	Core Material Make, Country		Insert	
3.3.8	Whether Core is pre-cut or cut at Factory		[Insert]	
3.3.9	Flux density at nominal voltage and frequency and at nominal ratio - (no load)			
a	Cores	T	[Insert]	
b	Yokes	T	[Insert]	
c	Volts/turn	V	[Insert]	
3.3.10	Over flux withstand capability of the Transformer [flux density & time]			
a	Continuously 10% over voltage and frequency and			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	at principal tap			
b	at 125% of rated Voltage	T, Min or s		
c	at 140% of rated Voltage	T, Min or s		
d	at 150% of rated Voltage	T, Min or s		
3.3.11	Magnetizing current (approx) at nominal ratio and			
a	at 0.90 x nominal voltage	% of FLA		
b	at 0.95 x nominal voltage	% of FLA		
c	at 1.0 x nominal voltage	% of FLA		
d	at 1.05 x nominal voltage	% of FLA		
e	at 1.1 x nominal voltage	% of FLA		
3.3.12	Power factor of magnetizing current at normal voltage ratio and frequency			
3.3.13	Oil Ducts among cores		Yes	
3.4	Winding Construction			
3.4.1	Materials of winding		Copper	
3.4.2	Make, country			
3.4.3	Conductor Used		CTC/others	
	HV		[Insert]	
	RV/ tap Winding			
	LV		[Insert]	
	TV		[Insert]	
3.4.4	Type of Conductor Used			
	HV		Disc	
	RV/ tap Winding		Insert	
	LV		Disc	
	TV		Helical/Disk	
3.4.5	Current density, Thermal			
	HV	A/mm ²	[Insert]	
	RV/ tap Winding	A/mm ²	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	LV	A/mm2	[Insert]	
	TV	A/mm2	[Insert]	
3.4.6	Current Density, Short circuit			
	HV	A/mm2	[Insert]	
	RV/ tap Winding	A/mm2	[Insert]	
	LV	A/mm2	[Insert]	
	TV	A/mm2	[Insert]	
3.4.7	Insulations at windings		Thermally Upgraded Paper	
3.4.7.1	Insulation Class		A	
3.4.7.2	Insulation Make ,Country			
3.4.7.3	Additional Insulations as Protection caps at windings			
	HV			
	LV			
	TV			
3.4.7.5	Oil Ducts among windings		Yes	
3.4.7.6	Material of Pressboard		[Insert]	
3.4.7.7	Key Spacer		[Insert]	
3.4.8	Resistance /phase [Design Value with Tolerance]			
	HV	Ω	[Insert]	
	LV	Ω	[Insert]	
	TV	Ω	[Insert]	
3.4.9	Connection of three-phase windings (vector group IEC 60076)		Dyn1	
3.4.10	Tertiary winding connection (TV)		NA	
3.4.11	Geometric Location of windings with respect to core			
	TW		[Insert]	
	LW/ common winding		[Insert]	
	HV/ series winding		[Insert]	
	RW		[Insert]	
3.4.11	Winding Method at Factory		(Hor/Ver.)[Insert]	
3.4.12	Winding connections			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	[crimped, Brazed or others]			
	Between Windings			
	Between Winding Layers/Disk			
	Between Main Winding & Tap Winding			
	Between Windings & Leads			
3.4.13	Clamping of Winding			
	The individual winding sets clamped separately from each other and separately from the core.		Yes	
	Core		Insert	
3.4.14	Guaranteed Tangent delta of winding		Insert	
3.4.15	Guaranteed PD level		pC	
3.4.16	Curing of Active Part			
	Highest temperature	°C	Insert	
	Duration	Hrs	Insert	
	Average temperature	°C	Insert	
	Duration	Hrs	Insert	
	Total duration	Hrs	Insert	
3.4.17	Active Part Compression during Pressure, (approx)	mm		
3.5	Sound / Noise			
	At No load , rated frequency , 100% rated voltage	dB	[Insert]	
	At No load , rated frequency , 105% rated voltage	dB	[Insert]	
	At load , rated frequency , 100% rated voltage	dB	[Insert]	
	At load , rated frequency , 105% rated voltage	dB	[Insert]	
	Guaranteed during Testing	dB	[Insert]	
	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete	dB	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	cooling system in service			
	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	μV	2500 max	
3.6	Short Circuit			
3.6.1	Current through windings for Terminal Fault			
	HV	kArms		
	LV	kArms		
	TV	kArms		
3.6.2	Pre-fault voltage	p.u.	1.05	
3.6.3	Withstand Duration	s	2	
3.6.4	Similar Design Transformer (as per IEC 60076-5, Annex A) type test reference			
	Testing Authority		STL Lab, insert Name	
	certificate reference			
	Contact address of test Lab			
	Validity of test certificate			
3.6.5	Force			
	Axial Force	kN	[Insert]	
	Free Buckling Force	kN	[Insert]	
	Compression Force	kN	[Insert]	
	Designed Safety Margin		[Insert]	
3.6.7	Offered & Reference Similar Design transformer Short Circuit Force relationship		Within 110%	
3.6.8	Temperature during SC			
	HV Winding [Actual]	0C	[Insert]	
	LV Winding [Actual]	0C	[Insert]	
	RV Winding [Actual]	0C	[Insert]	
	TV Winding [Actual]		[Insert]	
3.6.9	Maximum Circulating Current in Delta tertiary for L-G fault at TV terminal	kA	[Insert]	
