POWER GRID BANGLADESH PLC

Bidding Document
for

Design, Supply, Erection, Testing & Commissioning of capacity enhancement and Capacitor Bank installation with associated switchgear in existing grid substation (Package-2, Lot-2)

Volume 3 of 3

Issued on	**:**	**July 30, 2024**
Invitation for Bids No.	**:**	**27.21.0000.101.07.417.24.4060**
ICB No.	**:**	**POWERGRID/CEEGSTL/SS/Package-2/Lot-2/Re-Tender**
Country	**:**	**Bangladesh**

Employer:

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Contents of the Tender Documents

VOLUME 1

Part 1: Bidding Procedures

Section 1:	Instructions to Bidders (ITB)
Section 2:	Bid Data Sheet (BDS)
Section 3:	Evaluation and Qualification Criteria (EQC)
Section 4:	Bidding Forms (BDF)
Section 5:	Eligible Countries (ELC)

Part 2: Employer's Requirements

Section 6:	Employer's Requirements (ERQ)

Part 3: Conditions of Contract and Contract Forms

Section 7:	General Conditions of Contract (GCC)
Section 8:	Special Conditions of Contract (SCC)
Section 9:	Contract Forms (COF)

VOLUME 2

System Parameters & Plant Design
Technical Specifications & Requirements
Drawings forming Part of Specifications

VOLUME 3

Schedule A:	Scope of Work
Schedule B:	Bid Prices & Schedules
Schedule C:	Bar Chart Program of Key Activities-Delivery & Completion Time Schedule
Schedule D:	Manufacturers, Places of Manufacture and Testing
Schedule E:	Technical Particulars and Guarantees
Schedule F:	Proposed Subcontractors
Schedule G:	Proposed Alternative Standards to Which Equipment Shall Be Provided
Schedule H:	Proposed Contract and Site Organization
Schedule I :	Drawings and Documents to be submitted with the Bid and after contract
Schedule J:	Proposed Subcontractors
Schedule K:	Coefficient and Indices for Price Adjustment

Table of Contents

1. Schedule A: Scope of Works 4
   1.1 Description of Overall Project 4
   1.2 Description of this Package 4
   1.3 Requirement 6
      1.3.1 132/33kV transformer replacement at Joydebpur 132/33kV AIS Substation 6
      1.3.2 36kV Capacitor banks at Bhaluka 132/33kV AIS Substation 9
      1.3.3 36kV Capacitor banks at Netrokona 132/33kV AIS Substation 9
      1.3.4 36kV Capacitor banks at Lalmonirhat 132/33kV AIS Substation 9
      1.3.5 36kV Capacitor banks at Rajendrapur 132/33kV GIS Substation 11
      1.3.6 36kV Capacitor banks at Saidpur 132/33kV AIS Substation 13
      1.3.7 36kV Capacitor banks at Palashbari 132/33kV AIS Substation 13
   1.4 Detailed Description of the Scope of Supply for Tele-communication System (Not applicable) 13
      1.4.1 Recommendation of Communication system 14
      1.4.2 Architecture of the Overall Telecommunication System 15
      1.4.3 Scope of Work and Supply 15
      1.4.4 Engineering Services 16
   1.5 Detailed Description of the Scope of Supply for SCADA, Control & Monitoring System (Not applicable) 16
      1.5.1 Overall Scope of Work and Supply 16
      1.5.2 Adaptation and Configuration of the NLDC 17
      1.5.3 General Principle and Description of SCMS 19
      1.5.4 Scope of Work and Supply at New Substations (N 21
      1.5.5 Scope of Work and Supply at Existing Substations 23
      1.5.6 Engineering Services 23
   1.6 Terminal Points (Not applicable) 24
      1.6.1 Transmission Line Circuit Connections 24
      1.6.2 Communication and SCADA Equipment 24
   1.7 Training and Inspection 26
      1.7.1 Training Contents 27
2. Schedule B: Bid Prices & Schedules 29
   Schedule No. B1: Plant and Mandatory Spare Parts Supply from Abroad 30
   Schedule No. B2: Plant and Mandatory Spare Parts Supplied from Within the Employer's Country 30
   Schedule No. B4: Installation and Other Services 30
   Schedule No. B5: Grand Summary 30
   Schedule No. B6: Recommended Spare Parts 30
3. Schedule C: Bar Chart Program of Key Activities - Delivery & Completion Time Schedule 31
   3.1 Times for Delivery and Completion 31
4. Schedule D: Manufacturers, Places of Manufacture and Testing 32
5. Schedule E: Technical Particulars and Guarantees 38
   5.1 General 38
   5.2 Technical Data Schedule 38
      5.2.1 Part-1: HV AIS Switchgear 39
      5.2.2 Part 2: GIS Switchgear 107

5.2.3 AIS Switchgear 33 kV 123
5.2.4 Transformers 151
5.2.5 Control, Protection, Substation Automation & Metering 278
5.2.6 Digital Fault and Disturbance Recorder (DFDR) (Not applicable) 363
5.2.7 HV & LV Cable 368
5.2.8 Batteries, Chargers and DC Distribution: (Not Applicable) 386
5.2.9 LVDC/AC Distribution Panel (Not Applicable) 392
5.2.10 Telecommunication Equipment 392
5.2.11 36kV Capacitor Bank, 36kV Reactor, and 36kV NCT 400

17.85 406

Double Y ungrounded neutral 406

5.2.12 Others 408
5.3 Technical information 412
5.4 Drawings and Other Technical Information to be provided 417

6. Schedule F: Subcontractors 420

7. Schedule G: Proposed Alternative Standards to Which Equipment Shall Be Provided 421

8. Schedule H: Proposed Contract & Site Organization 422

10. Schedule I: Drawings and Documents to Be Submitted with Bid and After Contract 425

10.1 Drawing and Documents to be Submitted with BID 425
10.2 Drawings and Documents to be Submitted after Contract 426

11. Schedule J: Departures from The Specification 430

12. Schedule K: Coefficient and Indices for Price Adjustment 431

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 current grid substations, install new capacitor banks, replace existing conductors on existing transmission lines, and implement second circuit stringing 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.	Joydebpur 132/33kV	132/33kV 80/120MVA 3-phase Power Transformer	2	Replacement

36kV Capacitor Bank		
Sl. No.	Name of the Substations	Proposed compensation Block (MVar)
1.	Lalmonirhat 132/33kV	2x15

2.	Rajendrapur 132/33kV	3x15

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. 132/33 kV, 80/120MVA, 3-phase Power transformers with necessary switchgears and civil works. The above two (2) nos. 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.

36kV Capacitor Banks:

Design, supply, delivery, installation, testing and commissioning of Five (5) nos. 36kV 15MVAR 3-phase capacitor bank with necessary switchgears, civil works and in some case, supplements shall be included for extension from existing bus section. All capacitor banks and associated switchgears shall be designed as outdoor type. Bidders should submit their offer to make shunt compensation with capacitor banks at two (2) identified substations in all respects to make it fully operational.

Harmonic Study regarding capacitor bank installation:

The contractor shall provide harmonic analysis report focusing on its level and behaviours. The study as well as field measurement shall be conducted before design of the capacitor bank and after completion of work i.e. testing & commissioning in every location where the capacitor banks to be installed. The study shall be done by capacitor bank manufacturer. It shall be based on IEEE 67 standard and data shall be recorded for at least 72 hours. The Contractor will design capacitor bank reflecting the analysis data after the initial study of harmonics. Initially the inrush damping reactor has been selected for the series reactor of the capacitor bank configuration. However, if detuning reactor installation is required to suppress the harmonics for particular substations, based on the study, then the quoted price rate (refers to the Rajendrapur substation, in Schedule B) will be applicable for the modification. The cost of the harmonic study shall be deemed to be included in design services.

The detailed requirements are listed in the Technical Specification, Technical Particulars & Guarantee Schedule and Price schedule.

Following works are to be included in the scope of this project but shall not be limited to completion of this turnkey project.

This Bid provides for all parts of the works to be completed in every respect for commercial operation to the requirements of the Engineer. All details, accessories etc. required for the complete installation and satisfactory operation of the works not specifically mentioned in this Specification are deemed to be included in the contract price.

1.3 Requirement

1.3.1 132/33kV transformer replacement at Joydebpur 132/33kV AIS Substation

For Joydebpur substation, scheme of existing 132kV side is single bus scheme with both AIS and GIS bus. Replacement of existing two set 132/33kV, 50/75MVA transformer (GT-3 & GT-4) 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).
1B	**132kV Air Insulated Switchgear (AIS) (Replacement)**
	The 132kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements and shall comprise the following:-
1B1	Deleted
1B2	Deleted

1B3 Three (3) nos. of single-phase, 4-core, multi ratio, 132kV, 40kA/1sec, 50Hz, 650kVp BIL, outdoor, post type current transformer.

1C **132kV Gas Insulated Switchgears (GIS) (Replaced)**

The existing 132kV GIS model is 8DN8III (SIEMENS, Germany make). Only the existing GIS CT module of the existing 132kV GT4 GIS bay shall be replaced by new GIS CT module of the same manufacturer and model as per existing, having CT ratio as specified below. It is the bidder's responsibility to collect necessary data, drawings, and necessary expert services from the existing GIS manufacturer to replace the CT module. The Employer will not provide any additional information except whichever available in this bidding document. All cost regarding this replacement work (degassing, regassing, testing, expert services etc.) shall be deemed to be included in the Contract price. To replace the existing GIS CT module if any other interfacing module/equipment is required, the cost of that shall be deemed to be included in the contract price

The 132kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements and shall comprise the following: -

1C1 Three (3) nos. of single-phase, 6-core, multi ratio, 132kV, 40kA/1sec, 50Hz, 650kVp BIL, current transformer. The core shall be as follows-

i) 1250-800-600/1A, Cl. X
ii) 1250-800-600/1A, Cl. 5P20, 25VA
iii) 1250-800-600/1A, Cl. 1Fs5, 15VA
iv) 1250/1A, Cl. X
v) 1250/1A, Cl. X
vi) 1250-800-600/1A, Cl. 02Fs5, 10VA

1D **33kV Air Insulated Switchgear (AIS) (Replaced)**

The 132kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements and shall comprise the following:-

1D1 Deleted

1D2 Deleted

1E **Flexible conductors for jackbus, jumper, equipment connections**

1E1 One (1) lot of flexible conductors of suitable capacity for 132kV & 33kV system for jackbus, jumper, equipment connections including all necessary clamps & connectors required for completing replacement portion of the switchyard connection.

Insulator & fittings and steel structures

1F **Insulator & fittings and steel structures**

1F1 One (1) lot of insulators and fittings including all necessary accessories required to complete renovation portion of the switchyard.

1G **Steel structures**

1G1 One (1) lot of modification work of existing steel structures and new steel structures for gantry and equipment supports including nuts & bolts and cable tray with all necessary fitting & fixing accessories required for completing renovation portion of the switchyard.

1H **HV Power Cables, Cable Termination and GIS**

1H1 Deleted

1H2 Deleted

1I **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

1I1 Modification of existing two (2) sets of control and protection panel to integrate the new replaced transformers for 132kV Side of Transformer Bay.

1I2 Two (2) set of tap changer panel for 132kV Side of Transformer Bay.

1I3 Deleted

33kV Circuit

1I4 Modification of existing two (2) sets of control and protection panel to integrate the new replaced transformers for 33kV Side of Transformer Bay.

1J **Multicore Power & Control Cable**

1J1 One (1) lot of multicore low voltage 0.6/1.1kV XLPE insulated power cable, and control cables (IEC 60502,60870) shall be supplied, installed, glanced, terminated and have individual cores identified to be used for connection of all equipment supplied under this contract . The substation cable routing and core schedules shall also be provided for new bay.

1K **Earthing and Lightning Protection**

1K1 One (1) lot of design, supply and installation of earthing system including connections, connectors and clamps for renovation portion of switchyard and to suit the substation arrangement and provide supporting design calculations.

1L **Dismantling of equipment and materials**

1L1 Removal & shifting of two (2) set 132/33kV, 50/75MVA transformers at the same substation. Dismantling of existing equipment and handing over to the store excluding the transformers.

1M **Civil Works, Building and Foundation**

1M1 Complete design, supply and construction of one (1) lot of all civil items (modification and new works) required for the outdoor works suitable for transformer & equipment foundations (for 132kV equipment), Blast wall (if required), cable trenches, surface drain extension, gravel laying (removal, washing and replace), switchyard surface finishing etc to accommodate renovate transformer bays.

1M2 Deleted

1.3.2 36kV Capacitor banks at Lalmonirhat 132/33kV AIS Substation

The equipment to be designed, supplied, installed, tested & commissioned as per detail technical specification and as shown in bid drawings (Volume 2 of 3 of this bid document):

The equipment shall comply with the particular requirements as detailed in the Technical Requirements included as Schedule E to this volume and shall comprise the following:-

Item **Description**

2A **33kV Capacitor Banks with Accessories**

2A1 Two (2) sets of 33kV rated 15 MVar capacitor bank with necessary outdoor mounting arrangement considering minimum space utilization.

2A2 Six (6) nos. of 0.2% 33kV, 410A damping air core reactor with necessary outdoor mounting arrangement considering minimum space utilization.

2A3 Two (2) nos. of 33kV, two cores each single phase neutral current transformer.

2A4 Two (2) sets of key interlocking system.

2B **33kV outdoor Switchgear**

The 33kV outdoor type AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Schedule E of Volume 1 of 3 and shall comprise the following:

2B1 Two (2) sets of 33kV, 1250A, 31.5kA/1 sec, 50Hz, Vacuum Circuit Breaker suitable for capacitor banks.

2B2 Two (2) sets of 33kV, 1250A, 31.5kA/1 sec, horizontal or vertical mounting Disconnecting Switch without earth switch.

2B3 Six (6) nos. of 33kV, three cores each single-phase current transformer.

2B4 Twelve (12) nos. of 30kV Ur, 24kV Uc, gapless, metal oxide type 10kA, single phase surge arrester.

2C Control, Protection & Metering 33 kV Circuits

The equipment to be designed, supplied, installed and commissioned shall be as shown in bid drawings and comprise of:-

2C1 Control, Protection & Metering including panels for two (2) sets of capacitor banks.

2D LV and MV Cables including accessories

2D1 33kV XLPE, 500sqmm Cu single core cables for connecting two (2) capacitor banks to 33kV Switchgear. The quantity of XLPE cable mentioned on the price schedule may be varied and it will be finalized during detail engineering and the payment shall be done as per actual requirement. The laying method of cable shall be buried.

2D2 33kV XLPE, cable termination kit (suitable for 500sqmm Cu Cable) for connecting both ends of cables.

2D3 One (1) lot complete set of multicore low voltage 0.6/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under this Contract. The overall cable routing and core schedules shall also be provided.

2E Conductor, Steel Structure, Insulator & Hardware fittings

2E1 One (1) lot of flexible conductors for main bus, jack bus, jumper, equipment connection [ACSR/TACSR, appropriate capacity], including all necessary clamps & connectors required for completing 33kV bay and capacitor bank interfacing.

2E2 One (1) lot of insulators and fittings including all necessary accessories required to complete 33kV bay and capacitor bank interfacing.

2E3 One (1) lot of steel structures for gantry and outdoor equipment supports including nuts & bolts and cable tray including all necessary fitting & fixing accessories required to complete 33kV interfacing.

2F Earthing and Lightning Protection

2F Modification and extension of existing earthing and lightning protection system for capacitor bank 33kV bay as well as capacitor bank area.

2G DC Distribution

2G1	Extension of DC Distribution System with necessary material for new bays/equipment.
2H	**LV AC Distribution**
2H1	Extension of LVAC Distribution System with necessary material for new bays/equipment
2I	**Lighting, Small Power**
2I1	One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) and small power arrangements at strategic locations for equipment operation and inspection.
2J	**Civil Works, Building and Foundation**
2J1	One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, capacitor bank & extension of internal roads, cable trenches, gravel laying, safety fences, etc.

1.3.3 36kV Capacitor banks at Rajendrapur 132/33kV GIS Substation

The equipment to be designed, supplied, installed, tested & commissioned as per detail technical specification and as shown in bid drawings (Volume 2 of 3 of this bid document):

The equipment shall comply with the particular requirements as detailed in the Technical Requirements included as Schedule E to this volume and shall comprise the following:-

Item	**Description**
3A	**33kV Capacitor Banks with Accessories**
3A1	Three (3) sets of 33kV rated 15 MVar capacitor bank with necessary outdoor mounting arrangement considering minimum space utilization.
3A2	Nine (9) nos. of 6% 33kV, 410A damping air core reactor with necessary outdoor mounting arrangement considering minimum space utilization.
3A3	Three (3) nos. of 33kV, two cores each single phase neutral current transformer.
3A4	Three (3) sets of key interlocking system.
3A5	Nine (9) nos. of 30kV Ur, 24kV Uc, gapless, metal oxide type 10kA, outdoor, AIS single phase surge arrester.
3B	**33kV GIS Switchgear**

The existing 33kV GIS is SIEMENS, Germany make (Model- 8DA10, year- 2019). GIS bay extension in this substation under this project shall be done with the GIS of the same manufacturer and model as per existing GIS. The bidder's responsibility shall include all necessary interface data collection and expert service from existing GIS manufacturer and adaptation of new GIS bay accordingly. The Employer will not provide any additional information except whichever available in this bidding document. The price of interfacing/extension module, if required any, as well as the cost of interfacing/extension work shall be deemed to be included in the contract price.

The 33kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements and shall comprise the following: -

3B1 Two (2) sets of 33kV GIS Line Feeder Bay, each comprises with:

i) One (1) lot of 33kV, 3150A, 31.5kA/3s, single/three phase Enclosure double busbar

ii) One (1) set of 33kV, 2000A, 31.5kA/3s, three phase, gang operated Circuit Breaker complete with spring operating mechanism

iii) One (1) set of 33kV, 2000A, 31.5kA/3s, three phase busbar Disconnector with earth switch, complete with motor operating mechanism

iv) Deleted

v) Three (3) nos. of 33kV, 31.5kA/3s single phase, 3-core Current Transformer

vi) One (1) set of three phase GIS Cable compartment with externally operable isolation link.

vii) Three (3) sets of Single-phase complete GIS-to-Cable termination (both male and female) with all accessories for capacitor bank bay.

viii) One (1) lot of Local Control Cubicle with IEC 61850 compliant control, protection & metering system.

ix) One (1) lot of complete Set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate

3C Control, Protection & Metering 33 kV Circuits

The equipment to be designed, supplied, installed and commissioned shall be as shown in bid drawings and comprise of:-

3C1 Control, Protection & Metering including panels for three (3) sets of capacitor banks.

3D LV and MV Cables including accessories

3D1 33kV XLPE, 500sqmm Cu single core cables for connecting three (3) capacitor banks to 33kV Switchgear. The quantity of XLPE cable mentioned on the price schedule may be varied and it will be finalized during detail engineering and the payment shall be done as per actual requirement. The laying method of cable shall be buried.

3D2 33kV XLPE, cable termination kit (suitable for 500sqmm Cu Cable) for connecting capacitor bank ends of cables.

3D3 One (1) lot complete set of multicore low voltage 0.6/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under this Contract. The overall cable routing and core schedules shall also be provided.

3E **Conductor, Steel Structure, Insulator & Hardware fittings**

3E1 One (1) lot of flexible conductors for main bus, jack bus, jumper, equipment connection [ACSR/TACSR, appropriate capacity], including all necessary clamps & connectors required for completing 33kV bay and capacitor bank interfacing.

3E2 One (1) lot of insulators and fittings including all necessary accessories required to complete 33kV bay and capacitor bank interfacing.

3E3 One (1) lot of steel structures for gantry and outdoor equipment supports including nuts & bolts and cable tray including all necessary fitting & fixing accessories required to complete 33kV interfacing.

3F **Earthing and Lightning Protection**

3F1 Modification and extension of existing earthing and lightning protection system for capacitor bank 33kV bay as well as capacitor bank area.

3G **DC Distribution**

3G1 Extension of DC Distribution System with necessary material for new bays/equipment.

3H **LV AC Distribution**

3H1 Extension of LVAC Distribution System with necessary material for new bays/equipment

3I **Lighting, Small Power**

3I1 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) and small power arrangements at strategic locations for equipment operation and inspection.

3J **Civil Works, Building and Foundation**

3J1 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, capacitor bank & extension of internal roads, cable trenches, gravel laying, safety fences, etc.

1.4 Detailed Description of the Scope of Supply for Tele-communication 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, SNCPM)
- 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, SNCPM)
  - 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 fter 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 form 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

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

(a) **International Training:** The following engineers nominated by the Employer shall be provided with training at specialist manufacturer's works as follows:
Deleted

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

SL	Description	No. of Engineers per visit	Duration (Working Days) per visit	No. of Trip/ Visit
1.	Transformers	02	10	1 visits: 01 for 132/33kV Transformer.
2.	AIS Capacitor Bank	02	07	1 visit: 01 for 36kV Capacitor Bank

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

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

For CB at least 10% of the supplied quantity shall face witness of Employers Engineers.

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

For SAS, point-to-point communication, Relay communication protocol (PRP, HSR, RSTP etc. as applicable) test, inter-operability test (if applicable) shall be performed.

For Surge Arrester, relevant IEC standard shall be followed.
For XLPE Power Cable, relevant IEC standard shall be followed.
For other Equipment (DS, IT set, Capacitor Bank, CT, VT, battery & charger) 10% the Supplied quantity shall face witness of Employers Engineers.

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

SL	Description	No. of Engineer	Duration (Working days)
1.	HV GIS switchgears	NA	NA

2.	Transformers	10	06
3.	Protection & Substation automation system	NA	NA
4.	Fiber optic multiplexer & digital PABX	NA	NA
5.	SCADA system	NA	NA
6.	AIS Capacitor Bank	10	04

The Contractor shall be responsible for bearing all costs for the trainees (for item (a)), including air fares, accommodation, meal, healthcare, transportation, visa fees etc. together with payment of a daily allowance of **US$ 80 per day including travel time** for each of the Employer's trainee. The air ticket class for Training shall be Economy class. The Employer's engineer attending the Pre-shipment inspection (as mentioned in item no. b) shall be provided with the same facilities as mentioned above except the payment of daily allowance which is to be **US$ 100 per day including travel time.** ~~For local trainings (item no. C), contractor shall provide daily allowance of **US$ 50 per day**~~

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

1.7.1 Training Contents

The minimum requirements for different trainings are described here. The final schedule with contents shall be finalized during execution stage.

1.7.1.1 HV Substation & Equipment Design and Testing (as per IEC)

SL	Topics	Contents	Duration
1.	Transformer Design	1. Practical transformer design: a) Electrical Design: Short Circuit, Dielectric & Thermal Design b) Mechanical Design: External (Tank, Stifner,, Conservator, Cooling (Cooler, Fan, Pump) & Internal (Clamping, Fitch Plate, lead structure) 2. Manufacturing Process : Coil, Core & Post Vapour Drying 3. Computer Aided Design 4. Operation and maintenance of OLTC 5. Different types of faults in transformer 6. Troubleshooting of transformer faults	6 days
		Fire-fighting of Transformer	
		Testing of transformer as per IEC: Pros & Cons - Routine, Design & Special test	
2.	Substation Design	Insulation Co-ordination	3 days
		DC system Design including- Battery Sizing, Design & Testing Battery Charger Sizing, Design & Testing Battery Insulation Monitoring	
		Design Calculations including-	

		DSLP Calculation, Conductor sizing for Bus & cable sizing, Computer Aided Cantilever strength Sizing of PI, Lighting Design for Indoor & Outdoor, LVAC system Design including HVAC Design	
3.	CT-PT Design	CT-PT Sizing Calculation Design Testing	2 days
4.	Earthing system Design using	Theory of Earthing system design Soil resistivity, Testing methods & models, Single layer & two layer method for Earthing system design : Detailed system Design AIS & GIS Switchyard using software.	2 days
5.	FACTS Device	Series Rector Design & Testing Shunt Rector Design & Testing SVC Design & Testing	2 days

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

2. Schedule B: Bid Prices & Schedules

General

1. The Price Schedules are divided as follows:

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

2. *The Schedules do not generally give a full description of the plant to be supplied and the services to be performed under each item. To have comprehensive understanding of the technical specification of each equipment the bidder shall read technical specification in relevant sections in volume 02; Employer's Requirements & other sections of the Bidding Document (Requirement in Schedule A of Volume 03, GTP requirement in Appendix of Schedule A or Schedule E) and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices The entered rates and prices shall be deemed to cover the full scope as previously mentioned, including overheads and profit*.

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

Pricing

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

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

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

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

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

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

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

Notes

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

Schedule B: Schedules of Rates and Prices

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

Please see the separate Excel file for the above.

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

Please use the attached excel file

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

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

3.1 Times for Delivery and Completion

The individual dates are all contractually binding.