3.6.9.1	Winding withstand capacity of this current	Min or s		
3.7	Dielectric Design			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.7.1	Impulse Voltage at HV (LI)			
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	
	ZnO Block to limit distributed impulse [tap Winding/other]		No	
3.7.2	Impulse Voltage at HV (SI)		NA	
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	
	ZnO Block to limit distributed impulse [tap Winding/other]		No	
3.7.3	Impulse Voltage at LV (LI)			
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at HV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	
	ZnO Block to limit distributed impulse		No.	
3.7.4	Impulse Voltage at LV (LI)		NA	
	Maximum applied voltage at critical points	kV		
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at HV	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	ZnO Block to limit distributed impulse		No.	
3.8	Tap changer			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.8.1	Manufacturer		MR (EU), ABB (EU), Shanghai Huaming Power Equipment Co. Ltd, China	
3.8.1.1	Country of origin		Insert	
3.8.2	Switching technology		Vacuum	
3.8.3	Model designation		Insert	
3.8.4	Type of tap changing		On-load	
3.8.5	Electrical location of Tap winding		HV / Series Winding	
3.8.5.1	Geometric Location of Tap winding		[Insert]	
3.8.6	Type of voltage regulation		Constant Flux Variable Voltage (C.F.V.V.)	
3.8.7	Tapping range	% V	±10	
3.8.7.1	Tapping step/Size of Each tapping step	%	1.25	
3.8.8	Short circuit current - time	kA-s		
3.8.8.1	Rated current	A		
3.8.9	OLTC diverter switch		Separate oil filled Compartment	
3.8.10	Breathing of OLTC		Separate conservator	
3.8.11	OLTC Oil guided to Radiator for cooling		No	
3.8.12	OLTC tap change principle type		Resistance/Reactance type	
3.8.13	MVA Rating of Transformer due to OLTC operation		Rated power 120MVA, all taps	
3.8.14	Rated Voltage (No. load) due to OLTC operation	kV/kV/kV	132 ± 8 x 1,25 % / 33	
3.8.15	Percent Impedance design due to Tap Changing		Constant Impedance	
3.8.16	OLTC Motor			
3.8.16.1	Rating	50Hz, kW		
	AC voltage	V		
	Power	kW		
	Inrush	A		
3.8.16.2	Cabinet		Yes	
3.8.16.3	Handle		Insert	
	Tap position indicator		Digital code matrix (BCD)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Auxiliary supply		3x400 V / 230 V, 50 Hz	
3.9	Earthing			
3.9.1	Neutral [with double connection], with copper conductor	sqmm		
3.9.2	Core , taken out		Yes	
3.9.3	Clamp		Yes	
3.9.4	Tank Body		Yes	
3.9.5	Cubicles		Yes	
3.9.6	Radiators, if separately mount /connected		Yes	
3.9.7	Others		[Insert]	
3.10	Valves & Manholes			
3.10.1	Type of valves used			
3.10.2	Valve schedule attached		Yes	
3.10.3	Spare Manhole for inspection & future use		Yes, insert number & size	
3.11	Layout			
11.1	Primary winding bushings		Longitudinal axis	
11.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	
11.3	Tertiary winding bushings		As per Specification	
11.4	Conservator tank		As per Specification	
11.5	Tap changer		To be defined in design stage	
11.6	Control cabinet		To be defined in design stage	
11.7	Coolers		To be defined in design stage	
13	Dehydrating breather			
13.1	Type of dehydrating breather		Insert	
13.2	Dehumidifying agent	kg	Insert	
3.14	Transformer Tank			
14.1	Type of design		Welded/Bolted	
14.2	Thickness of transformer tank:			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	• Sides	mm	Insert	
	• Bottom	mm	Insert	
	• Top	mm	Insert	
14.3	Material of the autotransformer tank		Insert	
14.4	Corrosion protection of the tank		YES	
14.5	Vacuum withstand of the complete tank with cooler	mbar	1	
14.6	Over-pressure withstand of the complete autotransformer	bar	0.3	
14.7	Painting Color		Insert	
3.15	Conservator			
15.1	Type		With diaphragm	
15.2	Number of compartments	pcs.	Insert	
15.3	Oil level indicators with alarm for minimum oil level	pcs.	Insert	
15.4	Membrane provided inside the conservator for "breathing" of the transformer		Yes	
	Winding Temperature			
4	Oil for Transformer & Tap-Changer			
4.1	Manufacturer, Country		Insert	
4.2	Type		Mineral	
4.3	Type Designation			
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	Insert	
4.6	Viscosity at 20°C	mm ² /s	Insert	
4.7	Minimum dielectric strength	kV/cm	Insert	
5	Bushing			
	Standard		IEC 60137	
5.1	HV bushing (145 kV)			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.1.1	Make/Country		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany)	
5.1.2	Model		Insert	
5.1.3	Quantity		3	
5.1.4	Class	kV	145/650/275	
5.1.5	Housing		Composite SiR	
5.1.6	test tap	Yes		
5.1.7	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	2 kV	
5.1.8	Rated current	A	≥ 800	
5.1.8.1	Rated short circuit current (2 s)	kA rms	40	
5.1.9	Minimum creepage distance	mm/kV	≥ 31	
5.1.10	USCD, Unified Specific Creepage Distance	mm/kV	Insert	
5.1.11	Creepage factor , Cf [According to IEC 60815]		<3.2	
5.1.11.1	profile factor, P.F.		<1.1	
5.1.12	Min. flashover distance	mm		
5.1.13	Cantilever test load	kN	Insert	
5.1.14	Housing shed type	Alternate		
5.1.15	Air Vent		Yes	
5.1.16	Allowable mounting angle [with Vertical]	0 [deg]	Insert	
5.1.16.1	Mounted Angle [with Vertical] in this transformer	0 [deg]	Insert	
5.1.17	Total Length	mm		
5.1.18	Outer diameter	mm		
5.1.19	CT Pocket Length for BCT	mm	400 or as per design	
5.1.20	Oil quantity [for OIP type]	kg		
5.1.21	Mounting Flange made of corrosion free aluminium alloy	Yes		
5.1.21.1	No. of Hole	No.		
5.1.21.2	Diameter of each hole	mm		
5.1.21.3	Distance between hole	mm		
5.1.21.4	Fixing nut-bolt Material	AL or SS		
5.1.21.5	Earthing holes M12	No.		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.1.22	End-shielding		Yes	
5.1.23	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]			