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

Completion time for 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				

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	Circuit breakers 132 kV				
i.	Drive Mechanism				
ii.	Interrupter Chamber				
iii.	Insulator				
4..2.2	Disconnectors 132 kV				
i.	Drive Mechanism				
ii.	Male-Female Contact				
iii.	Insulator				
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.	Voltage transformers 132 kV				
i.	Core				
ii.	Winding				
iii.	Insulator				
4.2.5	Surge arresters 132 kV				
i.	ZnO Resistor Block				
ii.	Housing				
iii.	Surge Counter				
5.	33 kV Equipment				
5.1	Circuit breakers 33 kV				
5.2	Disconnectors 33 kV				
5.3	Current transformers 33 kV				
5.4	Voltage transformers 33 kV				
5.5	Surge arresters 33 kV				
6.	Control, Protection, and Metering Equipment				
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				

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
7.	**Substation Automation System (Not Applicable)**				
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				
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				

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nation
9.8	Surge arrester				
9.9	Wave Trap				
10	XLPE Cable & Cable Termination Kit				
10.1	400kV	N/A			
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				

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

5.2.1 Part-1: HV AIS Switchgear

5.2.1.1 Circuit Breaker 400kV (Not applicable)

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	**Circuit Breaker - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	
1.5	Standards		IEC 62271-100	
			IEC 60273	
			IEC 60694	
			IEC 60815	
			ISO 9001	
1.6	Quality control		ISO 14001	
			ISO 18001	
1.7	Isolating and quenching medium		SF6	
1.8	Type of circuit breaker		Outdoor	
1.9	Design		Double breaking	
1.10	Operating mechanism		Spring	
	Closing type		Insert	
	Opening type		Insert	
1.11	Number of poles	pcs.	3 (1 per phase)	
1.12	Number of operating mechanisms per circuit breaker	pcs.	1 / 3 (1 per phase)	
1.13	Control Switching Device		Yes	
2.	**Circuit Breaker - Characteristics**			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment Um	kV rms	420	
2.3	Rated lightning impulse withstand voltage i) between phase to ground and between phases	kV peak	1425	
	ii) across open switching device and/or isolating distance	kV peak	1425(+240)	
2.4	Rated switching impulse withstand voltage between phase to ground	kV peak	1050	
2.5	Rated Power frequency withstand voltage (dry), 1 minute i) between phase to ground and between phases	kV	520	
	ii) across open switching device and/or isolating distance	kV	610	
2.6	Standard value of transient recovery voltage (T100)	kV	Insert	
2.7	Rate of rise recovery voltage	kV/µs	Insert	
2.8	Corona extinction voltage with CB open or close	kV rms	320	
2.9	Radio interference voltage for frequency between 0.5MHz and 2MHz	µV	1000	

No.	Description	Unit	Minimum Requirements	Guaranteed
	(at 1.1*Um/√3)			
2.10	Rated frequency fr	Hz	50	
2.11	Rated current Ir	A	4000	
2.12	Rated short-circuit breaking currents, Isc	kA rms	63	
	Three phase Symmetrical breaking currents at 400kV	kA rms	Insert	
	Three phase Asymmetrical breaking current at 400kV	kA rms	Insert	
	Single phase Symmetrical breaking current for line to ground	kA rms	Insert	
	Single phase Asymmetrical breaking current for line to ground	kA rms	Insert	
2.13	D.C. component of the rated short-circuit breaking current	%	> 50	
2.14	a) Duration of short-circuit	s	≥1	
2.15	Rated capacitive switching capability (breaking currents):			
	a) Line charging	A rms	Insert	
	b) Cable charging	A rms		
	c) Capacitor Bank breaking current	A rms		
	Rated inductive switching capability:	A	Insert	
	Small inductive Magnetizing current for Reactor	A	Suitable for 25 Mvar	
	Maximum switching surge per unit value	p.u		
2.16	Rated peak withstands current Ip	kA peak	157.5	
2.17	a) Rated out-of-phase breaking current	kA	Insert	
	b) Rated out-of-phase making current	kA	Insert	
2.18	Rated short line fault breaking current capability			
	a) Percentage of rated breaking current	%	Insert	
	b) Surge Impedance	Ohms	Insert	
	c) Amplitude factor		Insert	
	d) Critical percentage of rated breaking current	%	Insert	
	e) Maximum arc duration	ms	Insert	
2.19	First-pole-to-clear factor			
	a) Terminal fault	p.u.	1.3	
	b) Short-line fault	p.u.	1.0	
	c) Out-of-phase	p.u.	2.0	
2.20	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.21	Auto reclosing		1p+3p	
2.22	Maximum total break time (trip initiation to final arc extinction) (pos.3.7.135 acc.	ms	40	

No.	Description	Unit	Minimum Requirements	Guaranteed
	to IEC 62271-100)			
2.23	Closing time i. Without current ii. With 100 % rated breaking current	ms ms ms	70 Insert Insert	
2.24	Opening time (trip initiation to contact separation) i. With rated current ii. With 100 % rated breaking current	ms ms	Insert insert	
2.25	Maximum time interval between opening interrupters	ms	Insert	
2.26	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	Insert	
2.27	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.28	Minimum time for auto reclosing (dead time) i. Single phase ii. Three phase	ms ms	Insert insert	
2.29	Pole discrepancy for the closing operation of CB ie, Maximum difference in closing Time between first contact touch and Last phase to close.	ms	Insert	
2.30	Restrike performance during capacitive current switching	Class	C2	
2.31	Number of operations without maintenance a) CO at no-load		> 10000	
	b) CO at rated current		> 2500	
	c) CO at rated breaking current Isc		> 5	
2.32	The frequency of mechanical operations	Class	M2	
2.33	Rated electrical endurance	Class	E2	
2.34	Rated pressure of a circuit breaker	Mpa	Insert	
2.35	Total mass of SF6 gas in a circuit breaker	kg	Insert	
2.36	Rated mechanical terminal loads			
2.36.1	Static horizontal force, longitudinal Fth_A	N	≥ 1750	
2.36.2	Static horizontal force, transversal Fth_B	N	≥ 1250	
2.36.3	Static vertical force Ftv	N	> 1500	
2.36.4	Dynamic horizontal force, longitudinal Fwx	N	Insert	
2.36.5	Dynamic horizontal force, transversal	N	Insert	
2.37	Is circuit-breaker re-strike free	Yes/No	Insert	
2.38	Rated supply pressure of gas for interruption Maximum		Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
	Normal Minimum Low Pressure Alarm Lockout Alarm	MPa (g)		
2.39	Limits for correct operation Max Normal min	Mpa (g)	Insert	
2.40	Trip free/or fixed trip		Trip Free	
2.41	Is lockout facility fitted?	Yes/No	Insert	
2.42	Rated supply voltage of shunt opening release	V	Insert	
2.43	Current required at rated supply voltage to open circuit-breaker	A	Insert	
2.44	Maximum pressure rise in circuit breakers due to the making or breaking of rated current		Insert	
2.45	X/R ratio		Insert	
2.46	Number of successive auto-Reclosing operations without derating		Insert	
2.47	Number of close-open operations possible without recharging		Insert	
2.48	Whether anti pumping facility is provided in the Circuit breaker mechanism	Yes/No	Insert	
2.49	Type of transmission of mechanical energy from the operating mechanism to the interrupter unit i.e. whether single mechanism coupled to three phases or three independent mechanisms		Insert	
2.50	Spring Charging Time	ms	Insert	
2.51	Whether there is provision for manual spring charging.	Yes/No	Insert	
2.52	Whether facility to close / open the CB manually in the Absence of DC control supply to the operating mechanism	Yes/No	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min > 31	
3.1.2.1	Total creepage distance	mm	Insert	
3.1.3	HV terminal	pcs.	2	
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 200 x 100	
3.1.3.3	Number of holes		Min 8	
3.1.3.4	Dimensions of holes	mm	Insert	
3.1.3.5	Distance between holes	mm	Insert	
3.1.3.6	Material suitable for		Al terminal	
3.1.5	Weight and dimensions			
3.1.5.1	Support insulator height	mm	Insert	
3.1.5.2	Total height	mm	Insert	
3.1.5.3	Pole weight	kg	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.1.5.4	Weight of operating mechanism	kg	Insert	
3.1.5.5	Total weight (with metal structure)	kg	Insert	
3.1.6	Minimum distance			
3.1.6.1	Between poles	mm	Insert	
3.1.6.2	To ground	mm	Insert	
3.1.7	Degree of Protection for			
	(a) auxiliary circuits		Insert	
	(b) moving parts		Insert	
3.1.8	Minimum clearances in air:			
	(a) between phases	mm	Insert	
	(b) phases to earth	mm	Insert	
	(c) across interrupters	mm	Insert	
	(d) live parts to ground level	mm	Insert	
3.1.9	Length of each break	mm	Insert	
3.1.10	Length of stroke	mm	Insert	
3.2	Operating mechanism			
3.2.1	Type		Insert	
3.2.2	Motor - auxiliary supply voltage	V. AC	230/415	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Control voltage	V. DC	110	
3.2.5	Number of making coils	pcs.	1	
3.2.6	Rated power of making coils	W	Insert	
3.2.7	Number of breaking coils	pcs.	2	
3.2.8	Rated power of breaking coils	W	Insert	
3.2.9	Heater		Yes	
3.2.10	Heater supply voltage	V, Hz	230, 50	
3.2.11	Total heater power	W	Insert	
3.2.12	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.13	Water-tight corrosion-resistant housing		IP55	
3.2.14	Operating mechanism material		Al or stainless steel	
3.2.15	A crank for manual spring loading		Yes	
3.3	Accessories in central control panel			
3.3.1	Anti-pumping relay		Yes	
3.3.2	Local/remote control selector switch		Yes	
3.3.3	Local operation push buttons		Yes	
3.3.4	Minimum pressure lock-out and alarm relays		Yes	
3.3.5	Service outlet (socket) - 230 V, 50 Hz		Yes	
3.3.6	Lighting switch		Yes	
3.3.7	Lighting - 230 V, 50 Hz		Yes	
3.3.8	Heater - 230 V, 50 HZ		Yes	
3.3.9	Humidity Sensor-Hygrometer		Yes	
3.3.10	Operation counter		Yes	
3.3.11	Motor MCB (miniature circuit breakers) (for all operating mechanisms)		Yes	
3.3.12	Time phase discrepancy relay		Yes	
3.3.13	Weatherproof, corrosion resistance enclosure, Al or stainless steel		IP55	
3.3.14	Copper earthing rails inside central control cabinet		Yes	
3.3.15	Detachable plates, the bottom of central control cabinet		Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.3.16	Set of cables for connection of operating mechanism and central control panel of circuit breaker		Yes	
3.3.17	Galvanized horizontal and vertical metal structure with minimum 70 µm zinc layer		Yes	
4	**Pre-insertion resistor**			
4.1	Required		No	
4.2	Pre insertion Resistor (PIR) for 400kV	Ohm	NA	
4.3	Pre-insertion time	ms	NA	
5	**Control Switching Device (CSD)**			
5.1	Required		Yes	
5.2	Manufacturer's name and address		Insert	
5.3	Country of origin		EU/UK/USA/Japan	
5.4	Type		Insert	
5.5	Model No.		Insert	
5.6	Standard		BS 402	
			IEC 60255	
			IEC 61810	
5.7	Operation voltage	V	Insert	
6	**Others**			
6.1	Type test certificate date/reference	Required	Yes	
6.2	Period of time equipment has been in commercial operation	years	Insert	
6.3	Number of the same type of CB supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.1.2 Circuit Breaker 230kV (Not applicable)

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	**Circuit Breaker - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	
1.5	Standards		IEC 62271-100	
			IEC 60273	
			IEC 60694	
			IEC 60815	
			ISO 9001	
1.6	Quality control		ISO 14001	
			ISO 18001	
1.7	Isolating and quenching medium		SF6	
1.8	Type of circuit breaker		Outdoor	
1.9	Design		Gang breaking	
1.10	Operating mechanism			
	Closing type		Spring	
	Opening type		Spring	
1.11	Number of poles	pcs.	3 (1 per phase)	
1.12	Number of operating mechanisms per circuit breaker	pcs.	1	
2.	**Circuit Breaker - Characteristics**			
2.1	Nominal system voltage	kV rms	230	
2.2	Highest voltage for equipment Um	kV rms	245	
2.3	Rated lightning impulse withstand voltage i) between phase to ground and between phases	kV peak	1050	
	ii) between open switching device (interrupting chamber)	kV peak	Insert	
2.4	Rated Power frequency withstand voltage (dry), 1 minute i) between phase to ground and between phases	kV	460	
	ii) between open switching device (interrupting chamber)	kV	Insert	
2.5	Standard value of transient recovery voltage (T100)	kV	Insert	
2.6	Rate of rise recovery voltage	kV/µs	Insert	
2.7	Corona extinction voltage with CB open or close	kV rms	Insert	
2.8	Radio interference voltage for frequency	µV	1000	

No.	Description	Unit	Minimum Requirements	Guaranteed
	between 0.5MHz and 2MHz (at 1.1*Um/√3)			
2.9	Rated frequency fr	Hz	50	
2.10	Rated current Ir	A	3150	
2.11 2.12	Rated short-circuit breaking currents, Isc (equal to short circuit withstand current):	kA rms	50	
	Three phase Symmetrical breaking currents at 400kV	kA rms	Insert	
	Three phase Asymmetrical breaking current at 400kV	kA rms	Insert	
	Single phase Symmetrical breaking current for line to ground	kA rms	Insert	
	Single phase Asymmetrical breaking current for line to ground	kA rms	Insert	
2.13	D.C. component of the rated short-circuit breaking current	%	≥ 50	
2.13 2.14	a) Duration of short-circuit	s	≥1	
	b) Rated short time current for 1 second	kA	50	
	c) Rated short time current for 3 seconds	kA	Insert	
2.15	Rated capacitive switching capability (breaking currents):			
	a) Line charging	A rms	Insert	
	b) Cable charging	A rms		
	c) Capacitor Bank breaking current	A rms		
	Rated inductive switching capability:	A	Insert	
	Small inductive Magnetizing current for Reactor	A	Suitable for 25 Mvar	
2.16	a) Rated peak withstands current Ip	kA peak	125	
2.17	a) Rated out-of-phase breaking current	kA	Insert	
	b) Rated out-of-phase making current	kA	Insert	
2.18	Rated short line fault breaking current capability			
	a) Percentage of rated breaking current	%	Insert	
	b) Surge Impedance	Ohms	Insert	
	c) Amplitude factor		Insert	
	d) Critical percentage of rated breaking current	%	Insert	
	e) Maximum arc duration	ms	Insert	
2.19	First-pole-to-clear factor			
	a) Terminal fault	p.u.	1.3	
	b) Short-line fault	p.u.	1.0	
	c) Out-of-phase	p.u.	2.0	
2.20	Rated operating sequence		O-0.3s-CO-3min-CO	
2.21	Auto reclosing		3p	
2.22	Maximum total break time (trip initiation to final arc extinction) (pos.3.7.135 acc.	ms	60	

No.	Description	Unit	Minimum Requirements	Guaranteed
	to IEC 62271-100)			
2.23	Closing time i. Without current ii. With 100 % rated breaking current	ms ms ms	100 Insert Insert	
2.24	Opening time (trip initiation to contact separation) i. Without current ii. With 100 % rated breaking current	ms ms	Insert insert	
2.25	Maximum time interval between opening interrupters	ms	Insert	
2.26	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	Insert	
2.27	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.28	Minimum time for auto reclosing (dead time) i. Single phase ii. Three phase	ms ms	Insert insert	
2.29	Pole discrepancy for the closing operation of CB ie, Maximum difference in closing Time between first contact touch and Last phase to close.	ms	Insert	
2.30	Restrike performance during capacitive current switching	Class	C2	
2.31	Number of operations without maintenance a) CO at no-load		> 10000	
	b) CO at rated current		> 2500	
	c) CO at rated breaking current Isc		> 5	
2.32	The frequency of mechanical operations	Class	M2	
2.33	Rated electrical endurance	Class	E2	
2.34	Rated pressure of a circuit breaker	Mpa	Insert	
2.35	Total mass of SF6 gas in a circuit breaker	kg	Insert	
2.36	Rated mechanical terminal loads			
2.36.1	Static horizontal force, longitudinal Fth_A	N	≥ 1750	
2.36.2	Static horizontal force, transversal Fth_B	N	≥ 1250	
2.36.3	Static vertical force Ftv	N	> 1500	
2.36.4	Dynamic horizontal force, longitudinal Fwx	N	Insert	
2.36.5	Dynamic horizontal force, transversal	N	Insert	
2.37	Is circuit-breaker re-strike free	Yes/No	Insert	
2.38	Rated supply pressure of gas for interruption Maximum Normal	MPa	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
	Minimum Low Pressure Alarm Lockout Alarm	(g)		
2.39	Limits for correct operation Max Normal min	Mpa (g)	Insert	
2.40	Trip free/or fixed trip		Trip Free	
2.41	Is lockout facility fitted?	Yes/No	Insert	
2.42	Rated supply voltage of shunt opening release	V	Insert	
2.43	Current required at rated supply voltage to open circuit-breaker	A	Insert	
2.44	Maximum pressure rise in circuit breakers due to the making or breaking of rated current		Insert	
2.45	X/R ratio		Insert	
2.46	Number of successive auto-Reclosing operations without derating		Insert	
2.47	Number of close-open operations possible without recharging		O-CO	
2.48	Whether anti pumping facility is provided in the Circuit breaker mechanism	Yes/No	Insert	
2.49	Type of transmission of mechanical energy from the operating mechanism to the interrupter unit i.e. whether single mechanism coupled to three phases or three independent mechanisms		Insert	
2.50	Whether there is provision for manual spring charging. (in case of hydraulic manual operation to build oil pressure)	Yes/No	Insert	
2.51	Whether facility to close / open the CB manually in the Absence of DC control supply to the operating mechanism	Yes/No	Insert	
2.52	Whether suitable facility is available for bleeding the hydraulic Circuit in order to remove the trapped gas if any in the Hydraulic mechanism	Yes/No	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min > 31	
3.1.2.1	Total creepage distance	mm	Insert	
3.1.3	HV terminal	pcs.	2	
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 100 x 100	
3.1.3.3	Number of holes		Min 4	
3.1.3.4	Dimensions of holes	mm	Insert	
3.1.3.5	Distance between holes	mm	Insert	
3.1.3.6	Material suitable for		Al terminal	
3.1.5	Weight and dimensions			
3.1.5.1	Support insulator height	mm	Insert	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.1.5.2	Total height	mm	Insert	
3.1.5.3	Pole weight	kg	Insert	
3.1.5.4	Weight of operating mechanism	kg	Insert	
3.1.5.5	Total weight (with metal structure)	kg	Insert	
3.1.6	Minimum distance			
3.1.6.1	Between poles	mm	Insert	
3.1.6.2	To ground	mm	Insert	
3.1.7	Degree of Protection for			
	(a) auxiliary circuits		Insert	
	(b) moving parts		Insert	
3.1.8	Minimum clearances in air:			
	(a) between phases	mm	Insert	
	(b) phases to earth	mm	Insert	
	(c) across interrupters	mm	Insert	
	(d) live parts to ground level	mm	Insert	
3.1.9	Length of each break	mm	Insert	
3.1.10	Length of stroke	mm	Insert	
3.2	Operating mechanism			
3.2.1	Type		Insert	
3.2.2	Motor - auxiliary supply voltage	V. AC	230/415	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Control voltage	V. DC	220	
3.2.5	Number of making coils	pcs.	1	
3.2.6	Rated power of making coils	W	Insert	
3.2.7	Number of breaking coils	pcs.	2	
3.2.8	Rated power of breaking coils	W	Insert	
3.2.9	Heater		Yes	
3.2.10	Heater supply voltage	V. Hz	230. 50	
3.2.11	Total heater power	W	Insert	
3.2.12	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.13	Water-tight corrosion-resistant housing		IP55	
3.2.14	Operating mechanism material		Al or stainless steel	
3.2.15	A crank for manual spring loading		Yes	
3.3	Accessories in central control panel			
3.3.1	Anti-pumping relay		Yes	
3.3.2	Local/remote control selector switch		Yes	
3.3.3	Local operation push buttons		Yes	
3.3.4	Minimum pressure lock-out and alarm relays		Yes	
3.3.5	Service outlet (socket) - 230 V, 50 Hz		Yes	
3.3.6	Lighting switch		Yes	
3.3.7	Lighting - 230 V, 50 Hz		Yes	
3.3.8	Heater - 230 V, 50 HZ		Yes	
3.3.9	Operation counter		Yes	
3.3.10	Motor MCB (miniature circuit breakers) (for all operating mechanisms)		Yes	
3.3.11	Time phase discrepancy relay		Yes	
3.3.12	Weatherproof, corrosion resistance enclosure, Al or stainless steel		IP55	
3.3.13	Cu earthing rails inside central control cabinet		Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
3.3.14	Detachable plates, the bottom of central control cabinet		Yes	
3.3.15	Set of cables for connection of operating mechanism and central control panel of circuit breaker		Yes	
3.3.16	Galvanized horizontal and vertical metal structure with minimum 70 |jm zinc layer		Yes	
4	**Pre-insertion resistor**			
4.1	Pre insertion Resistor (PIR) for 230kV	Ohm	N/A	
4.2	Pre-insertion time	ms	N/A	
5	**Control Switching Device (CSD)**			
5.1	Manufacturer's name and address		N/A	
5.2	Country of origin		N/A	
5.3	Type		N/A	
5.4	Model No.		N/A	
5.5	Standard		N/A	
			N/A	
			N/A	
5.6	Operation voltage	V	N/A	
6	**Others**			
6.1	Type test certificate date/reference	Required	Yes	
6.2	Period of time equipment has been in commercial operation	years	Insert	
6.3	Number of the same type of disconnectors supplied to date	Nos.	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.1.3 Circuit Breaker 132kV (For Tr. Bay) (Not applicable)

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
1.	**Circuit Breaker - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	
1.5	Made in		EU/UK/USA/Japan	
1.6	Standards		IEC 62271-100, 60273, 60694, 60815	
1.7	Quality control		ISO 9001, 14001	
1.8	Isolating and quenching medium		SF_6	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
1.9	Type of circuit breaker		Outdoor	
1.10	Design		Gang breaking	
1.11	Operating mechanism		Motor-wound spring	
1.12	Number of poles	pcs.	3	
1.13	Number of operating mechanisms per circuit breaker	pcs.	1(Gang operation)	
2.	**Circuit Breaker - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	132	
2.2	Highest voltage for equipment U_n	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	
2.4	Rated short duration power frequency voltage	kV	275	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	3150A	
2.7	Rated short-circuit breaking current I_{sc}	kA_{rms}	40kA	
2.8	Rated peak withstand current I_p (equal short-circuit making current)	kA	100kA	
2.9	D.C. component of the rated short-circuit breaking current	%	> 30	
2.10	First-pole-to-clear factor • Terminal fault • Short-line fault • Out-of-phase	 p.u. p.u. p.u.	 1.3 1.0 2.0	
2.11	Radio interference voltage	Micro volt	<1000 μV at 1.1Um/ sqrt(3)	
2.12	Standard value of transient recovery voltage (T100)	kV	Insert	
2.13	Rate of rise recovery voltage	kV/μs	Insert	
2.14	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.15	Duration of short-circuit	s	≥1	
2.16	Rated out-of-phase breaking current	kA	Insert	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
2.17	Auto reclosing		Not applicable	
2.18	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤sxi	
2.19	Time of final arc extinction (3.7.134 acc. IEC 62271-100)	ms	20 ± 5	
2.20	Opening time (trip initiation to contact separation) • Without current • With 100 % rated breaking current	ms ms	Insert Insert	
2.21	Length of each break			
2.22	Length of stroke (at the measuring point)			
2.23	Maximum time interval between opening interrupters	ms	Insert	
2.24	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	3	
2.25	Time for making (close initiation to contact touch) • Without current • 100 % making current	ms ms	Insert Insert	
2.26	Minimum dead time	ms	Insert	
2.27	Restrike performance during capacitive current switching	Class	C2	
2.28	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		≥O at r ≥at r ≥at	
2.29	The frequency of mechanical operations	Class	M2	
2.30	Rated electrical endurance	Class	Min E1	
2.31	Rated pressure of a circuit breaker	Mpa	Insert	
2.32	Limits of gas pressure at 20°C			
	Maximum	Mpa		
	Minimum	Mpa		
2.33	Guaranteed maximum gas leakage	% per year		