5.1.24	Top Terminal Suitable for	AL		
5.1.25	dissipation factor			
5.1.26	Partial discharge	pC	0.5% or lower	
5.1.27	Insulation Class	F/1550 C		
5.1.28	Total Weight	kg	[Insert]	
5.2	LV bushings (36 kV)			
5.2.1	Make/Country		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
5.2.2	Model		[Insert]	
5.2.3	Quantity		3	
5.2.4	Class	kV	36/170/70	
5.2.5	Manufacturer		Insert	
5.2.6	Type		Insert	
5.2.7	Model		Insert	
5.2.8	Rated current	A	≥ 2500	
5.2.8.1	Rated short circuit current (2 s)	kA rms	31.5	
5.2.9	Minimum creepage distance	mm/kV	≥ 31	
5.2.10	USCD, Unified Specific Creepage Distance	mm/kV	Insert	
5.2.11	Creepage factor , Cf [According to IEC 60815]		<3.2	
5.2.11.1	profile factor, P.F.		<1.1	
5.2.12	Min. flashover distance	mm		
5.2.13	Cantilever test load	kN		
5.2.14	Housing shed type	Alternate		
5.2.15	Air Vent	Yes		
5.2.16	Allowable mounting angle [with Vertical]	0 [deg]		
5.2.16.1	Mounted Angle [with Vertical] in this transformer	0 [deg]		
5.2.17	Total Length	mm		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2.18	Outer diameter	mm		
5.2.19	CT Pocket Length for BCT	mm	400 or as per design	
5.2.20	Oil quantity [for OIP type]	kg		
5.2.21	Mounting Flange made of corrosion free aluminium alloy	Yes		
5.2.21.1	No. of Hole			
5.2.21.2	Diameter of each hole			
5.2.21.3	Distance between hole			
5.2.21.4	Fixing nut-bolt Material	AL or SS		
5.2.21.5	Earthing holes M12	No.		
5.2.22	End-shielding		Yes [if required by design]	
5.2.23	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]		Yes	
5.2.24	Top Terminal Suitable for	AL		
5.2.25	dissipation factor			
5.2.26	Partial discharge	pC	0.5% or lower	
5.2.27	Insulation Class	F/1550 C		
5.2.28	Total Weight	kg		
5.3	TV bushings (36 kV)		NA	
5.3.1	Quantity			
5.3.2	Class	kV		
5.3.3	Manufacturer			
5.3.4	Type			
5.3.5	Rated current	A		
5.3.6	Minimum creepage distance	mm/kV	≥ 31	
5.3.7	Partial discharge	pc	Insert	
5.3.8	Insulation Class	F/1550 C		
5.3.9	Outer diameter	mm		
5.3.10	CT Pocket Length for BCT	mm		
5.3.11	Total Weight	kg		
5.4	NV bushings (36 kV)			
5.4.1	Quantity		1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.4.2	Class	kV	36/170/70	
5.4.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
5.4.4	Type		Insert	
5.4.5	Rated current	A	≥ 1250	
5.4.5.1	Rated short circuit current (2 s)	kA rms	31.5	
5.4.6	Minimum creepage distance	mm/kV	≥ 31	
5.4.7	Partial discharge	pC	0.5% or lower	
5.4.8	Insulation Class	F/1550 C		
5.4.9	Outer diameter	mm		
5.4.10	CT Pocket Length for BCT	mm	400 or as per design	
5.4.11	Total Weight	kg		
6	Weights			
6.1	Total weight of transformer, ready for service	kg	Insert	
6.2	Shipping Weight of Transformer [Without Oil]	kg	Insert	
6.3	Weight of Core	kg	Insert	
6.4	Weight of Winding	kg	Insert	
6.5	Weight of Active Parts	kg	Insert	
6.6	Weight of oil in Main tank	kg	Insert	
6.7	Weight of oil in radiator & Main tank Conservator	kg	Insert	
6.8	Weight of oil in OLTC tank & OLTC Conservator	kg	Insert	
6.9	Total Weight of oil in Transformer	kg	Insert	
7	Dimensions & Layout drawing			
7.1	Outer dimensions:			
	Length	mm	Insert	
	Width	mm	Insert	
	Height without Bushing	mm	Insert	
	Maximum Height with Bushing	mm	Insert	
7.3	Informative dimensional sketch		To be enclosed with bid	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
8	NA			
9	Auxiliary power supply			
9.1	Motors		3x400 V / 50 Hz	
9.2	Heaters		230 V / 50 Hz	
9.3	Control voltage		110 V DC	
9.4	Oil pump (if any)		3x400 V / 50 Hz	
10	Current transformer incorporated into the power transformer			
10.1	CT in HV bushings, for protection and WTI		In all phases, 3cores Characteristics shall be defined in design stage.	
10.2	CT in MV bushings, for protection, WTI and Tap Changer		In all phases, 4 cores characteristics shall be defined in design stage	
10.3	CT in TV bushings, for protection and WTI		NA	
10.4	CT in neutral bushing, for protection		In all phases, 2 cores Characteristics shall be defined in design stage	
11	Miscellaneous Item			
11.1	AVR Relay		Shall be from OLTC Manufacturer	
11.2	Bucholtz relay, Make		insert	
11.3	Control Cable , Make		insert	
11.4	OTI Make		insert	
11.5	WTI Make		insert	
11.6	Remote Transformer Panel with all accessories, Make		Yes, insert	
11.7	Marshalling Cubicle with all accessories, Make		Yes, insert	
11.8	Cooling Cabinet with all accessories, Make		Yes, insert	
11.9	Material (Cooling & Marshalling Cabinet)		Insert	
11.10	No. of PRD in Main Tank		Min 3	
11.11	No. of PRD in OLTC		Insert	
11.12	Oil Surge Relay			
11.13	WTI [Normal & Fiber Optic]		Yes, insert number	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
11.14	OTI		Yes, insert number	
11.15	Gasket Material		Nitrile Rubber	
11.16	Nut-Bolt, Make		Insert	
11.17	Nut-Bolt, Material		SS	
11.18	LA Make		Insert	
12	Operating conditions			
12.1	At the altitude (above sea level)	m	≤ 1000	
12.2	Maximum ambient temperature	°C	45	
12.3	Average daily temperature	°C	35	
12.4	Average annual temperature	°C	30	
12.5	Minimum ambient temperature	°C	-2	
	Overall compliance with the requirements (yes/no)			

5.2.4 HV & LV Cable

5.2.4.1 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 length	m															
Minimum installed bending																

radius	mm																
Maximum conductor temperature	°C																

5.2.5 Others

No	Description	Unit	Minimum Requirements	Guaranteed
1	Structural Steel			
1.1	Type and standard specification		Insert	
1.2	Manufacturer and country		Insert	
1.3	Minimum yield strength	kg/mm ²	Insert	
1.4	Ultimate tensile strength	kg/mm ²	Insert	
2.	Copper Conductors for Earthing system			
2.1	Type and standard specification		Insert	
2.2	Manufacturer and country		Insert	
2.3	Conductor material		Insert	
2.4	Size of conductors (Solid copper rods)	mm ²	Insert	
2.5	Size of conductors (Flat copper bars) (Width×Thickness×Bundles)	mm	Insert	
2.6	Rated current	A	Insert	
2.7	Short time withstand current	kA rms	Insert	
2.8	Peak withstand current	kA pk	Insert	
3	High Voltage Bus Work			
3.1	Switchyard Conductor			
3.1.1	Copper Tubular Conductors for Busbar			
3.1.1.1	Type and standard specification		Insert	
3.1.1.2	Manufacturer and country		Insert	
3.1.1.3	Inner diameter	mm	Insert	
3.1.1.4	Outer diameter	mm	Insert	
3.1.1.5	Rated continuous current (site rating)	A rms	Insert	
3.1.1.6	Temperature rise at rated current	°C	Insert	
3.1.1.7	Rated short time current	kA rms	Insert	
3.1.1.8	Peak withstand current	kA pk	Insert	
3.1.1.9	Weight	kg/m	Insert	
3.1.1.10	Moment of inertia	kg-m ²	Insert	
3.1.2	Aluminium Tubular Conductors for Busbar			
3.1.2.1	Type and standard specification		Insert	
3.1.2.2	Manufacturer and country		Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
3.1.2.3	Inner diameter	mm	Insert	
3.1.2.4	Outer diameter	mm	Insert	
3.1.2.5	Rated continuous current (site rating)	A rms	Insert	
3.1.2.6	Temperature rise at rated current	°C	Insert	
3.1.2.7	Rated short time current	kA rms	Insert	
3.1.2.8	Peak withstand current	kA pk	Insert	
3.1.2.9	Weight	kg/m	Insert	
3.1.2.10	Moment of inertia	kg-m ²	Insert	
3.1.2.11	Temperature rise at rated current	°C	Insert	
3.1.2.12	Rated short time current	kA rms	Insert	
3.1.2.13	Peak withstand current	kA pk	Insert	
3.1.2.14	Rated ultimate tensile strength	kN	Insert	
3.1.2.15	Mass, nominal	kg/m	Insert	
3.1.2.16	No. of conductors per bundle		Insert	
3.1.2.17	Bundle configuration		Insert	
3.1.2.18	Bundle spacing			
3.1.3	Flexible Bus Conductor			
3.1.3.1	Type and standard specification		Insert	
3.1.3.2	Manufacturer and country		Insert	
3.1.3.3	Conductor type		Insert	
3.1.3.4	Conductor size		Insert	
3.1.3.5	Standing - No. of Al wires Dia. Of each wire	mm	Insert	
3.1.3.6	Overall conductor dia.	mm	Insert	
3.1.3.7	Cross-sectional area	mm ²	Insert	
3.1.3.8	Rated continuous current (site rating)	A rms	Insert	
3.1.3.9	Temperature rise at rated current	°C	Insert	
3.1.3.10	Rated short time current	kA rms	Insert	
3.1.3.11	Peak withstand current	kA pk	Insert	
3.1.3.12	Rated ultimate tensile strength	kN	Insert	