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
2. 34	Total mass of SF_6 gas in a circuit breaker	kg	Insert	
2.35	Rated mechanical terminal loads			
2.35.1	Static horizontal force, longitudinal F_{thA}	N	Insert	
2.35.2	Static horizontal force, transversal F_{thB}	N	Insert	
2.35.3	Static vertical force F_{tv}	N	Insert	
2.35.4	Dynamic horizontal force, longitudinal F_{wx}	N	Insert	
2.35.5	Dynamic horizontal force, transversal	N	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Class of Insulation			
3.1.3	Material of contact surfaces primary arcing			
3.1.4	Wall thickness of interrupter chamber	mm		
3.1.5	Minimum creepage distance	mm/kV	Min. um31	
3.1.6	HV terminal	Pcs/ckt	2	
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	insert	
3.1.6.6	Material suitable for		Al terminal	
3.1.7	**Weight and dimensions**			
3.1.7.1	Support insulator height	mm	Insert	
3.1.7.2	Total height	mm	Insert	
3.1.7.3	Pole weight	kg	Insert	
3.1.7.4	Weight of operating mechanism	kg	Insert	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
3.1.7.5	Total weight (with metal structure) of CB	kg	Insert	
3.1.7	Minimum clearance			
3.1.7.1	Between poles	mm	Insert	
3.1.7.2	To ground	mm	Insert	
3.2	**Operating mechanism**			
3.2.1	Operating mechanism Manufacturer			
3.2.2	Type		Insert	
3.2.3	Is lockout facility fitted ?	Yes/No	Yes	
3.2.4	Motor - auxiliary supply voltage	V, Hz	230, 50	
3.2.5	Rated power of motor	W	Insert	
3.2.6	Control voltage	V. DC	110	
3.2.7	Number of making coils	pcs.	1	
3.2.8	Rated power of making coils	W	Insert	
3.2.9	Number of breaking coils	pcs.	2	
3.2.10	Rated power of breaking coils	W	Insert	
3.2.11	Heater		Yes	
3.2.12	Heater supply voltage	V, Hz	230,50	
3.2.13	Total heater power	W	Insert	
3.2.14	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.15	Water-tight corrosion-resistant housing		IP55	
3.2.16	Operating mechanism material		insert	
3.2.17	A crank for manual spring loading		Yes	
3.3	**Accessories in central control panel**			
3.3.1	Anti-pumping relay		Yes	
3.3.2	Local/remote control selector switch		Yes	
3.3.3	Local operation push buttons		Yes	
3.3.4	Minimum pressure lock-out and alarm relays		Yes	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
3.3.5	Service outlet (socket) - 230 V, 50 Hz,13A		Yes	
3.3.6	Lighting switch		Yes	
3.3.7	Lighting - 230 V, 50 Hz		Yes	
3.3.8	Heater - 230 V, 50 HZ		Yes	
3.3.9	Operation counter		Yes	
3.3.10	Motor MCB (miniature circuit breakers) (for all operating mechanisms)		Yes	
3.3.11	Time phase discrepancy relay		Yes	
3.3.12	Weather proof, corrosion resistance enclosure, Al or stainless steel		IP55	
3.3.13	Cu earthing rails inside central control cabinet		Yes	
3.3.14	Detachable plates, the bottom of central control cabinet		Yes	
3.3.15	Set of cables for connection of operating mechanism and central control panel of circuit breaker		Yes	
3.3.16	Galvanized horizontal and vertical metal structure with minimum 85 µm zinc layer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.4 Circuit Breaker 132kV (For Line Bay) (Not applicable)

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
1.	**Circuit Breaker - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
1.5	Made in		EU/UK/USA/Japan	
1.6	Standards		IEC 62271-100, 60273, 60694, 60815	
1.7	Quality control		ISO 9001, 14001	
1.8	Isolating and quenching medium		SF_6	
1.9	Type of circuit breaker		Outdoor	
1.10	Design		Single breaking	
1.11	Operating mechanism		Motor-wound spring	
1.12	Number of poles	pcs.	3	
1.13	Number of operating mechanisms per circuit breaker	pcs.	3 (Single/Individual operation)	
2.	**Circuit Breaker – Characteristics**			
2.1	Nominal system voltage	kV_{rms}	132	
2.2	Highest voltage for equipment U_n	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	
2.4	Rated short duration power frequency voltage	kV	275	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	3150A	
2.7	Rated short-circuit breaking current I_{sc}	kA_{rms}	40kA	
2.8	Rated peak withstand current I_p (equal short-circuit making current)	kA	100kA	
2.9	D.C. component of the rated short-circuit breaking current	%	> 30	
2.10	First-pole-to-clear factor • Terminal fault • Short-line fault • Out-of-phase	 p.u. p.u. p.u.	 1.5 1.0 2.0	
2.11	Radio interference voltage	Micro volt	<1000 µV at 1.1Um/ sqrt(3)	
2.12	Standard value of transient recovery voltage (T100)	kV	Insert	
2.13	Rate of rise recovery voltage	kV/µs	Insert	
2.14	Rated operating sequence		O-0.3 s-CO-3 min-CO	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
2.15	Duration of short-circuit	s	≥1	
2.16	Rated out-of-phase breaking current	kA	Insert	
2.17	Auto reclosing		1p + 3p	
2.18	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤sxi	
2.19	Time of final arc extinction (3.7.134 acc. IEC 62271-100)	ms	20 ± 5	
2.20	Opening time (trip initiation to contact separation) • Without current • With 100 % rated breaking current	ms ms	Insert Insert	
2.21	Length of each break			
2.22	Length of stroke (at the measuring point)			
2.23	Maximum time interval between opening interrupters	ms	Insert	
2.24	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	3	
2.25	Time for making (close initiation to contact touch) • Without current • 100 % making current	ms ms	Insert Insert	
2.26	Minimum dead time	ms	Insert	
2.27	Restrike performance during capacitive current switching	Class	C2	
2.28	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		≥O at r ≥at r ≥at	
2.29	The frequency of mechanical operations	Class	M2	
2.30	Rated electrical endurance	Class	Min E1	
2.31	Rated pressure of a circuit breaker	Mpa	Insert	
2.32	Limits of gas pressure at 20°C			
	Maximum	Mpa		

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
	Minimum	Mpa		
2.33	Guaranteed maximum gas leakage	% per year		
2. 34	Total mass of SF_6 gas in a circuit breaker	kg	Insert	
2.35	Rated mechanical terminal loads			
2.35.1	Static horizontal force, longitudinal F_{thA}	N	Insert	
2.35.2	Static horizontal force, transversal F_{thB}	N	Insert	
2.35.3	Static vertical force F_{tv}	N	Insert	
2.35.4	Dynamic horizontal force, longitudinal F_{wx}	N	Insert	
2.35.5	Dynamic horizontal force, transversal	N	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Class of Insulation			
3.1.3	Material of contact surfaces primary arcing			
3.1.4	Wall thickness of interrupter chamber	mm		
3.1.5	Minimum creepage distance	mm/kV	Min. um31	
3.1.6	HV terminal	Pcs/ckt	2	
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	insert	
3.1.6.6	Material suitable for		Al terminal	
3.1.7	**Weight and dimensions**			
3.1.7.1	Support insulator height	mm	Insert	
3.1.7.2	Total height	mm	Insert	
3.1.7.3	Pole weight	kg	Insert	
3.1.7.4	Weight of operating mechanism	kg	Insert	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
3.1.7.5	Total weight (with metal structure) of CB	kg	Insert	
3.1.7	Minimum clearance			
3.1.7.1	Between poles	mm	Insert	
3.1.7.2	To ground	mm	Insert	
3.2	**Operating mechanism**			
3.2.1	Operating mechanism Manufacturer			
3.2.2	Type		Insert	
3.2.3	Is lockout facility fitted ?	Yes/No	Yes	
3.2.4	Motor - auxiliary supply voltage	V, Hz	230, 50	
3.2.5	Rated power of motor	W	Insert	
3.2.6	Control voltage	V. DC	110	
3.2.7	Number of making coils	pcs.	1	
3.2.8	Rated power of making coils	W	Insert	
3.2.9	Number of breaking coils	pcs.	2	
3.2.10	Rated power of breaking coils	W	Insert	
3.2.11	Heater		Yes	
3.2.12	Heater supply voltage	V, Hz	230,50	
3.2.13	Total heater power	W	Insert	
3.2.14	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.15	Water-tight corrosion-resistant housing		IP55	
3.2.16	Operating mechanism material		insert	
3.2.17	A crank for manual spring loading		Yes	
3.3	**Accessories in central control panel**			
3.3.1	Anti-pumping relay		Yes	
3.3.2	Local/remote control selector switch		Yes	
3.3.3	Local operation push buttons		Yes	
3.3.4	Minimum pressure lock-out and alarm relays		Yes	

No.	Description	Minimum Requirement		Guaranteed
		Unit	Data	
3.3.5	Service outlet (socket) - 230 V, 50 Hz,13A		Yes	
3.3.6	Lighting switch		Yes	
3.3.7	Lighting - 230 V, 50 Hz		Yes	
3.3.8	Heater - 230 V, 50 HZ		Yes	
3.3.9	Operation counter		Yes	
3.3.10	Motor MCB (miniature circuit breakers) (for all operating mechanisms)		Yes	
3.3.11	Time phase discrepancy relay		Yes	
3.3.12	Weather proof, corrosion resistance enclosure, Al or stainless steel		IP55	
3.3.13	Cu earthing rails inside central control cabinet		Yes	
3.3.14	Detachable plates, the bottom of central control cabinet		Yes	
3.3.15	Set of cables for connection of operating mechanism and central control panel of circuit breaker		Yes	
3.3.16	Galvanized horizontal and vertical metal structure with minimum 85 µm zinc layer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.5 Disconnector 400kV without Earthing Switch (Not applicable)

1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU/ Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	

1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Three column Double break with horizontal motion only	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven	
1.11	Number of main blade operating mechanisms	pcs.	3	
1.12	Type of earthing blade operating mechanism		**Not applicable**	
1.13	Number of earthing blade operating mechanism		**Not applicable**	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment U_n	kV rms	420	
2.3	Rated lightning impulse withstand voltage	kV peak	1425	
2.4	Rated switching impulse withstand voltage between phase to ground	kV peak	1050	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥ 4000	
2.7	Rated short withstand current I_k	kA rms	≥ 63	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	**Not applicable**	
2.10	Rated peak withstand current Ip	kA	≥ 157.5	
2.11	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V DC	110	
2.12.2	Motor - auxiliary supply voltage		415 / 50	
2.12.3	Heaters	V AC / Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Mechanical endurance	Class	M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static Fa	N	>2000	
2.16.2	Transversal loading, static F_b	N	>660	
2.16.3	Vertical force F_c	N	>1500	
2.16.4	Direct loading, dynamic	N	>4500	

2.16.5	Transversal loading, dynamic	N	Insert	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/ EU /Japan	
3.1.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 200 x 100	
3.1.6.3	Number of holes		Min 8	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanized	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			
3.1.9.1	Pole height	mm	Insert	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	3	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	

3.2.9	Manual closing button		Yes	
3.2.10	Manual opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.6 Disconnector 400kV with Earthing Switch (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU /Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Three column Double break with horizontal motion only	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven	
1.11	Number of main blade operating mechanisms	pcs.	3	
1.12	Type of earthing blade operating mechanism		Motor driven	
1.13	Number of earthing blade operating mechanism		3	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	400	
2.2	Highest voltage for equipment U_n	kV_{rms}	420	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	1425	
2.4	Rated switching impulse withstand voltage between phase to ground	kV_{peak}	1050	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥a4000	
2.7	Rated short-time withstand current I_k	kA rms	≥ 63	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	≥1	
2.10	Rated peak withstand current Ip	kA	≥ 157.5	
2.11	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V DC	110	
2.12.2	Motor - auxiliary supply voltage	V AC, 3Φ / Hz	415 / 50	
2.12.3	Heaters	V AC/Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Mechanical endurance	Class	M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static Fa	N	>2000	
2.16.2	Transversal loading, static F_b	N	>660	
2.16.3	Vertical force F_c	N	>1500	
2.16.4	Direct loading, dynamic	N	>4500	
2.16.5	Transversal loading, dynamic	N	Insert	
2.17	Induced current switching capability of earthing switch		Class B	
2.18	Rated electrical endurance class of earthing switch		E1	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/EU /Japan	
3.1.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 200 x 100	
3.1.6.3	Number of holes		Min 8	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanize d	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			
3.1.9.1	Pole height	mm	Insert	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	3 + 3	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts for Main Switch (NO/NC/V)		12NO+12NC+1V	
	Minimum number of available contacts for Earthing Switch (NO/NC/V)		6NO+6NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	
3.2.9	Manual closing button		Yes	
3.2.10	Manual opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Mechanical Interlock between disconnector and earthing switch		Yes	
3.2.20	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.7 Disconnector 230kV without Earthing Switch (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU/Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Center break	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven + manual hand driven	
1.11	Number of main blade operating mechanisms	pcs.	1	
1.12	Type of earthing blade operating mechanism		Not applicable	
1.13	Number of earthing blade operating mechanism		Not applicable	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	230	
2.2	Highest voltage for equipment U_n	kV_{rms}	245	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	1050	
2.4	Rated short duration power frequency voltage	kV	460	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥ 3150	
2.7	Rated short-time withstand current I_k	kA_{rms}	≥ 50	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	Not applicable	
2.10	Rated peak withstand current Ip	kA	≥ 125	
2.11	Capacity of making and breaking transfer load of busbar system at 300V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V DC	220	
2.12.2	Motor - auxiliary supply voltage	V AC, 3Φ / Hz	415 / 50	
2.12.3	Heaters	V AC/Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Rated mechanical endurance class		M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static F_a	N	> 1000	
2.16.2	Transversal loading, static F_b	N	> 330	
2.16.3	Vertical force F_c	N	> 1250	
2.16.4	Direct loading, dynamic	N	> 4500	
2.16.5	Transversal loading, dynamic	N	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/EU /Japan	
3.1.3	Minimum creepage distance	mm/kV	≥ 31	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x m m	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanized	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			
3.1.9.1	Pole height	mm	Insert	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	1	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	
3.2.9	Local closing button		Yes	
3.2.10	Local opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Crank for manual hand operation		Yes	
3.2.20	Interlock between manual hand operation and motor		Yes	
3.2.21	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.8 Disconnector 230kV with Earthing Switch (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU/ Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Center break	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven + manual hand driven	
1.11	Number of main blade operating mechanisms	pcs.	1	
1.12	Type of earthing blade operating mechanism		Motor driven + manual hand driven	
1.13	Number of earthing blade operating mechanism		1	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	230	
2.2	Highest voltage for equipment U_n	kV_{rms}	245	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	1050	
2.4	Rated short duration power frequency voltage	kV	460	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥ 3150	
2.7	Rated short-time withstand current I_k	kA_{rms}	≥ 50	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	≥1	
2.10	Rated peak withstand current Ip	kA	≥ 125	
2.11	Capacity of making and breaking transfer load of busbar system at 300V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V d.c.	220	
2.12.2	Motor - auxiliary supply voltage	V AC, 3Φ / Hz	415 / 50	
2.12.3	Heaters	V a.c./Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Rated mechanical endurance class		M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static F_a	N	> 1000	
2.16.2	Transversal loading, static F_b	N	> 330	
2.16.3	Vertical force F_c	N	> 1250	
2.16.4	Direct loading, dynamic	N	> 4500	
2.16.5	Transversal loading, dynamic	N	Insert	
2.17	Induced current switching capability of earthing switch		Class A	
2.18	Rated electrical endurance class of earthing switch		E1	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/EU/ Japan	
3.1.3	Minimum creepage distance	mm/kV	≥ 31	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x m m	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanize d	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			
3.1.9.1	Pole height	mm	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	1+1	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts for Main Switch (NO/NC/V)		12NO+12NC+1V	
	Minimum number of available contacts for Earthing Switch (NO/NC/V)		6NO+6NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	
3.2.9	Local closing button		Yes	
3.2.10	Local opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Crank for manual hand operation		Yes	
3.2.20	Interlock between manual hand operation and motor		Yes	
3.2.21	Mechanical Interlock between disconnector and earthing switch		Yes	
3.2.22	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.9 Disconnector 132kV without earthing switch (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU /Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Center break	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven + manual hand driven	
1.11	Number of main blade operating mechanisms	pcs.	1	
1.12	Type of earthing blade operating mechanism		**Not applicable**	
1.13	Number of earthing blade operating mechanism		**Not applicable**	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	132	
2.2	Highest voltage for equipment U_n	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	
2.4	Rated short duration power frequency voltage	kV	275	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	**≥ 3150**	
2.7	Rated short-time withstand current I_k	kA_{rms}	≥ 40	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	**Not applicable**	
2.10	Rated peak withstand current Ip	kA	≥ 100	
2.11	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V d.c.	110	
2.12.2	Motor - auxiliary supply voltage	V AC, 3Φ / Hz	415 / 50	
2.12.3	Heaters	V a.c. / Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Mechanical endurance	Class	M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static Fa	N	> 500	
2.16.2	Transversal loading, static F_b	N	> 170	
2.16.3	Vertical force F_c	N	> 1000	
2.16.4	Direct loading, dynamic	N	> 1500	
2.16.5	Transversal loading, dynamic	N	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/EU/Japan	
3.1.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanize d	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			
3.1.9.1	Pole height	mm	Insert	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	**1**	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts (NO/NC/V)		12NO+12NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	
3.2.9	Manual closing button		Yes	
3.2.10	Manual opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Crank for manual hand operation		Yes	
3.2.20	Interlock between manual hand operation and motor		Yes	
3.2.21	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.10 Disconnector 132kV with earthing switch (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin & Manufacturing		USA/UK/EU/Japan	
1.5	Standards		IEC 62271-1 IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		center break	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Motor driven + manual hand driven	
1.11	Number of main blade operating mechanisms	pcs.	1	
1.12	Type of earthing blade operating mechanism		Motor driven + manual hand driven	
1.13	Number of earthing blade operating mechanism		**1**	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	132	
2.2	Highest voltage for equipment U_n	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	
2.4	Rated short duration power frequency voltage	kV	275	
2.5	Rated frequency f_r	Hz	50	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.6	Rated current I_r	A	**≥ 3150**	
2.7	Rated short-time withstand current I_k	kA $_{rms}$	≥ 40	
2.8	Rated duration of short-circuit on main blades	s	≥1	
2.9	Rated duration of short-circuit on earthing blades	s	≥**1**	
2.10	Rated peak withstand current Ip	kA	≥ 100	
2.11	Capacity of making and breaking transfer load of busbar system at 300 V (rms)	A	1600	
2.12	Nominal supply voltage			
2.12.1	Controls and alarm (signalling) circuits	V DC	110	
2.12.2	Motor - auxiliary supply voltage	V AC, 3Φ / Hz	415 / 50	
2.12.3	Heaters	V AC/Hz	230 / 50	
2.13	Opening time	s	Insert	
2.14	Closing time	s	Insert	
2.15	Mechanical endurance	Class	M2	
2.16	Rated mechanical terminal loads of terminals			
2.16.1	Direct loading, static Fa	N	> 500	
2.16.2	Transversal loading, static F_b	N	> 170	
2.16.3	Vertical force F_c	N	> 1000	
2.16.4	Direct loading, dynamic	N	> 1500	
2.16.5	Transversal loading, dynamic	N	Insert	
2.17	Induced current switching capability of earthing switch		Class A	
2.18	Rated electrical endurance class of earthing switch		E1	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain, brown	
3.1.2	Country of make of insulator		USA/UK/EU /Japan	
3.1.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.4	Quality of insulator		Min. C130	
3.1.5	Rated failing load of insulator (C10)	N	Min. 10000	
3.1.6	HV terminals			
3.1.6.1	Shape		Flat	
3.1.6.2	Dimensions	mm x mm	Min 100 x 100	
3.1.6.3	Number of holes		Min 4	
3.1.6.4	Dimensions of holes	mm	Ø 14	
3.1.6.5	Distance between holes	mm	50	
3.1.6.6	Material suitable for		Al terminal	
3.1.6.7	Country of make of main contacts		Same as the manufacturer of disconnector	
3.1.7	Steel parts of the disconnector		Hot-dip galvanize d	
3.1.8	Self-lubricating hinges and linkage of rods		Yes	
3.1.9	Weight and dimensions			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.1.9.1	Pole height	mm	Insert	
3.1.9.2	Support insulator height	mm	Insert	
3.1.9.3	Total height	mm	Insert	
3.1.9.4	Pole length	mm	Insert	
3.1.9.5	Distance between support axis of a pole	mm	Insert	
3.1.9.6	Shipping dimensions	mm	Insert	
3.1.9.7	Pole weight	kg	Insert	
3.1.9.8	Weight of operating mechanism	kg	Insert	
3.1.9.9	Total weight	kg	Insert	
3.1.9.10	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	**1+1**	
3.2.2	Type		Insert	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Total heater power	W	Insert	
3.2.5	Minimum number of available contacts for Main Switch (NO/NC/V)		12NO+12NC+1V	
	Minimum number of available contacts for Earthing Switch (NO/NC/V)		6NO+6NC+1V	
3.2.6	Heater, 230 V, 50 Hz		Yes	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Selection switch (local/neutral/remote)		Yes	
3.2.9	Manual closing button		Yes	
3.2.10	Manual opening button		Yes	
3.2.11	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.12	Single-phase socket		Yes	
3.2.13	Voltage presence controller		Yes	
3.2.14	Motor MCB (miniature circuit breakers)		Yes	
3.2.15	Heater MCB (miniature circuit breaker)		Yes	
3.2.16	Single-phase socket MCB (miniature circuit breaker)		Yes	
3.2.17	Equipotential bonding rails		Yes	
3.2.18	Housing of Al or stainless steel		Yes	
3.2.19	Crank for manual hand operation		Yes	
3.2.20	Interlock between manual hand operation and motor		Yes	
3.2.21	Mechanical Interlock between disconnector and earthing switch		Yes	
3.2.22	Dead centre interlocking of operating mechanisms		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.11 Current Transformer 400kV (Not applicable)

No.	Particulars	Minimum Requirements		Guaranteed
		Unit	Data	

No.	Particulars	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Current Transformer-General**			
a)	Manufacturer		*Insert*	
b)	Country of Manufacturing		*Insert*	
c)	Type		Post type, Single Phase, Free Standing, Oil immersed. Construction- Hairpin / Eye-bolt - Top core	
d)	Model designation		*Insert*	
e)	Country of origin		UK/USA/EU/Japan/ Turkey	
f)	Country of manufacturer			
g)	Standards		IEC 61869-1 IEC 61869-2	
h)	Quality control		ISO 9001	
i)	Type		Outdoor	
j)	Shape/Design		Live tank type/ Dead tank type	
k)	sealing		Hermetically closed	
l)	Service Condition: Ambient air temperature	°C	-5 to +45	
m)	Service Condition: Altitude	m	≤1000	
n)	Service Condition: System Earhing		Effectively earthed	
o)	Service Condition: Seismic Condition	g	0.1	
2.	**Current Transformers- Characteristics**			
2.1.	Nominal system voltage	kV_{rms}	400	
2.2.	Highest voltage for equipment U_n	kV_{rms}	420	
2.3.	Rated Lightning impulse withstand voltage	kV_{peak}	1425	
2.4.	Rated Switching impulse withstand voltage	kV_{peak}	1050	
2.5.	Rated Power frequency withstand voltage	kV	630	
2.6.	Rated frequency f_r	Hz	50	
2.7.	Rated short-time thermal current Ith, 1s	kA	63	
2.8.	Rated dynamic current I_{dyn}	kA	157.5	
2.9.1	Rated primary current	A	3200-1600-800	
2.9.2	Rated secondary current	A	1	

No.	Particulars	Minimum Requirements		Guaranteed
		Unit	Data	
2.9.3	Primary reconnection		No	
2.10.	Electrical dissipation factor at power frequency test voltage		*insert*	
2.11.	Capacitance	pF	*insert*	
2.12.	Maximum Allowable winding temperature	°C	Insert	
2.13.	Normal current density of primary winding		Insert	
2.14.	Rated continuous thermal current (40°C): • I core • II core • III core • IV core • V core • VI core	 % In % In % In % In % In % In	 150 150 120 120 120 120	
2.15.	Rated transformer ratio: • I core • II core • III core • IV core • V core • VI core	 A/A A/A A/A A/A A/A A/A	 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1	
2.16.	Instrument Security Factor (ISF) • I core • II core		 Fs=5 Fs=5	
2.17.	Accuracy class and Accuracy Limit Factor (ALF): • I core • II core • III core • IV core • V core • VI core		 0.2S 0.2S 5P20 5P20 5P20 5P20	
2.18.	Rated power • I core • II core • III core • IV core • V core • VI core	 VA VA VA VA VA VA	 15 15 30 30 30 30	
2.19.	Rated Knee Point Voltage, V_k(Min) at highest ratio • I core • II core • III core	 Volts Volts Volts Volts	 *Insert* *Insert* *Insert* *Insert*	

No.	Particulars	Minimum Requirements		Guaranteed
		Unit	Data	
	• IV core • V core • VI core	Volts Volts	*Insert* *Insert*	
2.20.	Max. magnetizing current guaranteed at knee point voltage and highest ratio • I core • II core • III core • IV core • V core • VI core	mA mA mA mA mA mA	*Insert* *Insert* *Insert* *Insert* *Insert* *Insert*	
2.21.	Max. magnetizing current guaranteed at half of knee point voltage ($V_k/2$), I_{Exc} at highest ratio • I core • II core • III core • IV core • V core • VI core	mA mA mA mA mA mA	*Insert* *Insert* *Insert* *Insert* *Insert* *Insert*	
2.22.	Max. magnetizing current guaranteed at quarter of knee point voltage ($V_k/4$), I_{Exc} at highest ratio • I core • II core • III core • IV core • V core • VI core	mA mA mA mA mA mA	*Insert* *Insert* *Insert* *Insert* *Insert* *Insert*	
2.23.	Max. resistance of primary winding at 75^0C , RCT for each rating: • I core • II core • III core • IV core • V core • VI core	Ohms Ohms Ohms Ohms Ohms Ohms	*Insert* *Insert* *Insert* *Insert* *Insert* *Insert*	
2.24.	Max. resistance of secondary winding at 75 ^{0}C, RCT for each rating: • I core • II core • III core • IV core • V core • VI core	Ohms Ohms Ohms Ohms Ohms Ohms	*Insert* *Insert* *Insert* *Insert* *Insert* *Insert*	
2.25.	Rated mechanical terminal loads	class	Min. Class II	
3.	**Current Transformers - Design and Construction**			
3.1	Insulator material		Porcelain, brown glaze	
3.2.1	Insulating medium		Oil-paper	

No.	Particulars	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.2	Type including Brand		*Insert*	
3.2.3	Quantity of insulating oil		*Insert*	
3.3	Porcelain Breaking Strength	kN	*Insert*	
3.4	Minimum creepage distance	mm/kV	Min. ≥31mm/kV	
3.5	Radio interference voltage at 1,1 $U\text{m}/\sqrt{3}$	µV	≤1000 @266kV rms	
3.6	Permissible level of partial discharges: • Test voltage $1.2*U_M/\sqrt{3}$ • Test voltage U_M	pC pC	Max. ≤5 ≤10	
3.7	Min. LV enclosure protection		IP55	
3.8	Insulation Class		Class A	
3.9.1	HV terminals: Shape		Flat	
3.9.2	HV terminals: Position		Horizontal	
3.9.3	HV terminals: Material Suitable for		Al terminal	
3.9.4	HV terminals: Adjustable holes		Yes	
3.9.5	HV terminals: Admissible Static Load	kN	*Insert*	
3.9.6	HV terminals: Admissible Dynamic Load	kN	*Insert*	
3.9.7	HV terminals: Cantilever test Load	kN	*Insert*	
3.10	Polarity Marking shall be as -		As per IEC	
3.11	Ten delta test terminal provided		Yes	
3.12	Pressure relieving device		Yes	
3.13	Oil level gauge		Yes	
3.14	Oil drain cock and sampling device		Yes	
3.15	Gland Plate provided in secondary terminal box		Yes	
3.16	Earthing terminal shall be provided		Yes	
3.17	Outdoor metal part made of		Aluminium/stainless steel	
3.18	Mass and dimensions: Total weight(with ±10% tolerance)	kg	*Insert*	
3.19	Mass and dimensions: Height (with ±10% tolerance)	mm	*Insert*	
	Reliability Data			
3.20	Mean Time to Failure in yrs		*Insert*	
3.21	Expected Operating Life in Yrs		*Insert*	
3.22	Mean time to repair in Hrs		*Insert*	
3.22	Mean time between preventive maintenance in Yrs		*Insert*	
3.23	Mean Time to (perform) preventive maintenance in Hrs		*Insert*	
	Overall compliance with the requirements (yes/no)			

N.B.: The equipment should be provided with oil level gauge and pressure relieving device. 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.

5.2.1.12 Current Transformer 230kV (Not applicable)

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	Current Transformer-General			
1.1	Manufacturer		*Insert*	
1.2	Country of Manufacturing		*Insert*	
1.3	Type		Post type, Single Phase, Free Standing, Oil immersed. Construction- Hairpin / Eye-bolt - Top core	
1.4	Model designation		*Insert*	
1.5	Country of Origin& Made in		EU/UK/USA/ Japan/Turkey	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor	
1.9	Shape/design		Live tank type/Dead tank type	
1.10	Sealing		Hermetically closed	
1.11	Service Condition: Ambient air temperature	°C	-5 to +45	
1.12	Service Condition: Altitude	m	≤1000	
1.13	Service Condition: System Earhing		Effectively earthed	
1.14	Service Condition: Seismic Condition	g	0.1	
2.	**Current Transformer-Characteristics**			
2.1	Nominal System Voltage	kV_{rms}	230	
2.2	Highest voltage for equipment, U_m	kV_{rms}	245	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	1050	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.4	Rated power frequency withstand voltage	kV_{rms}	460	
2.5	Rated frequency	Hz	50	
2.6	Rated short-time thermal current, I_{th}, 1s	kA	50	
2.7	Rated dynamic current, I_{dyn}	kA	125	
2.8.1	Rated primary current	A	3200-1600-800	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Maximum Allowable winding temperature	°C	*Insert*	
2.10	Normal current density of primary winding		*Insert*	
2.11	Rated continuous thermal current (40°C): Core-I Core-II Core-III Core-IV Core-V	 % In % In % In % In % In	 120 150 150 120 120	
2.12	Electrical dissipation factor at power frequency test voltage		*Insert*	
2.13	Capacitance	pF	*Insert*	
2.14	Rated Transformer ratio: • Core-I • Core-II • Core-III • Core-IV • Core-V	 A/A A/A A/A A/A A/A	 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1 3200-1600-800/1	
2.15	Accuracy Class: • Core-I • Core-II • Core-III • Core-IV • Core-V		 5P 0.2S 0.2S 5P 5P	
2.16	Rated Burden: • Core-I • Core-II • Core-III • Core-IV • Core-V	 VA VA VA VA VA	 30 15 15 30 30	
2.17	Rated Knee Point Voltage, V_k(Min) at highest ratio	V	*Insert* *Insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
	• Core-I • Core-II • Core-III • Core-IV • Core-V		*Insert* *Insert* *Insert*	
2.18	Max. magnetizing current guaranteed at half of knee point voltage ($V_k/2$), I_{Exc} at highest ratio • Core-I • Core-II • Core-III • Core-IV • Core-V	mA	*Insert* *Insert* *Insert* *Insert* *Insert*	
2.19	Max. magnetizing current guaranteed at quarter of knee point voltage ($V_k/4$), I_{Exc} at highest ratio • Core-I • Core-II • Core-III • Core-IV • Core-V	mA	*Insert* *Insert* *Insert* *Insert* *Insert*	
2.20	Max. resistance of primary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III • Core-IV • Core-V	Ohms	*Insert* *Insert* *Insert* *Insert* *Insert*	
2.21	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III • Core-IV • Core-V	Ohms	*Insert* *Insert* *Insert* *Insert* *Insert*	
2.22	Rated Accuracy limit Factor, ISF/ALF, for each core: • Core-I • Core-II • Core-III • Core-IV • Core-V		20 ≤5 ≤5 20 20	
2.23	Rated mechanical terminal loads	Class	Min. Class II	
3.	**Current Transformers-Design & Constructions**			
3.1	Insulator material		Porcelain, brown glaze	
3.2	Insulating medium		Oil paper	
3.3	Type including Brand		*Insert*	
3.4	Quantity of insulating oil		*Insert*	
3.5	Porcelain Breaking Strength	kN	*Insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.6	Minimum creepage distance	mm/kV	≥31	
3.7	Radio interference voltage at at 1,1 $Um/\sqrt{3}$	µV	≤500 @ 156kV rms	
3.8	Partial discharge level; test voltage U_m test voltage 1.2 $U_m/\sqrt{3}$	pC pC	≤10 ≤5	
3.9	Min. LV enclosure protection		IP55	
3.10	Insulation Class		Class A	
3.11.1	HV terminals: Shape		Flat	
3.11.2	HV terminals: Position		Horizontal	
3.11.3	HV terminals: Material Suitable for		Al terminal	
3.11.4	HV terminals: Adjustable holes		Yes	
3.11.5	HV terminals: Admissible Static Load	kN	*Insert*	
3.11.6	HV terminals: Admissible Dynamic Load	kN	*Insert*	
3.11.7	HV terminals: Cantilever test Load	kN	*Insert*	
3.12	Polarity Marking shall be as -		As per IEC	
3.13	Ten delta test terminal provided		Yes	
3.14	Pressure relieving device		Yes	
3.15	Oil level gauge		Yes	
3.16	Oil drain cock and sampling device provided		Yes	
3.17	Earthing terminal shall be provided		Yes	
3.18	Gland Plate provided in secondary terminal box		Yes	
3.19	Outdoor metal part made of		Aluminum/Stainless Steel	
3.20.1	Mass and dimensions: Total weight (with ±10% tolerance)	kg	*Insert*	
3.20.2	Mass and dimensions: Height (with ±10% tolerance)	mm	*Insert*	
	Reliability Data			
3.21	Mean Time to Failure in years		*Insert*	
3.22	Expected Operating Life in years		*Insert*	
3.23	Mean time to repair in hours		*Insert*	
3.24	Mean time between preventive maintenance in years		*Insert*	
3.25	Mean Time to (perform) preventive maintenance in hours		*Insert*	
4.0	**Overall compliance with the requirements (yes/no)**		Yes/No.	

N.B.: The equipment should be provided with oil level gauge and pressure relieving device. 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.

5.2.1.13 Current Transformer 132kV

SL No.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed

SL No.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	**Current Transformer-General**			
1.1	Manufacturer		*insert*	
1.2	Country of Manufacturing		*insert*	
1.3	Type		Post type, Single Phase, Free Standing, Oil immersed. Construction- Hairpin / Eye-bolt - Top core	
1.4	Model designation		*insert*	
1.5	Country of Origin & Made in		Insert	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor	
1.9	Shape/design		Live tank type/Dead tank type	
1.10	Sealing		Hermetically closed	
1.11	Service Condition: Ambient air temperature	°C	-5 to +45	
1.12	Service Condition: Altitude	m	$\leq$1000	
1.13	Service Condition: System Earhing		Effectively earthed	
1.14	Service Condition: Seismic Condition	g	0.1	
2.	**Current Transformer-Characteristics**			
2.1	Nominal System Voltage	kV_{rms}	132	
2.2	Highest voltage for equipment, U_m	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	
2.4	Rated power frequency withstand voltage	kV_{rms}	275	
2.5	Rated frequency	Hz	50	
2.6	Rated short-time thermal current, I_{th}, 1s	kA	40	
2.7	Rated dynamic current, I_{dyn}	kA	100	
2.8.1	Rated primary current	A	2400-1600-800	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	

SL No.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.9	Electrical dissipation factor at power frequency test voltage		*insert*	
2.10	Capacitance	pF	*insert*	
2.11	Maximum Allowable winding temperature	°C	*insert*	
2.12	Normal current density of primary winding		*insert*	
2.13	Rated continuous thermal current (40°C): • Core-I • Core-II • Core-III • Core-IV	% In % In % In % In	120 120 150 120	
2.14	Rated Transformer ratio: • Core-I • Core-II • Core-III • Core-IV	A/A A/A A/A A/A	2400-1600-800/1 2400-1600-800/1 2400-1600-800/1 2400-1600-800/1	
2.15	Accuracy Class: • Core-I • Core-II • Core-III • Core-IV		5P 5P 0.2S 5P	
2.16	Rated Burden: • Core-I • Core-II • Core-III • Core-IV	VA VA VA VA	30 30 15 30	
2.17	Rated Knee Point Voltage, V_k(Min) at highest ratio • Core-I • Core-II • Core-III • Core-IV	V	*insert* *insert* *insert* *insert*	
2.18	Max. magnetizing current guaranteed at half of knee point voltage ($V_k/2$), I_{Exc} at highest ratio • Core-I • Core-II • Core-III • Core-IV	mA	*insert* *insert* *insert* *insert*	
2.19	Max. magnetizing current guaranteed at quarter of knee point voltage ($V_k/4$), I_{Exc} at highest ratio • Core-I • Core-II	mA	*insert* *insert*	

SL No.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
	• Core-III • Core-IV		*insert* *insert*	
2.20	Max. resistance of primary winding at 75 ^{0}C, R_{CT} for each rating:	Ohms	*insert*	
2.21	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III • Core-IV	Ohms	*insert* *insert* *insert* *insert*	
2.22	Rated Accuracy Limit Factor, ISF/ALF: • Core-I • Core-II • Core-III • Core-IV		20 20 ≤5 20	
2.23	Rated mechanical terminal loads	Class	Min. Class II	
3.	**Current Transformers-Design & Constructions**			
3.1	Insulator material		Porcelain, brown glaze	
3.2	Insulating medium		Oil paper	
3.3	Type including Brand		*insert*	
3.4	Quantity of insulating oil		*insert*	
3.5	Porcelain Breaking Strength	kN	*insert*	
3.6	Minimum creepage distance	mm/kV	≥31	
3.7	Radio interference voltage at at 1,1 Um/√3	μV	≤500 @ 92kV rms	
3.8	Partial discharge level; test voltage U_m test voltage 1.2 $U_m/\sqrt{3}$	pC pC	≤10 ≤5	
3.9	Min. LV enclosure protection		IP55	
3.10.1	HV terminals: Shape		Flat	
3.10.2	HV terminals: Position		Horizontal	
3.10.3	HV terminals: Material Suitable for		Al terminal	
3.10.4	HV terminals: Adjustable holes		Yes	
3.10.5	HV terminals: Admissible Static Load	kN	*insert*	
3.10.6	HV terminals: Admissible Dynamic Load	kN	*insert*	
3.10.7	HV terminals: Cantilever test Load	kN	*insert*	
3.11	Insulation Class		Class A	
3.12	Polarity Marking shall be as		As per IEC	
3.13	Ten delta test terminal provided		Yes	
3.14	Pressure relieving device		Yes	
3.15	Oil level gauge		Yes	
3.16	Oil drain cock and sampling device provided		Yes	

SL No.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.17	Earthing terminal shall be provided		Yes	
3.18	Gland Plate provided in secondary terminal box		Yes	
3.19	Outdoor metal part made of		Aluminum/Stainless Steel	
3.20.1	Mass and dimensions: Total weight (with ±10% tolerance)	kg	*insert*	
3.20.2	Mass and dimensions: Height (with ±10% tolerance)	mm	*insert*	
	Reliability Data			
3.21	Mean Time to Failure in years		*insert*	
3.22	Expected Operating Life in years		*insert*	
3.23	Mean time to repair in hours		*insert*	
3.24	Mean time between preventive maintenance in years		*insert*	
3.25	Mean Time to (perform) preventive maintenance in hours		*insert*	
4.0	**Overall compliance with the requirements (yes/no)**		Yes/No	

N.B.: The equipment should be provided with oil level gauge and pressure relieving device. 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.

5.2.1.14 Voltage Transformer 400kV (Not applicable)

No.	Description	Unit	Minimum Requirements	Guaranteed
1.	**Voltage Transformers - General**			
1.1	Manufacturer		Insert	
1.2	Type		Capacitive	
1.3	Model designation		Insert	
1.4	Country of origin		UK/USA/EU/Japan/ Turkey	
1.5	Standards		IEC 61869-1 IEC 61869-5 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor	
1.8	Shape		Insert	
1.9	Sealing		Hermetically closed	
2.	**Voltage Transformers - Characteristics**			
2.1	Nominal system voltage	kV rms	400	
2.2	Highest voltage for equipment Un	kV rms	420	
2.3	Rated lightning impulse withstand voltage	kV peak	1425	

No.	Description	Unit	Minimum Requirements	Guaranteed
2.4	Rated switching impulse withstand voltage	kV peak	1050	
2.5	Rated Power frequency withstand voltage (dry), 1 minute	kV rms	520	
2.6	Power frequency withstand tests on secondary windings, 1 min	kV rms	3	
	Power frequency withstand voltage between LV terminal and earth, 1min	kV rms	4 (10 if the low voltage terminal is exposed)	
2.7	Rated primary voltage	kV	400 /√3	
2.8	Rated secondary voltage			
	a) I winding	V	110/√3	
	b) II winding	V	110/√3	
	c) III winding	V	110/√3	
2.9	Corona extinction voltage	kV rms	320	
2.10	Radio interference voltage for frequency between 0.5MHz and 2MHz (at 1.1*Um/√3)	µV	1000	
2.11	Rated frequency fr	Hz	50	
2.12	Rated short-time thermal current I_{th}, 1 s	kA	63	
2.13	Rated dynamic current I_{dyn}	kA peak	157.5	
2.14	Accuracy class:			
	a) I winding		0.2	
	b) II winding		3P	
	c) III winding		3P	
2.15	Rated power:			
	a) I winding	VA	10-30	
	b) II winding	VA	20-50	
	c) III winding	VA	20-50	
			Calculation is required during design stage	
2.16	Rated Total thermal Burden			
	a) I winding	VA	200	
	b) II winding	VA	200	
	c) III winding	VA	200	
			The accuracy of 0.2 on winding I shall be maintained upto Rated total Thermal burden (200VA).	
2.17	Load		Simultaneously	
2.18	Voltage factor	p.u./s	1.2 continuous 1.5/30	
2.19	Rated mechanical strength	Class	Min. Class II	
2.20	Capacitor value: Capacitance C1 Capacitance C2	pF	Insert Insert	
2.21	High frequency capacitance for entire carrier frequency range		Within 80% to 150% of rated capacitance	
2.22	Phase angle error	minutes	20	
2.23	Equivalent series resistance over the entire carrier frequency range	ohms	<40	

No.	Description	Unit	Minimum Requirements	Guaranteed
	or temperature range			
2.24	Stray capacitance and stray conductance of low voltage terminal over the entire capacitance		As per IEC 60358-1	
2.25	Standard reference range of frequencies for which the accuracies are valid		-97% to 103% for protection -99% to 101% for metering	
2.26	Maximum temperature rise	°C	Insert	
3.	**Voltage Transformers - Design and Construction**			
3.1	Insulator material		Porcelain, brown	
3.2	Insulating medium		Oil-paper - Mixed dielectric	
3.3	Minimum creepage distance	mm/kV	Min. > 31 mm/kV	
3.4	a) Test voltage 1.2*Um/√3	pC	Max. < 5	
	b) Test voltage Um	pC	< 10	
3.5	Min. LV enclosure protection		IP55	
3.6	HV terminals			
3.6.1	Shape		Flat	
3.6.2	Position		Vertical or horizontal	
3.6.3	Dimensions	Mm x mm	Min 200 x 100	
3.6.4	Number of holes		Min 8	
3.6.5	Dimensions of holes	mm	Insert	
3.6.6	Distance between holes	mm	Insert	
3.6.7	Material suitable for		Al terminal	
3.7	Oil drain cock and sampling device		Yes	
3.8	Enable sealing after accuracy class checks (sealing possibilities)		Yes	
3.9	Outdoor metal part made of aluminium or stainless steel		Yes	
3.10	Mass and dimensions			
3.10.1	Total mass	kg	Insert	
3.10.2	Height	mm	Insert	
3.11	Separate Tan Delta Test Tap		Yes	
3.12	Separate HF Tap		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.15 Voltage Transformer 230kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Voltage Transformers - General**			
1.1	Manufacturer		Insert	
1.2	Type		Inductive	
1.3	Model designation		Insert	
1.4	Country of origin		UK/USA/EU/Japan/ Turkey	
1.5	Standards		IEC 61869-1 IEC 61869-3 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor	
1.8	Shape		Insert	
1.9	Sealing		Hermetically closed	
2.	**Voltage Transformers - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	230	
2.2	Highest voltage for equipment U_n	kV_{rms}	245	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	1050	
2.4	Rated short duration power frequency voltage	kV	460	
2.5	Rated frequency f_r	Hz	50	
2.8	Rated primary voltage	kV	230/√3	
2.9	Rated secondary voltage • I winding • II winding • III winding	 V V V	 110/√3 110/√3 110/√3	
2.10	Accuracy class: • I winding • II winding • III winding		 0.2 3P 3P	
2.11	Rated power: • I winding • II winding • III winding	VA VA VA	10-20 20-50 20-50 (Calculation is required during design stage)	
2.12	Load		Simultaneously	
3.	**Voltage Transformers - Design and Construction**			
3.1	Insulator material		Porcelain, brown	
3.2	Insulating medium		Oil-paper - Mixed dielectric	
3.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.4	Max. radio interference voltage at 0.5-2 MHz (acc. IEC 60694)	μV	Max. 2500	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.5	Permissible level of partial discharges: • Test voltage $1.2*U_M/\sqrt{3}$ • Test voltage U_M	pC pC	Max. ≤ 5 ≤ 10	
3.7	Min. LV enclosure protection		IP55	
3.8	HV terminals			
3.8.1	Shape		Flat	
3.8.2	Position		Vertical or horizontal	
3.8.3	Dimensions	mm x mm	Min 100 x 100	
3.8.4	Number of holes		Min 4	
3.8.5	Dimensions of holes	mm	Ø 14	
3.8.6	Distance between holes	mm	50	
3.8.7	Material suitable for		Al terminal	
3.10	Oil drain cock and sampling device		Yes	
3.11	Enable sealing after accuracy class checks (sealing possibilities)		Yes	
3.13	Outdoor metal part made of aluminium or stainless steel		Yes	
3.14	Mass and dimensions			
3.14.1	Total mass	kg	Insert	
3.14.2	Height	mm	Insert	
3.15	Tan Delta Test Tap		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.16 Voltage Transformer 132 kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Voltage Transformers - General**			
1.1	Manufacturer		Insert	
1.2	Type		Inductive	
1.3	Model designation		Insert	
1.4	Country of origin		UK/USA/EU/Japan/ Turkey	
1.5	Standards		IEC 61869-1 IEC 61869-3 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor	
1.8	Shape		Insert	
1.9	Sealing		Hermetically closed	
2.	**Voltage Transformers - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	132	
2.2	Highest voltage for equipment U_n	kV_{rms}	145	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	650	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4	Rated short duration power frequency voltage	kV	275	
2.5	Rated frequency f_r	Hz	50	
2.8	Rated primary voltage	kV	132/√3	
2.9	Rated secondary voltage • I winding • II winding • III winding	 V V V	 110/√3 110/√3 110/√3	
2.10	Accuracy class: • I winding • II winding • III winding		 0.2 3P 3P	
2.11	Rated power: • I winding • II winding • III winding	 VA VA VA	 10-20 20-50 20-50 (Calculation is required during design stage)	
2.12	Load		Simultaneously	
3.	**Voltage Transformers - Design and Construction**			
3.1	Insulator material		Porcelain, brown	
3.2	Insulating medium		Oil-paper - Mixed dielectric	
3.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.4	Max. radio interference voltage at 0.5-2 MHz (acc. IEC 60694)	μV	Max. 2500	
3.5	Permissible level of partial discharges: • Test voltage $1.2*U_M/\sqrt{3}$ • Test voltage U_M	 pC pC	 Max. ≤ 5 ≤ 10	
3.7	Min. LV enclosure protection		IP55	
3.8	HV terminals			
3.8.1	Shape		Flat	
3.8.2	Position		Vertical or horizontal	
3.8.3	Dimensions	mm x mm	Min 100 x 100	
3.8.4	Number of holes		Min 4	
3.8.5	Dimensions of holes	mm	Ø 14	
3.8.6	Distance between holes	mm	50	
3.8.7	Material suitable for		Al terminal	
3.10	Oil drain cock and sampling device		Yes	
3.11	Enable sealing after accuracy class checks (sealing possibilities)		Yes	
3.13	Outdoor metal part made of aluminium or stainless steel		Yes	
3.14	Mass and dimensions			
3.14.1	Total mass	kg	Insert	
3.14.2	Height	mm	Insert	
3.15	Tan Delta Test Tap		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.1.17 Post Insulator 400kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
			Data	
1.	**Post Insulators - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain, outdoor	
2	Post Insulators - Characteristics			
2.1	Nominal system voltage		400	
2.2	Highest voltage for equipment U_n		420	
2.3	Rated lightning impulse withstand voltage		1550	
2.4	Rated short duration power frequency voltage		630/610	

No.	Description	Minimum Requirements		Guaranteed
			Data	
2.5	Switching impulse withstand voltage (kVp)		1050	
2.6	Corona extinction voltage		320	
2.7	Rated frequency f_r		50	
2.8	Minimum creepage distance		Min. um3 1 mm/kV	
2.9	Failing load bending (p0) (C10)		≥ailing	
2.10	Failing load torsion		≥milin	
3	Post Insulators - Design and Construction			
3.1	Insulation material		Porcelain , brown	
3.2	Material quality acc. IEC 60672		Min. C130	
3.3	Min. material density ρ_a		≥3m.	
3.4	Min. stretch strength of material σ_{fg}		≥Pa.	
3.5	Total min. cantilever strength (kg)		1000	
3.6	Total creepage distance (mm) pedestal		insert	
3.7	Total min. height of insulator (mm)		3500	
3.8	Max. diameter of insulating part		Insert	
3.9	Diameter of upper base		Insert	
3.10	Number of holes on upper base		Insert	
3.11	Diameter distance between holes on upper base		Insert	
3.12	Hole type on upper base		Insert	

No.	Description	Minimum Requirements		Guaranteed
			Data	
3.13	Diameter on lower base		Insert	
3.14	Number of holes on lower base		Insert	
3.15	Diameter distance between holes on lower base		Insert	
3.16	Hole type on lower base		Insert	
3.17	Insulator weight		Insert	
4	Others			
4.1	Type test certificate date/reference		Yes	
4.2	Period of time equipment has been in commercial operation		Insert	
4.3	Number of the same type of PIs supplied to date		Insert	
	Overall compliance with the requirements (yes/no)			

5.2.1.18 Post Insulator 230kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
			Data	
1.	**Post Insulators - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	

No.	Description	Minimum Requirements		Guaranteed
			Data	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain , outdoor	
2	Post Insulators - Characteristics			
2.1	Nominal system voltage		230	
2.2	Highest voltage for equipment U_n		245	
2.3	Rated lightning impulse withstand voltage		1050	
2.4	Rated short duration power frequency voltage		460	
2.5	Switching impulse withstand voltage (kVp)		850	
2.6	Corona extinction voltage		156	
2.7	Rated frequency f_r		50	
2.8	Minimum creepage distance		Min. um c mm/kV	
2.9	Failing load bending (p0) (C10)		≥ailing	
2.10	Failing load torsion		≥milin	

No.	Description	Minimum Requirements		Guaranteed
			Data	
3	Post Insulators - Design and Construction			
3.1	Insulation material		Porcelain , brown	
3.2	Material quality acc. IEC 60672		Min. C130	
3.3	Min. material density ρ_a		≥3m.	
3.4	Min. stretch strength of material σ_{fg}		≥Pa.	
3.5	Total min. cantilever strength (kg)		800	
3.6	Total creepage distance (mm) pedestal		insert	
3.7	Total min. height of insulator (mm)		2500	
3.8	Max. diameter of insulating part		Insert	
3.9	Diameter of upper base		Insert	
3.10	Number of holes on upper base		Insert	
3.11	Diameter distance between holes on upper base		Insert	
3.12	Hole type on upper base		Insert	
3.13	Diameter on lower base		Insert	
3.14	Number of holes on lower base		Insert	
3.15	Diameter distance between holes on lower base		Insert	
3.16	Hole type on lower base		Insert	
3.17	Insulator weight		Insert	
4	Others			
4.1	Type test certificate date/reference		Yes	

No.	Description	Minimum Requirements		Guaranteed
			Data	
4.2	Period of time equipment has been in commercial operation		**Insert**	
4.3	Number of the same type of PIs supplied to date		**Insert**	
	Overall compliance with the requirements (yes/no)			

5.2.1.19 Post Insulator 132 kV

No.	Description	Minimum Requirements		Guaranteed
			Data	
1.	**Post Insulators - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain, outdoor	
2	**Post Insulators - Characteristics**			
2.1	Nominal system voltage		132	
2.2	Highest voltage for equipment U_n		145	

No.	Description	Minimum Requirements		Guaranteed
			Data	
2.3	Rated lightning impulse withstand voltage		650	
2.4	Rated short duration power frequency voltage		275	
2.5	Switching impulse withstand voltage (kVp)		NA	
2.6	Corona extinction voltage		156	
2.7	Rated frequency f_r		50	
2.8	Minimum creepage distance		Min. um c mm/kV	
2.9	Failing load bending (p0) (C10)		≥ailing	
2.10	Failing load torsion		≥milin	
3	Post Insulators - Design and Construction			
3.1	Insulation material		Porcelain , brown	
3.2	Material quality acc. IEC 60672		Min. C130	
3.3	Min. material density ρ_a		≥3m.	
3.4	Min. stretch strength of material σ_{fg}		≥Pa.	
3.5	Total min. cantilever strength (kg)		800	
3.6	Total creepage distance (mm) pedestal		insert	

No.	Description	Minimum Requirements		Guaranteed
			Data	
3.7	Total min. height of insulator (mm)		2500	
3.8	Max. diameter of insulating part		Insert	
3.9	Diameter of upper base		Insert	
3.10	Number of holes on upper base		Insert	
3.11	Diameter distance between holes on upper base		Insert	
3.12	Hole type on upper base		Insert	
3.13	Diameter on lower base		Insert	
3.14	Number of holes on lower base		Insert	
3.15	Diameter distance between holes on lower base		Insert	
3.16	Hole type on lower base		Insert	
3.17	Insulator weight		Insert	
	Overall compliance with the requirements (yes/no)			

5.2.1.20 Surge Arrester 400kV (Not applicable)

No.	Description	Minimum Requirements Unit	Data	Guaranteed
1.	**Surge Arresters - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	
1.5	Made in		EU/UK/USA/Japan	
1.5.1	Country of origin of ZnO block		EU/UK/USA/Japan	
1.6	Standards		IEC 60099-4	
1.7	Quality control		ISO 9001	
1.8	Design		Metal oxide, gapless, outdoor	
1.9	Short circuit testing authority		Tests shall be conducted by STL- Short Circuit Testing Liaison and test report shall be certified from STL- Short Circuit Testing Liaison Authority	
1.10	ZnO block manufacturer with country of manufacturing		Shall be manufactured in EU/UK/USA/Japan	
1.11	Service Condition: Ambient Air temperature	^0C	-5 to +45	

No.	Description	Minimum Requirements Unit	Data	Guaranteed
1.12	Service Condition: Altitude	m	≤1000	
1.13	Service Condition: System Earhing		Solidly earthed	
1.14	Service Condition: Seismic Condition	g	0.1	
2.	**Surge Arresters - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	400	
2.2	Highest voltage for equipment U_n	kV_{rms}	420	
2.4	Rated voltage of surge arrester U_r	kV_{rms}	≥390	
2.5	Max. continuous operating voltage U_c	kV_{rms}	≥312	
2.8	Rated frequency	Hz	48-62	
2.9	Nominal discharge current In (8/20 µs)	kA_{peak}	≥10	
2.10	High current impulse of an arrester (4/10 µs)	kA_{peak}	insert	
2.11	High current pressure relief rating	kA_{rms}	≥m63 for 1 sec.	
3.	**Surge Arresters - Design and Construction**			
3.1	Line discharge class	Class	4	
3.2	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 8	
3.3	Long duration current impulse (2000 µs)	A	Insert	
3.4	Maximum residual voltage U_{res}			
3.4.1	For switching impulse current 30/60 µs at 0,5 kA	kV_{peak}	≤ 375	
3.4.2	For switching impulse current 30/60 µs at 1 kA	kV_{peak}	≤ 385	
3.4.3	For switching impulse current 30/60 µs at 2 kA	kV_{peak}	≤ 405	
3.4.4	For lightning impulse current 8/20 µs at 5 kA	kV_{peak}	≤ 862	
3.4.5	For lightning impulse current 8/20 µs at 10 kA	kV_{peak}	≤ 916	
3.4.6	For lightning impulse current 8/20 µs at 20 kA	kV_{peak}	≤ 990	
3.5.	Dielectric endurance of arrester housing			
3.5.1	Lightning impulse withstand voltage of arrester housing up (1.2/50 µs)	kV	≥ 1450	
3.5.2	Power frequency withstand voltage of arrester housing (1 min wet)	kV	≥ 630	
3.6.	Mechanical requirements			
3.6.1	Specified short-term load SSL (F_{dyn})	N	Insert	
3.6.2	Specified long-term load SSL (F_{stat})	N	Insert	
3.7	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
3.8.	Housing insulating material		Composite/Silicone	
3.9	Insulating basement		Yes	
3.10	Surge arrester height	mm	Insert	
3.11	Surge arrester weight	kg	Insert	
3.12	No. of surge arrester unit		Insert	
3.13	Voltage distribution ring present / ring diameter	yes / no / mm	Insert	
3.14.1	Surge Counter		Yes	

No.	Description	Minimum Requirements Unit	Data	Guaranteed
3.14.2	Leakage Current Measuring Display option in counter		Yes	
3.14.3	Measuring Range	mA	Min. 0-30	
3.15	HV terminal			
3.16.1	Shape		Flat	
3.16.2	Dimension	mm x mm	Insert	
3.16.3	Number of holes		Insert	
3.16.4	Distance between holes	mm x mm	Insert	
3.16.5	Material suitable for		Al terminal	
	Overall compliance with the requirements (yes/no)			

5.2.1.21 Surge Arrester 132kV (Not applicable)

No.	Description	Minimum Requirements Unit	Data	Guaranteed
1.	**Surge Arresters - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan	
1.5	Made in		EU/UK/USA/Japan	
1.6	Standards		IEC 60099-4	
1.7	Quality control		ISO 9001	
1.8	Design		Metal oxide, gapless, outdoor	
1.9	Short circuit testing authority		Tests shall be conducted by STL- Short Circuit Testing Liaison and test report shall be certified from STL- Short Circuit Testing Liaison Authority	
1.10	ZnO block manufacturer with country of manufacturing		Shall be manufactured in EU/UK/USA/Japan	
1.11	Service Condition: Ambient Air temperature	^{0}C	-5 to +45	
1.12	Service Condition: Altitude	m	≤1000	
1.13	Service Condition: System Earthing		Solidly earthed	
1.14	Service Condition: Seismic Condition	g	0.1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.	**Surge Arresters - Characteristics**			
2.1	Nominal system voltage	kV rms	132	
2.2	Highest voltage for equipment U_n	kV rms	145	
2.4	Rated voltage of surge arrester U_r	kV rms	120	
2.5	Max. continuous operating voltage U_c	kV rms	102	
2.8	Rated frequency	Hz	50	
2.9	Nominal discharge current In (8/20 µs)	kA peak	10	
2.10	High current impulse of an arrester (4/10 urr		Insert	
2.11	High current pressure relief rating	kA rms	≥msh for 1 sec.	
3.	**Surge Arresters - Design and Construction**			
3.1	Line discharge class	Class	3	
3.2	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	
3.3	Long duration current impulse (2000 µs)	A	Insert	
3.4	Maximum residual voltage U_{res}			
3.4.1	For switching impulse current 30/60 µs at 0,5 kA	kV peak	≤ 235	
3.4.2	For switching impulse current 30/60 µs at 1 kA	kV peak	≤ 240	
3.4.3	For switching impulse current 30/60 µs at 2 kA	kV peak	≤ 255	
3.4.4	For lightning impulse current 8/20 µs at 5 kA	kV peak	≤ 280	
3.4.5	For lightning impulse current 8/20 µs at 10 kA	kV peak	≤ 300	
3.4.6	For lightning impulse current 8/20 µs at 20 kA	kV peak	≤ 320	
3.5.	Dielectric endurance of arrester housing			
3.5.1	Lightning impulse withstand voltage of arrester housing up (1.2/50 µs)	kV	≥ 550	
3.5.2	Power frequency withstand voltage of arrester housing (1 min wet)	kV	≥ 250	
3.6.	Mechanical requirements			
3.6.1	Specified short-term load SSL (F_{dyn})	N	insert	
3.6.2	Specified long-term load SSL (F_{stat})	N	insert	
3.7	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
3.8.	Housing insulating material		Composite/silicon	
3.9	Insulating basement		Yes	
3.10	Surge arrester height	mm	Insert	
3.11	Surge arrester weight	kg	Insert	
3.12	No. of Arrester Units		1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.13	Voltage distribution ring present / ring diameter	yes / no / mm	Insert	
3.14.1	Surge Counter		YES	
3.14.2	Leakage Current Measuring display option in counter		YES	
3.14.3	Measuring Range		Min. 0-30	
3.15	HV terminal			
3.16.1	Shape		Flat	
3.16.2	Dimension	mm x mm	Insert	
3.16.3	Number of holes		Insert	
3.16.4	Distance between holes	mm x mm	Insert	
3.16.5	Material suitable for		Al terminal	
	Overall compliance with the requirements (yes/no)			

5.2.1.22 Wave Trap 400kV (Not applicable)

No	Description	Unit	Minimum Requirements	Guaranteed
1.	Wave Trap - General			
2.	Type of Line Trap Installation		To be inserted into high voltage A.C transmission line phase in series	
3.	Type of mounting		Pedestal	
4.	Model designation		Insert	
5.	Country of origin		EU/UK/USA/Japan	
6.	Suitable for system Frequency	Hz	50	
7.	Nominal System Voltage	kV	400	
8.	Highest System Voltage	kV	420	
9.	Rated Continuous Current	A	4000	
10.	Rated Short time current for 1 second	kA	63	
11.	Asymmetrical peak value of the first half	kA	157.5	

No	Description	Unit	Minimum Requirements	Guaranteed
	wave of the rated short-time current			
12.	Rated inductance	mH	1.0	
13.	Type of Tuning		Band tuned line trap	
14.	Blocking Band frequency range	kHz kHz	Band-I: 56 to 124 Band-II: 76 to 500	
15.	Minimum Guaranteed resistive Component of impedance in Blocking Frequency Rang	Ohm	500	
16.	Protective device		a) Non-linear resistive type Gapped lightning arresters for A.C system. b) Polymer housed Metal oxide surge arrester without Gaps for A.C system.	
17.	Nominal discharge current of protective device	kA	10 kA However, Co-ordination shall be done by taking 20kA, 8/20 micro-sec discharge into consideration.	
18.	Rated voltage of protective device	kV rms	>15.72	
19.	Minimum value of power frequency spark over voltage (Dry & wet) of protective device	kV rms	>23.58	
20.	Visual Corona Extinction Voltage	kV rms	320 kV rms	
21.	Radio influence Voltage (RIV)	μV	<500 @280 kV	
22.	Attention in tuned frequency band	dB	<7.5 dB	
23.	Maximum tapping loss over blocking Band I & II stated above	dB	2.6 dB	
24.	Insulation class	Class	F	
25.	Maximum working stress		Twice the weight of wave trap+500 kgs.	

5.2.1.23 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 Part 2: GIS Switchgear

5.2.2.1 GIS Switchgear 230kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Switchgear 230 kV - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Nominal system voltage	kV_{rms}	230	
1.6	Highest voltage for equipment U_n	kV_{rms}	245	
1.7	Rated lightning impulse withstand voltage	kV_{peak}	1050	
1.8	Rated short duration power frequency voltage	kV	460	
1.9	Rated frequency f_r	Hz	50	
1.10	Rated current I_r			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	• Busbars	A	≥ 2000	
	• Line bay	A	NA	
	• Transformer bay	A	≥ 1600	
	• Bus Coupler bay	A	NA	
1.11	Rated short-circuit breaking current I_{sc}	kA rms	≥ 40	
1.12	Duration of short-circuit	s	≥ 3	
1.13	Rated peak withstand current I_p (equal short-circuit making current)	kA	≥ 100	
	Control voltage	V. DC	110	
	Motor - auxiliary supply voltage	V. DC	110	
	Heater supply voltage	V. Hz	230, 50	
1.14	Type of busbars	-	Double, passive	
2.	**Circuit Breaker**			
2.1	Model			
2.2	Country of Origin			
2.3	Isolating and quenching medium		SF_6	
2.4	Type of circuit breaker		GIS / Indoor	
2.5	Design		Single breaking	
2.6	Operating mechanism		Motor-wound spring	
2.8	Number of poles	pcs.	3	
2.9	Number of operating mechanisms per circuit breaker			
	• Line bay	pcs.	NA	
	• Transformer bay	pcs.	1	
	• Bus Coupler bay	pcs.	NA	
2.10	D.C. component of the rated short-circuit breaking current	%	> 30	
2.11	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.12	Auto reclosing			
	• Line bay		NA	
	• Transformer bay		3p	
	• Bus Coupler bay		NA	
2.13	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 60	
2.14	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
	Dead Time		300	
2.15	Restrike performance during capacitive current switching	Class	C2	
2.16	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		 ≥ 10000 ≥ 2500 ≥ 10	
2.17	The frequency of mechanical operations	Class	M2	
2.18	Rated electrical endurance	Class	E2	
	Operating mechanism			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.19	Number of closing coils	pcs.	1	
2.20	Number of triping coils	pcs.	2	
2.21	Minimum number of available contacts (NO/NC)		12NO+12NC+1 W	
	Accessories in central control panel			
2.22	Anti-pumping relay		Yes	
2.23	Local/remote control selector switch		Yes	
2.24	Local operation push buttons		Yes	
2.25	Minimum pressure lock-out and alarm relays		Yes	
2.26	Operation counter		Yes	
3.	**Disconnector**			
3.1	Type		GIS / Indoor	
3.2	Type of disconnector			
	• Three pole, three position DES (close/open/earthed), motor operated, insulated, with earthing switch		Yes	
	• Three pole Disconnector, motor operated, without earthing switch		Yes	
	• Three pole, motor operated earthing switch		Yes	
	• Three pole, make-proof, motor operated earthing switch		Yes	
	• Three pole, Disconnector Link, hand operated		Yes	
3.3	Number of poles	pcs.	3	
3.4	Number of operating mechanism	pcs.	1	
3.5	Type of operating mechanism			
	• Disconnector/Three position DES/ES		Motor driven	
	• Make-proof		Motor-wound spring	
	• Disconnector Link		Manual	
	Making and breaking busbar transfer currrent		1600A	
	• Operating time (Disconnector/Three position DES/ES)			
	- For opening		≤ 4 sec	
	- For closing		≤ 4 sec	
	No. of auxiliary contact		12NO+12NC, 1NO early make, INC delayed	
	Hand operating facilities		Yes	
	Mechanical number of guaranteed operation		10000 (M2)	
	Power requirement		INSERT	
4.	**Current Transformer**			
4.1	Type		GIS / Indoor	
	Characteristics of Current Transformers are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.2	Rated continuous thermal current (40°C): • I core • II core • III core • IV core • V core	 % In % In % In % In % In	 120 120 200 200 120	
4.3	Rated transformer ratio: • I core • II core • III core • IV core • V core	 A/A A/A A/A A/A A/A	1600-800/1 1600-800/1 1600-800/1 1600-800/1 1600-800/1	
4.4	Accuracy class: • I core • II core • III core • IV core • V core		 PX PX 0.2 0.2 PX	
4.5	Security factor: • III core • IV core		 Fs<5 Fs<5	
4.6	Rated power: • I core • II core • III core • IV core • V core	 VA VA VA VA VA	 - - 30-15 30-15 -	
4.7	Knee point voltage (Vk) • I core • II core • V core	V	As per existing	
4.8	CT secondary resistance (R_{CT}) • I core • II core • V core	ohm	As per existing	
5.	**Voltage Transformer**			
5.1	Type		GIS / Indoor	
5.2	Rated primary voltage	kV	230/√3	
5.3	Rated secondary voltage • I winding • II winding	 V V	 110√3 110√3	
5.4	Accuracy class: • I winding • II winding		 0.2 3P	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.5	Rated power: • I winding • II winding	VA VA	50 50	
5.6	Load		Simultaneously	
6.	**Surge Arresters**			
6.1	Type		GIS / outdoor	
	Quantity, Position & Characteristic of Surge Arresters are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	
6.2	Rated voltage of surge arrester U_r	kV_{rms}	192	
6.3	Max. continuous operating voltage U_c	kV_{rms}	154	
6.4	Nominal discharge current In (8/20 µs)	kA_{peak}	10	
6.5	High current impulse of an arrester (4/10 µs)	kA_{peak}	100	
6.6	Line discharge class	Class	3	
6.7	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	
6.8	Long duration current impulse (2000 µs)	A	≥ 850	
6.9	Maximum residual voltage U_{res}			
	For switching impulse current 30/60 µs at 0,5 kA	kV_{peak}	≤ 375	
	For switching impulse current 30/60 µs at 1 kA	kV_{peak}	≤ 385	
	For switching impulse current 30/60 µs at 2 kA	kV_{peak}	≤ 405	
	For lightning impulse current 8/20 µs at 5 kA	kV_{peak}	≤ 435	
	For lightning impulse current 8/20 µs at 10 kA	kV_{peak}	≤ 465	
	For lightning impulse current 8/20 µs at 20 kA	kV_{peak}	≤ 515	
7	**Connection**			
7.1	Type: GIL – Gas Insulated Line, Outdoor		Yes	
7.2	Type: Single phase or Three phase, according to the design		Yes	
7.3	Insulator, Single phase, SF6 - Air		Yes	
7.4	Insulating material		Composite/Silicon	
7.5	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
8	**Maintenance requirement**			
8.1	Maintenance of any circuit breaker shall be possible without interruption of adjacent bays		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.2.2 GIS Switchgear 132kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Switchgear 132 kV - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Nominal system voltage	kV_{rms}	132	
1.6	Highest voltage for equipment U_n	kV_{rms}	145	
1.7	Rated lightning impulse withstand voltage	kV_{peak}	650	
1.8	Rated short duration power frequency voltage	kV	275	
1.9	Rated frequency f_r	Hz	50	
1.10	Rated current I_r			
	• Busbars	A	≥ 2500	
	• Line bay	A	NA	
	• Transformer bay	A	≥ 2000	
	• Bus Coupler bay	A	NA	
1.11	Rated short-circuit breaking current I_{sc}	kA_{rms}	≥ 31.5	
1.12	Duration of short-circuit	s	≥ 3	
1.13	Rated peak withstand current I_p (equal short-circuit making current)	kA	≥ 79	
	Control voltage	V. DC	110	
	Motor - auxiliary supply voltage	V. DC	110	
	Heater supply voltage	V. Hz	230, 50	
1.14	Type of busbars	-	Double, active	
2.	**Circuit Breaker**			
2.1	Isolating and quenching medium		SF_6	
2.2	Type of circuit breaker		GIS / Indoor	
2.3	Design		Single breaking	
2.4	Operating mechanism		Motor-wound spring	
2.5	Number of poles	pcs.	3	
2.6	Number of operating mechanisms per circuit breaker			
	• Line bay	pcs.	NA	
	• Transformer bay	pcs.	1	
	• Bus Coupler bay	pcs.	NA	
2.7	D.C. component of the rated short-circuit breaking current	%	> 30	
2.8	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.9	Auto reclosing			
	• Line bay		NA	
	• Transformer bay		3p	
	• Bus Coupler bay		NA	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.10	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 60	
2.11	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.12	Restrike performance during capacitive current switching	Class	C2	
2.13	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		 ≥ 10000 ≥ 2500 ≥ 5	
2.14	The frequency of mechanical operations	Class	M2	
2.15	Rated electrical endurance	Class	Min E1	
	Operating mechanism			
2.13	Number of making coils	pcs.	1	
2.14	Number of breaking coils	pcs.	2	
2.15	Minimum number of available contacts (NO/NC)		12NO+12NC	
	Accessories in central control panel			
2.16	Anti-pumping relay		Yes	
2.17	Local/remote control selector switch		Yes	
2.18	Local operation push buttons		Yes	
2.19	Minimum pressure lock-out and alarm relays		Yes	
2.20	Operation counter		Yes	
3.	**Disconnector**			
3.1	Type		GIS / Indoor	
3.2	Type of disconnector			
	• Three pole, three position DES (close/open/earthed), motor operated, insulated, with earthing switch		Yes	
	• Three pole Disconnector, motor operated, without earthing switch		Yes	
	• Three pole, motor operated earthing switch		Yes	
	• Three pole, make-proof, motor operated earthing switch		Yes	
	• Three pole, Disconnector Link, hand operated		Yes	
3.3	Number of poles	pcs.	3	
3.4	Number of operating mechanism	pcs.	**1**	
3.5	Type of operating mechanism			
	• Disconnector/Three position DES/ES		Motor driven	
	• Make-proof		Motor-wound spring	
	• Disconnector Link		Manual	
4.	**Current Transformer**			
4.1	Type		GIS / Indoor	
	Characteristics of Current Transformers are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject to the PGCB's approval		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.2	Rated continuous thermal current (40°C): • I core • II core • III core • IV core • V core	 % In % In % In % In % In	 120 120 200 200 120	
4.3	Rated transformer ratio: • I core • II core • III core • IV core • V core	A/A A/A A/A A/A A/A	**2000-1000/1** **2000-1000/1** **2000-1000/1** **2000-1000/1** **2000-1000/1**	
4.4	Accuracy class: • I core • II core • III core • IV core • V core		 PX PX 0.2 0.5 PX	
4.5	Security factor: • III core • IV core		 Fs<5 Fs<5	
4.6	Rated power: • I core • II core • III core • IV core • V core	 VA VA VA VA VA	 - - 30-15 30-15 -	
4.7	Knee point voltage (Vk) • I core • II core • V core	V	As per existing	
4.8	CT secondary resistance (R_{CT}) • I core • II core • V core	ohm	As per existing	
5.	**Voltage Transformer**			
5.1	Type		GIS / Indoor	
5.2	Rated primary voltage	kV	132/√3	
5.3	Rated secondary voltage • I winding • II winding	 V V	 110√3 110√3	
5.4	Accuracy class: • I winding • II winding		 0.2 3P	
5.5	Rated power: • I winding • II winding	 VA VA	 50 50	
5.6	Load		Simultaneously	

No.	Description	Minimum Requirements Unit	Minimum Requirements Data	Guaranteed
6.	**Surge Arresters**			
6.1	Type		GIS / outdoor	
	Quantity, Position & Characteristic of Surge Arresters are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	
6.2	Rated voltage of surge arrester U_r	kV rms	120	
6.3	Max. continuous operating voltage U_c	kV rms	110	
6.4	Nominal discharge current In (8/20 µs)	kA peak	10	
6.5	High current impulse of an arrester (4/10 µs)	kA peak	100	
6.6	Line discharge class	Class	3	
6.7	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	
6.8	Long duration current impulse (2000 µs)	A	≥ 850	
6.9	Maximum residual voltage U_{res}			
	For switching impulse current 30/60 µs at 0,5 kA	kV peak	≤ 235	
	For switching impulse current 30/60 µs at 1 kA	kV peak	≤ 240	
	For switching impulse current 30/60 µs at 2 kA	kV peak	≤ 255	
	For lightning impulse current 8/20 µs at 5 kA	kV peak	≤ 280	
	For lightning impulse current 8/20 µs at 10 kA	kV peak	≤ 300	
	For lightning impulse current 8/20 µs at 20 kA	kV peak	≤ 320	
7	**Connection**			
7.1	Type: GIB – Gas Insulated Busbars, Outdoor		Yes	
7.2	Type: Single phase or Three phase, according to the design		Yes	
7.3	Insulator, Single phase, SF6 / Air		Yes	
7.4	Insulating material		Composite/Silicon	
7.5	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
8	**Maintenance requirement**			
8.1	Maintenance of any circuit breaker shall be possible without interruption of adjacent bays		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.2.1 GIS Switchgear 132kV (Not applicable)

No.	Description	Minimum Requirements Unit	Minimum Requirements Data	Guaranteed
1.	**Switchgear 132 kV - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Nominal system voltage	kV_{rms}	132	
1.6	Highest voltage for equipment U_n	kV_{rms}	145	
1.7	Rated lightning impulse withstand voltage	kV_{peak}	650	
1.8	Rated short duration power frequency voltage	kV	275	
1.9	Rated frequency f_r	Hz	50	
1.10	Rated current I_r			
	• Busbars	A	≥ 2500	
	• Line bay	A	NA	
	• Transformer bay	A	≥ 1250	
	• Bus Coupler bay	A	NA	
1.11	Rated short-circuit breaking current I_{sc}	kA_{rms}	≥ 31.5	
1.12	Duration of short-circuit	s	≥ 3	
1.13	Rated peak withstand current I_p (equal short-circuit making current)	kA	≥ 79	
	Control voltage	V. DC	110	
	Motor - auxiliary supply voltage	V. DC	110	
	Heater supply voltage	V. Hz	230, 50	
1.14	Type of busbars	-	Double, active	
2.	**Circuit Breaker**			
2.1	Isolating and quenching medium		SF_6	
2.2	Type of circuit breaker		GIS / Indoor	
2.3	Design		Single breaking	
2.4	Operating mechanism		Motor-wound spring	
2.5	Number of poles	pcs.	3	
2.6	Number of operating mechanisms per circuit breaker			
	• Line bay	pcs.	NA	
	• Transformer bay	pcs.	1	
	• Bus Coupler bay	pcs.	NA	
2.7	D.C. component of the rated short-circuit breaking current	%	> 30	
2.8	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.9	Auto reclosing			
	• Line bay		NA	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	• Transformer bay		3p	
	• Bus Coupler bay		NA	
2.10	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 60	
2.11	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.12	Restrike performance during capacitive current switching	Class	C2	
2.13	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		 ≥ 10000 ≥ 2500 ≥ 5	
2.14	The frequency of mechanical operations	Class	M2	
2.15	Rated electrical endurance	Class	Min E1	
	Operating mechanism			
2.13	Number of making coils	pcs.	1	
2.14	Number of breaking coils	pcs.	2	
2.15	Minimum number of available contacts (NO/NC)		12NO+12NC	
	Accessories in central control panel			
2.16	Anti-pumping relay		Yes	
2.17	Local/remote control selector switch		Yes	
2.18	Local operation push buttons		Yes	
2.19	Minimum pressure lock-out and alarm relays		Yes	
2.20	Operation counter		Yes	
3.	**Disconnector**			
3.1	Type		GIS / Indoor	
3.2	Type of disconnector			
	• Three pole, three position DES (close/open/earthed), motor operated, insulated, with earthing switch		Yes	
	• Three pole Disconnector, motor operated, without earthing switch		Yes	
	• Three pole, motor operated earthing switch		Yes	
	• Three pole, make-proof, motor operated earthing switch		Yes	
	• Three pole, Disconnector Link, hand operated		Yes	
3.3	Number of poles	pcs.	3	
3.4	Number of operating mechanism	pcs.	**1**	
3.5	Type of operating mechanism			
	• Disconnector/Three position DES/ES		Motor driven	
	• Make-proof		Motor-wound spring	
	• Disconnector Link		Manual	
4.	**Current Transformer**			
4.1	Type		GIS / Indoor	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Characteristics of Current Transformers are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	
4.2	Rated continuous thermal current (40°C): • I core • II core • III core • IV core • V core	 % In % In % In % In % In	 120 120 200 200 120	
4.3	Rated transformer ratio: • I core • II core • III core • IV core • V core	A/A A/A A/A A/A A/A	2000-1000/1 2000-1000/1 2000-1000/1 2000-1000/1 2000-1000/1	
4.4	Accuracy class: • I core • II core • III core • IV core • V core		 PX PX 0.2 0.5 PX	
4.5	Security factor: • III core • IV core		 Fs<5 Fs<5	
4.6	Rated power: • I core • II core • III core • IV core • V core	 VA VA VA VA VA	 - - 30-15 30-15 -	
4.7	Knee point voltage (Vk) • I core • II core • V core	V	As per existing	
4.8	CT secondary resistance (R_{CT}) • I core • II core • V core	ohm	As per existing	
5.	**Voltage Transformer**			
5.1	Type		GIS / Indoor	
5.2	Rated primary voltage	kV	132/√3	

No.	Description	Minimum Requirements Unit	Minimum Requirements Data	Guaranteed
5.3	Rated secondary voltage • I winding • II winding	 V V	 110√3 110√3	
5.4	Accuracy class: • I winding • II winding		 0.2 3P	
5.5	Rated power: • I winding • II winding	 VA VA	 50 50	
5.6	Load		Simultaneously	
6.	**Surge Arresters**			
6.1	Type		GIS / outdoor	
	Quantity, Position & Characteristic of Surge Arresters are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	
6.2	Rated voltage of surge arrester U_r	kV_{rms}	120	
6.3	Max. continuous operating voltage U_c	kV_{rms}	110	
6.4	Nominal discharge current In (8/20 µs)	kA_{peak}	10	
6.5	High current impulse of an arrester (4/10 µs)	kA_{peak}	100	
6.6	Line discharge class	Class	3	
6.7	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	
6.8	Long duration current impulse (2000 µs)	A	≥ 850	
6.9	Maximum residual voltage U_{res}			
	For switching impulse current 30/60 µs at 0,5 kA	kV_{peak}	≤ 235	
	For switching impulse current 30/60 µs at 1 kA	kV_{peak}	≤ 240	
	For switching impulse current 30/60 µs at 2 kA	kV_{peak}	≤ 255	
	For lightning impulse current 8/20 µs at 5 kA	kV_{peak}	≤ 280	
	For lightning impulse current 8/20 µs at 10 kA	kV_{peak}	≤ 300	
	For lightning impulse current 8/20 µs at 20 kA	kV_{peak}	≤ 320	
7	**Connection**			
7.1	Type: GIB – Gas Insulated Busbars, Outdoor		Yes	
7.2	Type: Single phase or Three phase, according to the design		Yes	
7.3	Insulator, Single phase, SF6 / Air		Yes	
7.4	Insulating material		Composite/Silicon	
7.5	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
8	**Maintenance requirement**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
8.1	Maintenance of any circuit breaker shall be possible without interruption of adjacent bays		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.2.2 GIS Switchgear 33kV (For Rajendrapur)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Switchgear 33kV - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Nominal system voltage	kV rms	33	
1.6	Highest voltage for equipment U_n	kV rms	36	
1.7	Rated lightning impulse withstand voltage	kV peak	170	
1.8	Rated short duration power frequency voltage	kV	70	
1.9	Rated frequency f_r	Hz	50	
1.10	Rated current I_r			
	• Busbars	A	≥ 3150	
	• Line bay	A	≥ 2000	
	• Transformer bay	A	NA	
	• Bus Coupler bay	A	NA	
	• Bus Sectionalizer bay	A	NA	
	• Aux Trafo bay	A	NA	
1.11	Rated short-circuit breaking current I_{sc}	kA rms	≥ 31.5	
1.12	Duration of short-circuit	s	≥ 3	
1.13	Rated peak withstand current I_p (equal short-circuit making current)	kA	≥ 80	
	Control voltage	V. DC	110	
	Motor - auxiliary supply voltage	V. DC	110	
	Heater supply voltage	V. Hz	230. 50	
1.14	Type of busbars	-	As per existing	
2.	**Circuit Breaker**			
2.1	Isolating and quenching medium		Insert	
2.2	Type of circuit breaker		GIS /Indoor	
2.3	Design		Single breaking	
2.4	Operating mechanism		Motor-wound spring	
2.5	Number of poles	pcs.	3	
2.6	Number of operating mechanisms per circuit breaker			
	• Line bay	pcs.	NA	
	• Transformer bay	pcs.	1	
	• Bus Coupler bay	pcs.	NA	
2.7a	D.C. component of the rated short-circuit	%	> 30	

	breaking current			
2.7b	First-pole-to-clear factor • Terminal fault • Short-line fault • Out-of-phase	p.u. p.u. p.u.	1.3 N. A. N. A	
2.8	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.9	Auto reclosing			
	• Line bay		NA	
2.10	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 100	
2.11	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.12	Restrike performance during capacitive current switching	Class	C2	
2.13	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc		≥ 10000 ≥ 2500 ≥ 5	
2.14	The frequency of mechanical operations	Class	M2	
2.15a	Rated electrical endurance	Class	Min E1	
2.15b	Operating mechanism			
No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	**Data**	
2.13	Number of making coils	pcs.	1	
2.14	Number of breaking coils	pcs.	2	
2.15	Minimum number of available contacts (NO/NC)		12NO+12NC	
	Accessories in central control panel			
2.16	Anti-pumping relay		Yes	
2.17	Local/remote control selector switch		Yes	
2.18	Local operation push buttons		Yes	
2.19	Minimum pressure lock-out and alarm relays		Yes	
2.20	Operation counter		Yes	
3.	**Disconnector**			
3.1	Type		GIS /Indoor	
3.2	Type of disconnector			
	Three pole, three position DES (close/open/earthed), motor operated, insulated, with earthing switch		Yes	
	Three pole Disconnector, motor operated, without earthing switch		Yes	
	Three pole, motor operated earthing switch		Yes	
	Three pole, make-proof, motor operated earthing switch		Yes	
	Three pole, Disconnector Link, hand operated		Yes	
3.3	Number of poles	pcs.	3	
3.4	Number of operating mechanism	pcs.	1	
3.5	Type of operating mechanism			
	• Disconnector/Three position DES/ES		Motor driven	
	• Make-proof		NA	
	• Disconnector Link		Manual	

4.	**Current Transformer**			
4.1	Type		GIS /Indoor	
	Characteristics of Current Transformers are preliminary and for Tender purpose only. The Contractor has to make Engineering and to provide detail calculation and detail design, which will be subject of the PGCB's approval		Yes	
4.2	Rated continuous thermal current (40°C): • I core • II core • III core	% In % In % In	200 120 120	
4.3	Rated transformer ratio: • I core • II core • III core •	AA A	2000/1 2000/1 2000/1	
4.4	Accuracy class: • I core • II core • III core		0.2 5P20 5P20	
No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	**Data**	
4.5	Security factor: • I core		Fs=10	
4.6	Rated power: • I core • II core • III core	VA VA VA	7.5 15 15	
5.	**Voltage Transformer**			
5.1	Type		GIS /Outdoor	
5.2	Rated primary voltage	kV	33/√3	
5.3	Rated secondary voltage • I winding • II winding	V V	110√3 110√3	
5.4	Accuracy class: • I winding • II winding		0.2 3P	
5.5	Rated power: • I winding • II winding	VA VA	25 75	
5.6	Load		Simultaneously	

6.	**Surge Arresters (Not Applicable)**			
6.1	Nominal system voltage	kV rms	33	
6.2	Highest voltage for equipment U_n	kV rms	36	
6.4	Rated voltage of surge arrester U_r	kV rms	30	
6.5	Max. continuous operating voltage U_c	kV rms	24	
6.8	Rated frequency	Hz	50	
6.9	Nominal discharge current In (8/20 µs)	kA peak	10	
6.10	High current impulse of an arrester (4/10 µs)	kA peak	100	
6.11	Type		GIS /Indoor	
7	**Connection**			
7.1	Type: Cable Connection , Indoor		Yes	
7.2	Type: Single phase or Three phase, according to the design		Yes	
7.3	Outgoing feeder shall be provided with dummy scoket		Yes	
8	**Maintenance requirement**			
8.1	Maintenance of any circuit breaker shall be possible without interruption of adjacent bays		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.3 AIS Switchgear 33 kV

5.2.3.1 Circuit Breaker 33 kV (For Transformer's incomer)

No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	**Data**	
1.	**Circuit Breaker - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-100 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Isolating and quenching medium		Vacuum	
1.8	Type of circuit breaker		Outdoor	
1.9	Design		Single breaking	
1.10	Operating mechanism		Motor-wound spring	
1.11	Number of poles	pcs.	3	
1.12	Number of operating mechanisms per circuit breaker	pcs.	1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.	**Circuit Breaker - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	33	
2.2	Highest voltage for equipment U_n	kV_{rms}	36	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	170	
2.4	Rated short duration power frequency voltage	kV	70	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥ 2500 (for 120MVA Tr.)	
		A	≥ 630 (for earthing Tr.)	
2.7	Rated short-circuit breaking current I_{sc}	kA_{rms}	≥ 31.5	
2.8	Rated peak withstand current I_p (equals to short-circuit making current)	kA	≥ 80	
2.9	D.C. component of the rated short-circuit breaking current	%	> 30	
2.10	First-pole-to-clear factor • Terminal fault • Short-line fault • Out-of-phase	 p.u. p.u. p.u.	 1.3 N.A. N.A.	
2.11	Standard value of transient recovery voltage (T100)	kV	Insert	
2.12	Rate of rise recovery voltage	kV/µs	Insert	
2.13	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.14	Duration of short-circuit	s	≥ 1	
2.15	Rated out-of-phase breaking current	kA	Insert	
2.16	Auto reclosing		3p	
2.17	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 100	
2.18	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.19	Opening time (trip initiation to contact separation) • Without current • With 100 % rated breaking current	 ms ms	 Insert Insert	
2.20	Maximum time interval between opening interrupters	ms	Insert	
2.21	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	3	
2.22	Time for making (trip initiation to contact touch) • Without current • 100 % making current	 ms ms	 Insert Insert	
2.23	Minimum dead time	ms	Insert	
2.24	Restrike performance during capacitive current switching	Class	C2	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.25	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc	No.	≥ 10000 ≥ 2500 ≥ 5	
2.26	The frequency of mechanical operations	Class	M2	
2.27	Rated electrical endurance	Class	Min E1	
2.28	Rated pressure of a circuit breaker	Mpa	Insert	
2.29	Total mass of SF_6 gas in a circuit breaker	kg	Insert	
2.30	Rated mechanical terminal loads			
2.30.1	Static horizontal force, longitudinal F_{thA}	N	Insert	
2.30.2	Static horizontal force, transversal F_{thB}	N	Insert	
2.30.3	Static vertical force F_{tv}	N	Insert	
2.30.4	Dynamic horizontal force, longitudinal F_{wx}	N	Insert	
2.30.5	Dynamic horizontal force, transversal	N	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min. ≥ 31	
3.1.3	HV terminal	pcs.	2	
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 100 x 50	
3.1.3.3	Number of holes		Min 2	
3.1.3.4	Dimensions of holes	mm	Ø 14	
3.1.3.5	Distance between holes	mm	50	
3.1.3.6	Material suitable for		Al terminal	
3.1.5	Weight and dimensions			
3.1.5.1	Support insulator height	mm	Insert	
3.1.5.2	Total height	mm	Insert	
3.1.5.3	Pole weight	kg	Insert	
3.1.5.4	Weight of operating mechanism	kg	Insert	
3.1.5.5	Total weight (with metal structure)	kg	Insert	
3.1.6	Minimum distance			
3.1.6.1	Between poles	mm	Insert	
3.1.6.2	To ground	mm	Insert	
3.2	Operating mechanism			
3.2.1	Type		Insert	
3.2.2	Motor - auxiliary supply voltage	V. AC	230/415	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Control voltage	V. DC	110 220 (for Tongi SS)	
3.2.5	Number of making coils	pcs.	1	
3.2.6	Rated power of making coils	W	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.7	Number of breaking coils	pcs.	2	
3.2.8	Rated power of breaking coils	W	Insert	
3.2.9	Heater		Yes	
3.2.10	Heater supply voltage	V. Hz	230. 50	
3.2.11	Total heater power	W	Insert	
3.2.12	Minimum number of available contacts (NO/NC/V)		6NO+6NC+1V	
3.2.15	Water-tight corrosion-resistant housing		IP55	
3.2.17	Operating mechanism material		Al or stainless steel	
3.2.19	Local/remote control selector switch		Yes	
3.4	Local operation push buttons			
3.4.1	Anti-pumping relay		Yes	
3.4.2	Operation counter		Yes	
3.4.3	Motor MCB (miniature circuit breakers)		Yes	
3.4.4	Heater - 230 V, 50 HZ		Yes	
3.4.5	Cu earthing rails inside central control cabinet		Yes	
3.4.6	Detachable plates, the bottom of central control cabinet		Yes	
3.4.7	Galvanized horizontal and vertical metal structure with minimum 70 µm zinc layer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.3.2 Circuit Breaker 33 kV (For capacitor bank)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Circuit Breaker - General**			
1.1.	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-100 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Isolating and quenching medium		SF6	
1.8	Type of circuit breaker		Outdoor	
1.9	Design		Single breaking	
1.10	Operating mechanism		Motor-wound spring	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.11	Number of poles	pcs.	3	
1.12	Number of operating mechanisms per circuit breaker	pcs.	1	
2.	**Circuit Breaker - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	33	
2.2	Highest voltage for equipment U_n	kV_{rms}	36	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	170	
2.4	Rated short duration power frequency voltage	kV	70	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated current I_r	A	≥ 1250	
2.7	Rated short-circuit breaking current I_{sc}	kA_{rms}	≥ 31.5	
2.8	Rated peak withstand current I_p (equals to short-circuit making current)	kA	≥ 80	
2.9	D.C. component of the rated short-circuit breaking current	%	> 30	
2.10	First-pole-to-clear factor • Terminal fault • Short-line fault • Out-of-phase	 p.u. p.u. p.u.	 1.3 N.A. N.A.	
2.11	Standard value of transient recovery voltage (T100)	kV	Insert	
2.12	Rate of rise recovery voltage	kV/µs	Insert	
2.13	Rated operating sequence		O-0.3 s-CO-3 min-CO	
2.14	Duration of short-circuit	s	≥ 1	
2.15	Rated out-of-phase breaking current	kA	Insert	
2.16	Auto reclosing		3p	
2.17	Maximum total break time (trip initiation to final arc extinction) pos.3.7.135 acc. to IEC 62271-100)	ms	≤ 100	
2.18	Time of final arc extinction (3.7..134 acc. IEC 62271-100)	ms	20 ± 5	
2.19	Opening time (trip initiation to contact separation) • Without current • With 100 % rated breaking current	 ms ms	 Insert Insert	
2.20	Maximum time interval between opening interrupters	ms	Insert	
2.21	Maximum time interval between opening of first and last phase of three-phase circuit breakers	ms	3	
2.22	Time for making (trip initiation to contact touch) • Without current • 100 % making current	 ms ms	 Insert Insert	
2.23	Minimum dead time	ms	Insert	
2.24	Restrike performance during capacitive current switching	Class	C2	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.25	Number of operations without maintenance • CO at no-load • CO at rated current • CO at rated breaking current Isc	No.	≥ 10000 ≥ 2500 ≥ 5	
2.26	The frequency of mechanical operations	Class	M2	
2.27	Rated electrical endurance	Class	Min E1	
2.28	Rated pressure of a circuit breaker	Mpa	Insert	
2.29	Total mass of SF_6 gas in a circuit breaker	kg	Insert	
2.30	Rated mechanical terminal loads			
2.30.1	Static horizontal force, longitudinal F_{thA}	N	Insert	
2.30.2	Static horizontal force, transversal F_{thB}	N	Insert	
2.30.3	Static vertical force F_{tv}	N	Insert	
2.30.4	Dynamic horizontal force, longitudinal F_{wx}	N	Insert	
2.30.5	Dynamic horizontal force, transversal	N	Insert	
3.	**Circuit Breaker - Design and Construction**			
3.1	Circuit Breaker			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min. ≥ 31	
3.1.3	HV terminal	pcs.	2	
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 100 x 50	
3.1.3.3	Number of holes		Min 2	
3.1.3.4	Dimensions of holes	mm	Ø 14	
3.1.3.5	Distance between holes	mm	50	
3.1.3.6	Material suitable for		Al terminal	
3.1.5	Weight and dimensions			
3.1.5.1	Support insulator height	mm	Insert	
3.1.5.2	Total height	mm	Insert	
3.1.5.3	Pole weight	kg	Insert	
3.1.5.4	Weight of operating mechanism	kg	Insert	
3.1.5.5	Total weight (with metal structure)	kg	Insert	
3.1.6	Minimum distance			
3.1.6.1	Between poles	mm	Insert	
3.1.6.2	To ground	mm	Insert	
3.2	Operating mechanism			
3.2.1	Type		Insert	
3.2.2	Motor - auxiliary supply voltage	V. AC	230/415	
3.2.3	Rated power of motor	W	Insert	
3.2.4	Control voltage	V. DC	110	
3.2.5	Number of making coils	pcs.	1	
3.2.6	Rated power of making coils	W	Insert	
3.2.7	Number of breaking coils	pcs.	1	
3.2.8	Rated power of breaking coils	W	Insert	
3.2.9	Heater		Yes	
3.2.10	Heater supply voltage	V. Hz	230. 50	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2.11	Total heater power	W	Insert	
3.2.12	Minimum number of available contacts (NO/NC/V)		6NO+6NC+1V	
3.2.15	Water-tight corrosion-resistant housing		IP55	
3.2.17	Operating mechanism material		Al or stainless steel	
3.2.19	Local/remote control selector switch		Yes	
3.4	Local operation push buttons			
3.4.1	Anti-pumping relay		Yes	
3.4.2	Operation counter		Yes	
3.4.3	Motor MCB (miniature circuit breakers)		Yes	
3.4.4	Heater - 230 V, 50 HZ		Yes	
3.4.5	Cu earthing rails inside central control cabinet		Yes	
3.4.6	Detachable plates, the bottom of central control cabinet		Yes	
3.4.7	Galvanized horizontal and vertical metal structure with minimum 70 µm zinc layer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.3.3 Disconnector 33 kV without ES

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Vertical break, horizontal or wall mounting	
1.9	Number of poles	pcs.	3	
1.10	Type of operating mechanism		Hand operated/Motorized	
1.11	Number of operating mechanisms	pcs.	1	
2.	**Disconnector - Characteristics**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1	Nominal system voltage	kV rms	33	
2.2	Highest voltage for equipment U_n	kV rms	36	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	170	
2.4	Rated short duration power frequency voltage	kV	70	
2.5	Rated frequency f_r	Hz	50	
2.7	Rated current I_r	A	≥ 2500 (for 120MVA Tr.)	
		A	≥ 1250 (for 33kV Capacitor Bank)	
		A	≥ 630 (for earthing Tr.)	
2.8	Rated short withstand current I_k	kA_{rms}	≥ 31.5	
2.9	Rated duration of short-circuit	s	≥1	
2.10	Rated maximum withstand current Ip	kA	≥ 80	
2.13	Nominal supply voltage			
2.13.1	Controls and alarm (signalling) circuits	V d.c.	110 220 (for Tongi SS)	
2.13.2	Heaters	V a.c. / Hz	230 / 50	
2.14	Opening time	s	Insert	
2.15	Closing time	s	Insert	
2.16	Mechanical endurance	Class	Min M1	
2.17	Rated mechanical terminal loads of terminals			
2.17.1	Direct loading, static Fa	N	Insert	
2.17.2	Transversal loading, static F_b	N	Insert	
2.17.3	Vertical force F_c	N	Insert	
2.17.4	Direct loading, dynamic	N	Insert	
2.17.5	Transversal loading, dynamic	N	Insert	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.3	HV terminals			
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 100 x 50	
3.1.3.3	Number of holes		Min 2	
3.1.3.4	Dimensions of holes	mm	Ø 14	
3.1.3.5	Distance between holes	mm	50	
3.1.3.6	Material suitable for		Al terminal	
3.1.4	Weight and dimensions			
3.1.4.1	Pole height	mm	Insert	
3.1.4.2	Pole length	mm	Insert	
3.1.4.3	Distance between support axis of a pole	mm	Insert	
3.1.4.4	Shipping dimensions	mm	Insert	
3.1.4.5	Pole weight	kg	Insert	
3.1.4.6	Total weight	kg	Insert	
3.1.4.7	Shipping weight	kg	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	1	
3.2.2	Type		Insert	
3.2.3	Minimum number of available contacts (NO/NC)	pcs.	6NO+6NC	
3.2.4	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.5	Heater, 230 V, 50 Hz		Yes	
3.2.6	Total heater power	W	Insert	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Housing of Al or stainless steel		Yes	
3.2.9	Equipotential bonding rails		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.3.1 Disconnector 33 kV with ES

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Disconnector- General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Vertical break, horizontal or wall mounting	
1.9	Number of poles	pcs.	3	
1.10	Type of main blade operating mechanism		Hand operated/Motorized	
1.11	Number of main blade operating mechanisms	pcs.	1	
1.12	Type of main blade operating mechanism		Hand operated/Motorized	
1.13	Number of main blade operating mechanisms	pcs.	1	
2.	**Disconnector - Characteristics**			
2.1	Nominal system voltage	kV rms	33	
2.2	Highest voltage for equipment U_n	kV rms	36	
2.3	Rated lightning impulse withstand voltage	kV_{peak}	170	
2.4	Rated short duration power frequency voltage	kV	70	
2.5	Rated frequency f_r	Hz	50	
2.7	Rated current I_r	A	≥ 2500 (for 120MVA Tr.)	
		A	≥ 1250 (for 33kV Capacitor Bank)	
		A	≥ 630 (for earthing Tr.)	
2.8	Rated short-time withstand current I_k	kA_{rms}	≥ 31.5	
2.9	Rated duration of short-circuit	s	≥1	
2.10	Rated maximum withstand current Ip	kA	≥ 80	
2.13	Nominal supply voltage			
2.13.1	Controls and alarm (signalling) circuits	V d.c.	110 220 (for Tongi SS)	
2.13.2	Heaters	V a.c. / Hz	230 / 50	
2.14	Opening time	s	Insert	
2.15	Closing time	s	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.16	Mechanical endurance	Class	Min M1	
2.17	Rated mechanical terminal loads of terminals			
2.17.1	Direct loading, static Fa	N	Insert	
2.17.2	Transversal loading, static F_b	N	Insert	
2.17.3	Vertical force F_c	N	Insert	
2.17.4	Direct loading, dynamic	N	Insert	
2.17.5	Transversal loading, dynamic	N	Insert	
3.	**Disconnector - Design and Construction**			
3.1	Disconnector			
3.1.1	Insulator material		Porcelain	
3.1.2	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.1.3	HV terminals			
3.1.3.1	Shape		Flat	
3.1.3.2	Dimensions	mm x mm	Min 100 x 50	
3.1.3.3	Number of holes		Min 2	
3.1.3.4	Dimensions of holes	mm	Ø 14	
3.1.3.5	Distance between holes	mm	50	
3.1.3.6	Material suitable for		Al terminal	
3.1.4	Weight and dimensions			
3.1.4.1	Pole height	mm	Insert	
3.1.4.2	Pole length	mm	Insert	
3.1.4.3	Distance between support axis of a pole	mm	Insert	
3.1.4.4	Shipping dimensions	mm	Insert	
3.1.4.5	Pole weight	kg	Insert	
3.1.4.6	Total weight	kg	Insert	
3.1.4.7	Shipping weight	kg	Insert	
3.2	Operating mechanism			
3.2.1	Number of operating mechanism	pcs.	1+1	
3.2.2	Type		Insert	
3.2.3	Minimum number of available contacts (NO/NC)	pcs.	6NO+6NC	
3.2.4	Anti-condensation heater inside the operating mechanism cabinet		Yes	
3.2.5	Heater, 230 V, 50 Hz		Yes	
3.2.6	Total heater power	W	Insert	
3.2.7	Water-tight corrosion-resistant housing		IP55	
3.2.8	Housing of Al or stainless steel		Yes	
3.2.9	Equipotential bonding rails		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.3.2 Current Transformer 33 kV (For 120MVA Tr. Bay) (Not applicable)

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	**Current Transformer-General**			
1.1	Manufacturer		*insert*	
1.2	Country of Manufacturing		EU/UK/USA/ Japan/Turkey	
1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		*insert*	
1.5	Country of Origin		EU/UK/USA/ Japan/Turkey	
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 Earhing		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	2400	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.9	Electrical dissipation factor at power frequency test voltage		*insert*	
2.10	Capacitance	pF		
2.11	Maximum Allowable winding temperature	°C	*insert*	
2.12	Normal current density of primary winding		*insert*	
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	 2400-1600-800/1 2400-1600-800/1 2400-1600-800/1 2400-1600-800/1	
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	*insert* *insert* *insert* *insert*	
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	*insert* *insert* *insert* *insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
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	*insert* *insert* *insert* *insert*	
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	*insert* *insert* *insert* *insert*	
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 ^{0}C, R_{CT} for each rating:	Ohms	*insert*	
2.23	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III • Core-IV	Ohms	*insert*	
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)		*Insert*	
3.4	Type including Brand		*Insert*	
3.5	Quantity of insulating oil		*Insert*	
3.6	Porcelain Breaking Strength	kN	*Insert*	
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)	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.10	Min. LV enclosure protection		IP55	
3.11	Insulation Class		Class A/Class E	
3.12	Insulation test tapping data		Yes/No.	
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	*insert*	
3.13.6	MV terminals: Admissible Dynamic Load	KN	*insert*	
3.13.7	MV terminals: Cantilever test Load	KN	*insert*	
3.14	Total weight	kg	*insert*	
3.15	Total Height	mm	*insert*	
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		*insert*	
4.2	Expected Operating Life in Yrs		*insert*	
4.3	Mean time to repair in Hrs		*insert*	
4.4	Mean time between preventive maintenance in Yrs		*insert*	
4.5	Mean Time to (perform) preventive maintenance in Hrs		*insert*	
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 ingression 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.

5.2.3.3 Voltage Transformer 33 kV (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Voltage Transformers - General**			
1.1	Manufacturer		Insert	
1.2	Type		Inductive	
1.3	Model designation		Insert	
1.4	Country of origin		EU/UK/USA/Japan/Turkey	
1.5	Standards		IEC 61869-1 IEC 61869-3 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001	
1.7	Type		Outdoor, post type	
2.	**Voltage Transformers - Characteristics**			
2.1	Nominal system voltage, U_n	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	70	
2.5	Rated frequency f_r	Hz	50	
2.6	Rated short-time thermal current Ith, 1 s	kA	31.5	
2.7	Rated dynamic current I_{dyn}	kV_{peak}	80	
2.8	Rated primary voltage	kV	33/√3	
2.9	Rated secondary voltage • I winding • II winding • III winding	 V V V	 110/√3 110/√3 110/√3	
2.10	Accuracy class: • I winding • II winding • III winding		 0.2 0.2 3P	
2.11	Rated power: • I winding • II winding • III winding	 VA VA VA	 10 10 15	
2.12	Load		Simultaneously	
2.13	Voltage factor	p.u./s	1.2 (continuous) 1.5/30 (for solidly grounded system) 1.9/30 (for ungrounded system)	
2.14	Rated mechanical strength	Class	Min. Class I	
2.15	Power frequency withstand voltage on secondary windings, 1 min	kV rms	3	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.	**Voltage Transformers - Design and Construction**			
3.1	Insulator material		Composite/silicone	
3.2	Insulating medium		paper - Mixed dielectric	
3.3	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
3.4	Max. radio interference voltage at 0.5-2 MHz (acc. IEC 60694)	μV	Max. 2500	
3.5	Permissible level of partial discharges: • Test voltage 1.2*U_M/es • Test voltage U_M	 pC pC	 Max. ≤ 5 ≤ 10	
3.7	Min. LV enclosure protection		IP55	
3.8	HV terminals			
3.8.1	Shape		Flat	
3.8.2	Position		Vertical or horizontal	
3.8.3	Dimensions	mm x mm	Min 100 x 50	
3.8.4	Number of holes		Min 2	
3.8.5	Dimensions of holes	mm	Ø 14	
3.8.6	Distance between holes	mm	50	
3.8.7	Material suitable for		Al terminal	
3.10	Mass and dimensions			
3.11	Total mass	kg	Insert	
3.13	Height	mm	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.3.4 Current Transformer 33kV (For Capacitor Bank)

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	**Current Transformer-General**			
1.1	Manufacturer		*insert*	
1.2	Country of Manufacturing		Insert	
1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		*insert*	
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 Indoor (For Cox's Bazar grid)	
1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earhing		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	400	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Electrical dissipation factor at power frequency test voltage		*insert*	
2.10	Capacitance	pF	*insert*	
2.11	Maximum Allowable winding temperature	°C	*insert*	
2.12	Normal current density of primary winding		*insert*	
2.13	Rated continuous thermal current (40°C): • Core-I • Core-II • Core-III	% In % In	150 120 120	
2.14	Rated Transformer ratio: • Core-I • Core-II • Core-III	A/A A/A A/A	400/1 400/1 400/1	
2.15	Accuracy Class: • Core-I • Core-II • Core-III		0.2s 5P 5P	
2.16	Rated Burden: • Core-I • Core-II • Core-III	VA VA VA	10 15 30	
2.17	Rated Knee Point Voltage, V_k(Min) at highest ratio • Core-I • Core-II • Core-III	V	*insert* *insert* *insert*	
2.18	Max. magnetizing current guaranteed at knee point voltage, I_{Exc} at V_k at highest ratio • Core-I • Core-II • Core-III	mA	*insert* *insert* *insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
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	mA	*insert* *insert* *insert*	
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	mA	*insert* *insert* *insert*	
2.21	Rated Accuracy limit Factor, ISF/ALF: • Core-I • Core-II • Core-III		≤5 20 20	
2.22	Max. resistance of primary winding at 75 ^{0}C, R_{CT} for each rating:	Ohms	*insert*	
2.23	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III	Ohms	*insert*	
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)		*Insert*	
3.4	Type including Brand		*Insert*	
3.5	Quantity of insulating oil		*Insert*	
3.6	Porcelain Breaking Strength	kN	*Insert*	
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.	
3.13.1	MV terminals : Shape		Flat	
3.13.2	MV terminals: Position		Horizontal	
3.13.3	MV terminals: Material Suitable for		Al terminal	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.13.4	MV terminals: Adjustable holes		Yes	
3.13.5	MV terminals: Admissible Static Load	KN	*insert*	
3.13.6	MV terminals: Admissible Dynamic Load	KN	*insert*	
3.13.7	MV terminals: Cantilever test Load	KN	*insert*	
3.14	Total weight	kg	*insert*	
3.15	Total Height	mm	*insert*	
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		*insert*	
4.2	Expected Operating Life in Yrs		*insert*	
4.3	Mean time to repair in Hrs		*insert*	
4.4	Mean time between preventive maintenance in Yrs		*insert*	
4.5	Mean Time to (perform) preventive maintenance in Hrs		*insert*	
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 ingression 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.

5.2.3.5 Current Transformer 33kV (For Earthing Transformer) (Not applicable)

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	**Current Transformer-General**			
1.1	Manufacturer		*insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.2	Country of Manufacturing		EU/UK/USA/ Japan/Turkey	
1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		*insert*	
1.5	Country of Origin		EU/UK/USA/ Japan/Turkey	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor Indoor (For Cox's Bazar grid)	
1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earhing		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	600	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.9	Electrical dissipation factor at power frequency test voltage		*insert*	
2.10	Capacitance	pF	*insert*	
2.11	Maximum Allowable winding temperature	°C	*insert*	
2.12	Normal current density of primary winding		*insert*	
2.13	Rated continuous thermal current (40°C): • Core-I • Core-II • Core-III	% In % In % In	150 120 120	
2.14	Rated Transformer ratio: • Core-I • Core-II • Core-III	A/A A/A A/A	10/1 200/1 600/1	
2.15	Accuracy Class: • Core-I • Core-II • Core-III		0.2s 5P 5P	
2.16	Rated Burden: • Core-I • Core-II • Core-III	VA VA VA	10 30 30	
2.17	Rated Knee Point Voltage, V_k(Min) at highest ratio • Core-I • Core-II • Core-III	V	*insert* *insert* *insert*	
2.18	Max. magnetizing current guaranteed at knee point voltage, I_{Exc} at V_k at highest ratio • Core-I • Core-II • Core-III	mA	*insert* *insert* *insert*	
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	mA	*insert* *insert* *insert*	

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	mA	*insert* *insert* *insert*	
2.21	Rated Accuracy limit Factor, ISF/ALF: • Core-I • Core-II • Core-III		≤5 20 20	
2.22	Max. resistance of primary winding at 75 ^{0}C, R_{CT} for each rating:	Ohms	*insert*	
2.23	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II • Core-III	Ohms	*insert*	
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)		*Insert*	
3.4	Type including Brand		*Insert*	
3.5	Quantity of insulating oil		*Insert*	
3.6	Porcelain Breaking Strength	kN	*Insert*	
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.	
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	*insert*	
3.13.6	MV terminals: Admissible Dynamic Load	KN	*insert*	
3.13.7	MV terminals: Cantilever test Load	KN	*insert*	
3.14	Total weight	kg	*insert*	
3.15	Total Height	mm	*insert*	
3.16	Ten delta test terminal provided		Yes	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
3.17	Pressure relieving device		Yes	
3.18	Oil level gauge		Yes	
4.	**Reliability Data**			
4.1	Mean Time to Failure in yrs		*insert*	
4.2	Expected Operating Life in Yrs		*insert*	
4.3	Mean time to repair in Hrs		*insert*	
4.4	Mean time between preventive maintenance in Yrs		*insert*	
4.5	Mean Time to (perform) preventive maintenance in Hrs		*insert*	
4.0	**Overall compliance with the requirements (yes/no)**		Yes/No.	

Note:

3) The oil immersed Type CT shall be hermetically sealed to eliminate breathing and to prevent ingression 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.
4) 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.

5.2.3.6 Surge Arrester 33 kV

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	**Surge Arresters - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.5	Standards		IEC 60099-4	
1.6	Quality control		ISO 9001	
1.7	Design		Metal oxide, gapless, outdoor	
1.8	Short circuit testing authority		Insert authority	
1.9	ZnO block manufacturer with country of manufacturing		Shall be manufactured in European countries/ USA/Canada/Japan	
2	**Surge Arresters - Characteristics**			
2.1	Nominal system voltage	kV rms	33	
2.2	Highest voltage for equipment Um	kV rms	36	
2.4	Rated voltage of surge arrester Ur	kV rms	30	
2.5	Max. continuous operating voltage Uc	kV rms	24	
2.8	Rated frequency	Hz	50	
2.9	Nominal discharge current In (8/20 μs)	kA peak	10	
2.10	High current impulse of an arrester (4/10 μs)	kA peak	100	
3	**Surge Arresters - Design and Construction**			
3.1	Line discharge class	Class	3	
3.2	Energy dissipation capacity (per kV of rated voltage)	kJ/kV	≥ 6.5	
3.3	Long duration current impulse (2000 μs)	A	≥ 850	
3.4	Maximum residual voltage Ures			
3.4.1	For switching impulse current 30/60 μs at 0,5 kA	kV peak	≤ 65	
3.4.2	For switching impulse current 30/60 μs at 1 kA	kV peak	≤ 67.5	
3.4.3	For switching impulse current 30/60 μs at 2 kA	kV peak	≤ 70	
3.4.4	For lightning impulse current 8/20 μs at 5 kA	kV peak	≤ 75	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.5	For lightning impulse current 8/20 μs at 10 kA	kV peak	≤ 80	
3.4.6	For lightning impulse current 8/20 μs at 20 kA	kV peak	≤ 90	
3.5.	Dielectric endurance of arrester housing**)**			
3.5.1	Lightning impulse withstand voltage of arrester housing up (1.2/50 μs)	kV	≥ 235	
3.5.2	Power frequency withstand voltage of arrester housing (1 min wet)	kV	≥ 105	
3.6.	Mechanical requirements			
3.6.1	Specified short-term load SSL (Fdyn)	N	≥ 7500	
3.6.2	Specified long-term load SSL (Fstat)	N	≥ 5000	
3.7	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
3.8.	Housing insulating material		Composite/Silicon	
3.9	Insulating basement		Yes	
3.10	Surge arrester height	mm	Insert	
3.11	Surge arrester weight	kg	Insert	
3.12	Voltage distribution ring present / ring diameter	yes / no / mm	Insert	
3.14	HV terminal			
3.14.1	Shape		Flat	
3.14.2	Dimension	mm x mm	Min 100 x 50	
3.14.3	Number of holes		Min 2	
3.14.4	Distance between holes	Mm	50	
3.14.5	Material suitable for		Al terminal	
	Overall compliance with the requirements (yes/no)			

5.2.3.7 33kV Post Insulator

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Post Insulators - General**			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain, outdoor	
2	**Post Insulators - Characteristics**			
2.1	Nominal system voltage	kV_{rms}	33	
2.2	Highest voltage for equipment U_n	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	Switching impulse withstand voltage (kVp)	kV peak	NA	
2.6	Corona extinction voltage	kVrms	22	
2.7	Rated frequency f_r	Hz	50	
2.8	Minimum creepage distance	mm/kV	Min. ≥ 31 mm/kV	
2.9	Failing load bending (p0) (C10)	N	≥ 10000	
2.10	Failing load torsion	Nm	≥ 4000	
3	Post Insulators - Design and Construction			
3.1	Insulation material		Porcelain, brown	
3.2	Material quality acc. IEC 60672		Min. C130	
3.3	Min. material density ρ_a	Mgm^{-3}	≥ 2.5	
3.4	Min. stretch strength of material σ_{fg}	MPa	≥ 140	
3.5	Total min. cantilever strength (kg)	kg	800	
3.6	Total creepage distance (mm) pedestal	mm	insert	
3.7	Total min. height of insulator (mm)	mm	2500	
3.8	Max. diameter of insulating part	mm	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.9	Diameter of upper base	mm	Insert	
3.10	Number of holes on upper base		Insert	
3.11	Diameter distance between holes on upper base	mm	Insert	
3.12	Hole type on upper base		Insert	
3.13	Diameter on lower base	mm	Insert	
3.14	Number of holes on lower base		Insert	
3.15	Diameter distance between holes on lower base	mm	Insert	
3.16	Hole type on lower base		Insert	
3.17	Insulator weight	kg	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.4 Transformers

5.2.4.1 400/138/33 kV 250/325 MVA Autotransformer (Not applicable)

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		Autotransformer three-phase, oil immersed, with tertiary winding, hermetically sealed, with on-load tap changer, outdoor	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60044	
1.5.1			IEC 60076	
1.5.2			IEC 60137	
1.5.3			IEC 60214	
1.5.4			IEC 60354	
1.5.5			IEC 60529	
1.5.6			IEC 60815	
1.5.7			IEC 60947	
1.5.8			NEMA TR-1	
1.5.9			CENELEC EN 50216	
1.6	Quality control		ISO 9001	
1.7	Tertiary winding function		Stabilizing winding & auxiliary power supply	
1.8	Thermal insulation class		A	
2	**Ratings and properties**			
2.1	**Rating (three phase)**		Rated power 325 MVA, all taps	
2.1.1	Frequency	Hz	50	
2.1.2	Corresponding minimum Frequency	Hz	48	
2.1.3	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	
2.1.4	Neutral point insulation		LI 325 AC 140	
2.1.5	Voltage ratio (No Load)	kV	400/138/33	
2.2	**Rated power by cooling ONAN / ONAF**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.2.1	Primary / secondary winding	MVA	250/325	
2.2.2	Tertiary – minimum	MVA	75/100	
2.2.3	Loading Type		Simultaneous on HV-LV-TV (The 3 windings of the transformer shall be designed for **arithmetic loading** in such a way that **the tertiary winding** can be loaded continuously for the specified MVA rating)	
2.3	**Rated (highest) voltage of windings**			
2.3.1	HV winding	kV	420	
2.3.2	LV winding	kV	145	
2.3.3	TV - stabilizing winding	kV	36	
2.3.4	NV - Neutral voltage	kV	72.5	
2.4	**Tap changer**			
2.4.1	Manufacturer		Insert	
2.4.2	Manufacturer		MR/ABB	
2.4.3	Country of origin		EU	
2.4.4	Switching technology		Vacuum	
2.4.5	Model designation		Insert	
2.4.6	Type of tap changing		On-load	
2.4.7	Electrical location of Tap winding		HV / Series Winding	
2.4.8	Geometric Location of Tap winding		[Insert]	
2.4.9	Type of voltage regulation		Constant Flux Variable Voltage (C.F.V.V.)	
2.4.10	Tapping range	% V	±10	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.11	Tapping step/Size of Each tapping step	%	1.25	
2.4.12	Number of steps		17	
2.4.13	Short circuit current - time	kA-s	[Insert]	
2.4.14	Insulation level	kV	[Insert]	
2.4.15	Rated current	A	≥ 1600	
2.4.16	BIL to ground through the regulating coil	kV peak	Insert	
2.4.17	Power frequency withstand voltage for 1 minute through the regulating coil	kV rms	Insert	
2.4.18	Tap position indicator		Digital code matrix (BCD)	
2.4.19	Auxiliary supply		3x400 V / 230 V, 50 Hz	
2.4.20	OLTC diverter switch tank		Separate from Main tank	
2.4.21	Breathing of OLTC		Separate/Shared conservator	
2.4.22	OLTC Oil guided to Radiator for cooling		No	
2.4.23	OLTC tap change principle type		Resistance/Reactance type	
2.4.24	MVA Rating of Transformer due to OLTC operation		Rated power 325 MVA, all taps	
2.4.25	Rated Voltage (No. load) due to OLTC operation	kV/kV/kV	Insert	
2.4.26	Percent Impedance design due to Tap Changing		Constant	
2.4.27	OLTC Drive Type		Insert	
3	**Special technical requirements**			
3.1	**Short circuit impedance corrected to reference temperature of 75°C at rated frequency and rated power**			
3.1.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	13 ±10 %	
3.1.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV line side 31.5 kArms)	
3.1.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV line side 31.5 kArms)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.2	**Zero-sequence impedance, with tap changer in middle position:**			
3.2.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	Insert	
3.2.4	X/R ratio			
3.3	**Autotransformer capacity to withstand external short circuits**			
3.3.1	Short-circuit duration	sec	2	
3.3.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period:			
3.3.3	HV winding	kA	Infinite	
3.3.4	LV winding	kA	Infinite	
3.3.5	TV winding	kA	Infinite	
3.3.6	Pre-fault voltage	p.u.	1.05	
3.4	**Guaranteed losses [HV-LV-TV Simultaneously loaded]**			
3.4.1	**No Load Loss**			
3.4.1.1	No-load losses with tap changer in nominal (principal) tap position at rated voltage and at rated frequency	kW	Insert	
3.4.1.2	No-load losses with tap changer in nominal (principal) tap position at 110 % rated voltage and at rated frequency	kW	Insert	
3.4.1.3	No-load losses with tap changer in nominal (principal) tap position at 90 % rated voltage and at rated frequency	kW	Insert	
3.4.1.4	Average of the above & No-Load Loss for Loss capitalization (N) [This value will be evaluated]	kW	Insert	
3.4.1.5	No-load losses capitalized value	BDT/kW	600,000	
3.4.1.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
3.4.2	**On-load losses at 75°C,**			
3.4.2.1	On-load losses at 75°C and rated frequency, with tap changer in nominal tap position at rated tapping current (ONAF) of that tap position	kW	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.2.2	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	
3.4.2.3	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	
3.4.2.4	Average of the above & On-load Loss for Loss capitalization (L) [This value will be evaluated]	kW	Insert	
3.4.2.5	On-load losses capitalized value	BDT/kW	300,000	
3.4.2.6	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.4.3	Ancillary Loss			
3.4.3.1	Ancillary equipment (fans, pumps, heaters, motors etc.)			
3.4.3.2	Load of ancillary equipment (this value will be evaluated)	kW	Insert	
3.4.3.3	Capitalized valued of ancillary equipment load	BDT/kW	300,000	
3.4.3.4	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
3.5	**Rated Insulation level**			
3.5.1	High voltage (HV)		LI 1425 SI 1050	
			AC650	
3.5.2	Low voltage (LV)		LI 650 AC 275	
3.5.3	Tertiary voltage (TV)		LI 170 AC 70	
3.5.4	Neutral voltage (NV)		LI 325 AC 140	
3.5.5	Method of Neutral Earthing		Solid Ground	
3.6	**Efficiencies [HV-LV-TV Loading]**			
3.6.1	If cosφ = 1.0 and:			
3.6.1.1	• 25 % load of the rated value		Insert	
3.6.1.2	• 50 % load of the rated value		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.6.1.3	• 75 % load of the rated value		Insert	
3.6.1.4	• 100 % load of the rated value		Insert	
3.6.2	If cosφ = 0.9 (inductive) and:			
3.6.2.1	• 25 % load of the rated value		Insert	
3.6.2.2	• 50 % load of the rated value		Insert	
3.6.2.3	• 75 % load of the rated value		Insert	
3.6.2.4	• 100 % load of the rated value		Insert	
3.6.3	If cosφ = 0.8 (inductive) and:			
3.6.3.1	• 25 % load of the rated value		Insert	
3.6.3.2	• 50 % load of the rated value		Insert	
3.6.3.3	• 75 % load of the rated value		Insert	
3.6.3.4	• 100 % load of the rated value		Insert	
3.7	**Voltage drop at the terminals of secondary**			
3.7.1	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position**			
3.7.1.1	• cosφ = 1.00		Insert	
3.7.1.2	• cosφ = 0.95 (inductive)		Insert	
3.7.1.3	• cosφ = 0.90 (inductive)		Insert	
3.7.1.4	• cosφ = 0.80 (inductive)		Insert	
3.7.2	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position [HV-LV-TV loaded, TV at 0.95 leading pf]**			
3.7.2.1	• cosφ = 1.00		Insert	
3.7.2.2	• cosφ = 0.95 (inductive)		Insert	
3.7.2.3	• cosφ = 0.90 (inductive)		Insert	
3.7.2.4	• cosφ = 0.80 (inductive)		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.8	**No-load current at rated frequency**			
3.8.1	At 0.90 Un		Insert	
3.8.2	At 1.00 Un		Insert	
3.8.3	At 1.05 Un		Insert	
3.9	**At the emergency cases it is allowed:**	MVA	Compliant to IEC 60076-7	
	• Continuous overload at the highest winding temperature which exceeds by 2.5°C the guaranteed limit value	%		
	• Continuous voltage increase when the top oil temperature exceeds the guaranteed limit by 2.5°C at rated power (in % of the rated volt age)			
3.10	**Guaranteed value of overloads in % of the rated power**			
3.10.1	Normal overloads prediction which can occur once a day (in % of the rated power) within the winding temperature rise limit of 75°C			
3.10.1.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.2	After operation under 20 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.3	After operation under 120 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2	Sudden transient overloads (in % of the rated power) with the winding temperature rise limit of 85°C			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.10.2.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.2	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.3	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.11	**Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits:**			
3.11.1	• with all cooling groups in operation (excluding stand-by cooling group)		Insert	
3.11.2	• with one cooling group out of operation		Insert	
3.11.3	• with two cooling groups out of operation		Insert	
4	**Design & Construction**			
4.1*	**Cooling system**			
4.1.1	**Oil Flow through Windings/ windings group**			
4.1.1.1	Guided Oil Flow inside transformer	Yes/No.	Yes	
4.1.1.2	Pattern of Oil Flow through Duct	Axial/Zig-Zag	[Insert]	
4.1.2	**Pressure drop inside transformer**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.1.2.1	Radial Locations with respect to core	bar	[Insert]	
4.1.2.2	Axial Locations with respect to core	bar	[Insert]	
4.1.3	**Radiators & Coolers**			
4.1.3.1	Radiator Location		A	
	Attached to Tank or Separate		Attached to Tank	
4.1.3.2	Number of cooling groups (total)	Qty.	Insert	
	Number of cooling groups (for rated power)	Qty.	Insert	
	Number of stand-by cooling groups	Qty.	Insert	
	Number of coolers in a cooling group	Qty.	Insert	
	Number of spare fans	Qty.	Insert	
	Rating of each cooler	kW	Insert	
4.1.3.3	Full vacuum withstand of complete cooler	mbar	Yes	
4.1.4	**HV side**			
4.1.4.1	No. of Radiator Bank	No.	[Insert]	
4.1.4.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.4.3	No. of Cooler Fans	No.	[Insert]	
4.1.4.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.4.5	Spare Fans in each group	No.	[Insert]	
4.1.4.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.4.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.4.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.4.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.4.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
4.1.4.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil	No.	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Pipes)			
4.1.4.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.4.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.5	**LV side**			
4.1.5.1	No. of Radiator Bank	No.	[Insert]	
4.1.5.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.5.3	No. of Cooler Fans	No.	[Insert]	
4.1.5.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.5.5	Spare Fans in each group	No.	[Insert]	
4.1.5.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.5.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.5.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.5.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.5.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
4.1.5.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
4.1.5.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare n+1, shall be considered)	
4.1.5.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.2*	**Oil Flow rate**			
4.2.1	**Oil Flow rate inside Transformer during ONAN Cooling**			
4.2.1.1	Highest Flow rate (Approx.)	m/s	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.2.1.2	Location at Transformer		[Insert]	
4.2.1.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.1.4	Location at Transformer		[Insert]	
4.2.1.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.2	**Oil Flow rate inside Transformer during ONAF Cooling**			
4.2.2.1	Highest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.2	Location at Transformer		[Insert]	
4.2.2.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.4	Location at Transformer		[Insert]	
4.2.2.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.3	**Predicted Hot Spot Location**			
4.2.3.1	HV Side		Insert	
4.2.3.2	LV side		Insert	
4.2.3.3	TV side		Insert	
4.2.3.4	Temperature Difference (D-Temp) between Inlet & Outlet of Radiator banks --- Design value	^{0}C	[Insert]	
4.3	**Temperature rise limits, at rated power, with complete cooling system in service and at rated voltage tap**			
4.3.1	Average Oil Temperature rise	^{0}C		
4.3.2	Top oil	°C	≤ 60	
4.3.3	Winding	°C	≤ 65	
4.3.4	Hottest spot	°C	≤ 78	
4.3.5	Maximum hot spot temperature rises in core at rated power	^{0}C	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.3.6	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	^{0}C	130	
4.3.7	Surface Temperature (Amb. Temp. + Top oil rise + Core surface temp.)	^{0}C	Insert	
4.3.8	Temperature gradient at rating specified	K		
4.3.9				
4.3.10*	**Temperature rise of metallic parts**			
4.3.10.1	Tank walls	^{0}C		
4.3.10.2	Tie plate	^{0}C		
4.3.10.3	Top clamp	^{0}C		
4.3.10.4	Bottom clamp	^{0}C		
4.4	**Core Construction**			
4.4.1	Type of Transformer Core (Shell or Core)		Core	
4.4.2	No. of Core Limb		Insert	
4.4.3	Core Material		CRGO Si steel [Hi-B]	
4.4.4	Grade Designation		Insert	
4.4.5	Core Graining Method		Laser-beam or plasma jet irradiation	
4.4.6	Thickness of Sheet	mm		
4.4.7	Specific Loss at 1.7T,50Hz	W/kg	<0.85	
4.4.8	Insulation material & Class			
4.4.9	Safe Working Temperature of Core	^{0}C		
4.4.10	Whether step lap construction adopted		Yes	
4.4.11	Whether boltless construction adopted		Yes	
4.4.12	Core Material Make , Country		Insert	
4.4.13	Whether Core is pre-cut or cut at Factory		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Method of joining of legs		Insert	
	Method of joining of yokes		Insert	
	Joining material		Insert	
4.4.14	Flux density at nominal voltage and frequency and at nominal ratio - (no load)			
4.4.15	Cores	T		
4.4.16	Yokes	T		
4.4.17	Volts/turn	V		
4.4.18	Over flux withstand capability of the Transformer [flux density & time]	T, Min or s		
4.4.19	Continuously 10% over voltage and frequency and at principal tap	T, Min or s		
4.4.20	at 125% of rated Voltage	T, Min or s		
4.4.21	at 140% of rated Voltage	T, Min or s		
4.4.22	at 150% of rated Voltage	T, Min or s		
4.4.23	Magnetizing current (approx) at nominal ratio and			
4.4.23.1	at 0.90 x nominal voltage	% of FLA		
4.4.23.2	at 0.95 x nominal voltage	% of FLA		
4.4.23.3	at 1 .0 x nominal voltage	% of FLA		
4.4.23.4	at 1 .05 x nominal voltage	% of FLA		
4.4.23.5	at 1 .1 x nominal voltage	% of FLA		
4.4.24	Power factor of magnetizing current at normal voltage ratio and frequency			
4.4.25	Oil Ducts among cores		Yes	
4.5	**Winding Construction**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.1	Materials of winding		Copper	
4.5.2	Make, country			
4.5.3	Conductor Used		CTC/others	
4.5.3.1	HV		[Insert]	
4.5.3.2	RV/ tap Winding		[Insert]	
4.5.3.3	LV		[Insert]	
4.5.3.4	TV		[Insert]	
4.5.4*	**Type of Conductor Used**			
4.5.4.1	HV		Cu - 'Interleaved' Disc	
4.5.4.2	RV/ tap Winding		Layer/Muti-start	
4.5.4.3	LV		Cu - Interleaved / disc-transposed, cured in epoxy coating	
4.5.4.4	TV		Helical/Disk/Layer [Cu - transposed, cured in epoxy coating]	
4.5.5	**Current density, Thermal**			
4.5.5.1	HV	A/mm^2	[Insert]	
4.5.5.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.5.3	LV	A/mm^2	[Insert]	
4.5.5.4	TV	A/mm^2	[Insert]	
4.5.6	**Current Density, Short circuit**			
4.5.6.1	HV	A/mm^2	[Insert]	
4.5.6.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.6.3	LV	A/mm^2	[Insert]	
4.5.6.4	TV	A/mm^2	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.7	Insulations at windings		Thermally Upgraded Paper	
4.5.7.1	Insulation Class		A	
4.5.7.2	Insulation Make, Country			
4.5.7.3	Additional Insulations as Protection caps at windings			
4.5.7.4	HV	Yes/No		
4.5.7.5	LV	Yes/No		
4.5.7.6	TV	Yes/No		
4.5.8	Oil Ducts among windings		Yes	
4.5.9	Material of Pressboard		[Insert]	
4.5.10	Material of Key Spacer		[Insert]	
4.5.11	**Resistance /phase [Design Value with Tolerance]**			
4.5.11.1	HV	Ω	[Insert]	
4.5.11.2	LV	Ω	[Insert]	
4.5.11.3	TV	Ω	[Insert]	
4.5.12	Connection of three-phase windings (vector group IEC 60076)		YNa0d1	
4.5.13	Tertiary winding connection (TV)		Delta made inside the tank, with three terminals brought out outside of the tank	
4.5.14	Geometric Location of windings with respect to core			
4.5.14.1	TW		[Insert]	
4.5.14.2	LW/ common winding		[Insert]	
4.5.14.3	HV/ series winding		[Insert]	
4.5.14.4	RW		[Insert]	
4.5.14.5	Winding Method		(Hor/Ver.)[Insert]	
4.5.15	**Winding connections [crimped, Brazed or others]**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.15.1	Between Windings			
4.5.15.2	Between Winding Layers/Disk			
4.5.15.3	Between Main Winding & Tap Winding			
4.5.15.4	Between Windings & Leads			
4.5.15.5	Clamping of Winding			
4.5.15.6	The individual winding sets clamped separately from each other and separately from the core.		Yes	
4.5.15.7	Acceptable Tangent delta of winding		Insert	
4.5.15.8	Acceptable PD level	pC		
4.6*	**Curing of Active Part**			
4.6.1	Highest temperature	^{0}C		
4.6.1.1	Duration	Hrs		
4.6.2	Average temperature	^{0}C		
4.6.2.1	Duration	Hrs		
4.6.5	Total duration	Hrs		
4.6.6	Active Part Compression during Pressure, (Approx.)	mm		
5	**Short Circuit**			
5.1	**Minimum Current through windings for Terminal Fault**			
5.1.1	HV (RMS/PEAK)	kArms/kAp		
5.1.2	LV (RMS/PEAK)	kArms/kAp		
5.1.3	TV (RMS/PEAK)	kArms/kAp		
5.1.4	Peak Factor		2.69	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2	Pre-fault voltage	p.u.	1.05	
5.3	Withstand Duration	s	2	
5.4	Similar Design Transformer (as per IEC 60076-5, Annex A) type test reference			
5.4.1	Testing Authority		STL Lab, insert Name	
5.4.2	certificate reference			
5.4.3	Contact address of test Lab			
5.4.4	Validity of test certificate			
5.5	Force [Shall be based on Highest SCC among LLG, LL, LLL, LG at each side-HV/LV/TV] for offered TR			
5.5.1	Axial Force [CW/SW/RW/TW]	kN		
5.5.2	Free Buckling Force [CW/SW/RW/TW]	kN		
5.5.3	Compression Force [CW/SW/RW/TW]	kN		
5.5.4	Designed Safety Margin [CW/SW/RW/TW]			
a	For indivisual winding clamping		> 1.4	
b	For other design		>2	
5.6	Offered & Reference Similar Type testedDesign transformer Short Circuit Force relationship		Within 110%	
5.7	Temperature during SC			
5.7.1	HV Winding [Actual/Allowable]	^{0}C		
5.7.2	LV Winding[Actual/Allowable]	^{0}C		
5.7.3	RV Winding [Actual/Allowable]	^{0}C		
5.7.4	TV Winding[Actual/Allowable]			
5.8	Maximum Circulating Current in Delta tertiary for L-G fault at TV terminal	kA		
5.8.1	Winding withstand capacity of this current	Min or s		
6*	**Dielectric Design**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.1	**Impulse Voltage At HV (LI)**			
6.1.1	Maximum applied voltage at critical points	kVp		
6.1.2	Permissible Voltage	kVp		
6.1.3	Safety Factor		>2	
6.1.4	Transferred surge at LV	kVp		
6.1.5	Transferred surge at TV	kVp		
6.1.6	ZnO Block to limit distributed impulse [tap Winding/other]		[At design satge]	
6.2	**Impulse Voltage At HV (SI)**			
6.2.1	Maximum applied voltage at critical points	kVp		
6.2.2	Permissible Voltage	kVp		
6.2.3	Safety Factor		>2	
6.2.4	Transferred surge at LV	kVp		
6.2.5	Transferred surge at TV	kVp		
6.2.6	ZnO Block to limit distributed impulse [tap Winding/other]		At Design stage	
6.3	**Impulse Voltage At LV (LI)**			
6.3.1	Maximum applied voltage at critical points	kVp		
6.3.2	Permissible Voltage	kVp		
6.3.3	Safety Factor		>2	
6.3.4	Transferred surge at HV	kVp		
6.3.5	Transferred surge at TV	kVp		
6.3.6	ZnO Block to limit distributed impulse [tap Winding/other]	kVp	At Design stage	
6.4	**Impulse Voltage at TV (LI)**			
6.4.1	Maximum applied voltage at critical points	kVp		
6.4.2	Permissible Voltage	kVp		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.4.3	Safety Factor		>2	
6.4.4	Transferred surge at HV	kVp		
6.4.5	Transferred surge at LV	kVp		
6.4.6	ZnO Block to limit distributed impulse		No.	
7*	**Earthing**			
7.1	Neutral [with double connection], with copper conductor	Sq-mm		
7.2	Core , taken out		Yes	
7.3	Clamp, taken out		Yes	
7.4	Tank Body		Yes	
7.5	Cubicles		Yes	
7.6	Radiators, if separately mount /connected from tank		NA	
7.7	Others		Insert	
8*	**Valves & Manholes**			
8.1	Type of valves used			
8.2	Valve schedule attached		Yes	
8.3	Spare Manhole for inspection & future use		Yes, insert number & size	
9*	**Oil for Transformer & Tap Changer**			
9.1	Manufacturer		Insert	
9.2	Type, Grade & Model		Insert	
9.3	Standard		IEC 60296	
9.4	Minimum flash point	°C	>140	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
9.5	Viscosity at 40°C	mm^2/s	Max 8	
9.5.1	Viscosity at -30°C	mm^2/s	Max 800	
9.6	Maximum dielectric strength before / after treatment	kV (at 2.5cm)	60/70	
9.7	Total sulphur content	%	<0.01	
9.8	Corrosive Sulphur		No	
9.9	PCB content		Without PCB	
9.10	Water Content	mg/kg	<20	
9.11	DDF at 90°C [IEC 60247]		<0.001	
9.12	Density at 20°C	Kg/dm^3	>0.7	
9.13	Stray gassing under thermooxidative stress			
	Hydrogen	µL/L	<5	
	Methane/Ethane		<1	
9.14	Sludge	wt %	<0.01	
9.15	Antioxidants	wt %	<0.24	
9.16	Total acidity [IEC 61125]	mg KOH/g	<0.05	
9.17	Data sheet attached		Yes	
10	**Bushing**		IEC60137	
10.1	**HV bushing**			
10.1.1	Quantity		03	
10.1.2	Class	kV	420	
10.1.3	Manufacturer		ABB (Sweden, Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.1.4	Type		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.5	Rated current	A	≥ 1600	
10.1.6	Rated short circuit current (2 s)	kA rms	63	
10.1.7	Rated lightning impulse withstand voltage	kV peak	1425	
10.1.8	Rated switching impulse withstand voltage	kV peak	1050	
10.1.9	Rated power frequency withstand voltage (dry)	kV rms	695	
10.1.10	Connectors			
10.1.10.1	Shape	mm	Ø 50	
10.1.10.2	Length	mm	125	
10.1.10.3	Suitable for		Al wire	
10.1.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.1.12	Full vacuum withstand of complete bushing		YES	
10.1.13	Housing		Composite SiR	
10.1.14	Test tap	Yes		
10.1.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	2 kV	
10.1.16	USCD, Unified Specific Creepage Distance	Mm/kV	53.7	
10.1.17	Creepage factor ,Cf [According to IEC 60815]		<3.2	
10.1.18	profile factor, P.F.		<1.1	
10.1.19	Min. flashover distance	mm		
10.1.20	Cantilever test load	kN		
10.1.21	Housing shed type	Alternate		
10.1.22	Air Vent	Yes		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.1.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.1.25	Total Length	mm		
10.1.26	Outer diameter	mm		
10.1.27	CT Pocket Length for BCT	mm		
10.1.28	Oil quantity [for OIP type]	kg		
10.1.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.1.30	No. of Hole			
10.1.31	Diameter of each hole			
10.1.32	Distance between hole			
10.1.33	Fixing nut-bolt Material	AL or SS		
10.1.34	Earthing holes M12	No.		
10.1.35	End-shielding		Yes	
10.1.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.1.37	Top Terminal Suitable for	AL		
10.1.38	dissipation factor			
10.1.39	Partial discharge			
10.1.40	Insulation Class	F/155^0 C		
10.1.41	Total Weight	kg		
10.2	**LV bushing**			
10.2.1	Quantity		03	
10.2.2	Class	kV	145	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.2.4	Type		Insert	
10.2.5	Rated current	A	≥ 2000	
10.2.6	Rated short circuit current (2 s)	kA rms	40	
10.2.7	Rated lightning impulse withstand voltage	kV peak	650	
10.2.8	Rated switching impulse withstand voltage	kV peak	-	
10.2.9	Rated power frequency withstand voltage (wet)	kV rms	275	
10.2.10	Connectors			
10.2.10.1	Shape	mm	Ø 50	
10.2.10.2	Length	mm	125	
10.2.10.3	Suitable for		Al wire	
10.2.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.2.12	Full vacuum withstand of complete bushing		YES	
10.2.13	Housing		Composite SiR	
10.2.14	Test tap	Yes		
10.2.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	2 kV	
10.2.16	USCD, Unified Specific Creepage Distance	Mm/kV	53.7	
10.2.17	Creepage factor ,Cf [According to IEC 60815]		<3.2	
10.2.18	profile factor, P.F.		<1.1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.19	Min. flashover distance	mm		
10.2.20	Cantilever test load	kN		
10.2.21	Housing shed type	Alternate		
10.2.22	Air Vent	Yes		
10.2.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.2.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.2.25	Total Length	mm		
10.2.26	Outer diameter	mm		
10.2.27	CT Pocket Length for BCT	mm		
10.2.28	Oil quantity [for OIP type]	kg		
10.2.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.2.30	No. of Hole			
10.2.31	Diameter of each hole			
10.2.32	Distance between hole			
10.2.33	Fixing nut-bolt Material	AL or SS		
10.2.34	Earthing holes M12	No.		
10.2.35	End-shielding			
10.2.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.2.37	Top Terminal Suitable for	AL		
10.2.38	dissipation factor			
10.2.39	Partial discharge			
10.2.40	Insulation Class	F/155^0 C		
10.2.41	Total Weight	kg		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3	**TV bushing**			
10.3.1	Quantity		03	
10.3.2	Class	kV	36	
10.3.3	Manufacturer		ABB(Sweden, Switzerland), Trench(France/USA), HSP (Germany),GE (Italy)	
10.3.4	Type		Insert	
10.3.5	Rated current	A	≥ 2000	
10.3.6	Rated short circuit current (2 s)	kA rms	31.5	
10.3.7	Rated lightning impulse withstand voltage	kV peak	170	
10.3.8	Rated switching impulse withstand voltage	kV peak	-	
10.3.9	Rated power frequency withstand voltage (wet)	kV rms	70	
10.3.10	Connectors			
10.3.10.1	Shape	mm	Ø 50	
10.3.10.2	Length	mm	125	
10.3.10.3	Suitable for		Al wire	
10.3.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.3.12	Full vacuum withstand of complete bushing		YES	
10.3.13	Housing		Composite SiR	
10.3.14	Test tap	Yes		
10.3.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	2 kV	
10.3.16	USCD, Unified Specific Creepage Distance	Mm/kV	53.7	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.17	Creepage factor ,Cf [According to IEC 60815]		<3.2	
10.3.18	profile factor, P.F.		<1.1	
10.3.19	Min. flashover distance	mm		
10.3.20	Cantilever test load	kN		
10.3.21	Housing shed type	Alternate		
10.3.22	Air Vent	Yes		
10.3.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.3.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.3.25	Total Length	mm		
10.3.26	Outer diameter	mm		
10.3.27	CT Pocket Length for BCT	mm		
10.3.28	Oil quantity [for OIP type]	kg		
10.3.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.3.30	No. of Hole			
10.3.31	Diameter of each hole			
10.3.32	Distance between hole			
10.3.33	Fixing nut-bolt Material	AL or SS		
10.3.34	Earthing holes M12	No.		
10.3.35	End-shielding			
10.3.36	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]			
10.3.37	Top Terminal Suitable for	AL		
10.3.38	dissipation factor			
10.3.39	Partial discharge	pC		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.40	Insulation Class	F/155^0 C		
10.3.41	Total Weight	kg		
10.4	**NV bushing**			
10.4.1	Quantity		01	
10.4.2	Class	kV	72.5	
10.4.3	Manufacturer		ABB(Sweden, Switzerland), Trench(France/USA), HSP (Germany), GE (Italy)	
10.4.4	Type		Insert	
10.4.5	Rated current	A	≥ 2000	
10.4.6	Rated short circuit current (2 s)	kA rms	63	
10.4.7	Rated lightning impulse withstand voltage	kV peak	325	
10.4.8	Rated switching impulse withstand voltage	kV peak	-	
10.4.9	Rated power frequency withstand voltage (wet)	kV rms	140	
10.4.10	Connectors			
10.4.10.1	Shape	mm	Ø 50	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.10.2	Length	mm	125	
10.4.10.3	Suitable for		Al wire	
10.4.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.4.12	Full vacuum withstand of complete bushing		YES	
10.4.13	Housing		Composite SiR	
10.4.14	Test tap	Yes		
10.4.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	2 kV	
10.4.16	USCD, Unified Specific Creepage Distance	Mm/kV	53.7	
10.4.17	Creepage factor ,Cf [According to IEC 60815]		<3.2	
10.4.18	profile factor, P.F.		<1.1	
10.4.19	Min. flashover distance	mm		
10.4.20	