3.1.3.13	Mass, nominal	kg/m	Insert	
3.1.3.14	No. of conductors per bundle		Insert	
3.1.3.15	Bundle configuration		Insert	
3.1.3.16	Bundle spacing		Insert	
3.1.4	Shield Wire			
	Type and standard specification		Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	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 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	
	Radio interference voltage - Test voltage to ground Max. RIV at $1.1xU_r/3$ 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	N N N-m N N	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	Impact strength	N-m		
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	
	Radio interference voltage - Test voltage to ground Max. RIV at $1.1xU_r/3$ 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	
3.3	Clamps and Fittings			

No	Description	Unit	Minimum Requirements	Guaranteed
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Maximum working stresses		Insert	
	All accessories for installation (bolts, nuts, etc.)		Insert	

5.3 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	GIS Equipment		
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		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
4.10	List of mandatory spare parts		
4.11	List of recommended spare parts		
4.12	Training plan and program		
5	Circuit breakers:		
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		
6.6	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	Disconnectors:		
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		
6.9	List of mandatory special tools		
6.10	List of mandatory spare parts		
6.11	List of recommended spare parts		
6.12	Training plan and program		
7	Current transformers:		
7.1	Manufacturer's authorization letter		
7.2	Manufacturer's quality assurance certificates		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
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	Voltage transformers:		
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		
8.7	Descriptive catalogue		
8.8	Reference list for the last five years for the offered type		
9	Surge arresters:		
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		
10	Control system:		
10.1	Manufacturer's authorization letter		
10.2	Manufacturer's quality assurance certificates		
10.3	Technical data sheet		
10.4	Drawing		
10.5	List of performed type tests		
10.6	Type test certificates		
10.7	Descriptive catalogue		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
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	Relay Protection System:		
11.1	Manufacturer's authorization letter		
11.2	Manufacturer's quality assurance certificates		
11.3	Technical data sheet		
11.4	Drawing, system topology, block diagrams		
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		
11.12	Training plan and program		
12	Metering System:		
12.1	Manufacturer's authorization letter		
12.2	Manufacturer's quality assurance certificates		
12.3	Technical data sheet		
12.4	Drawing		
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		
13	Communication System:		
13.1	Manufacturer's authorization letter		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
13.2	Manufacturer's quality assurance certificates		
13.3	Technical data sheet		
13.4	Drawing, system topology		
13.5	General description of hardware		
13.6	General description of software		
13.7	Descriptive catalogue		
13.8	Reference list for the last five years for the offered type		
13.9	List of mandatory special tools		
13.10	List of mandatory spare parts		
13.11	List of recommended spare parts		
	Overall compliance with the requirements (yes/no)		

5.4 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		
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		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
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		
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		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
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		

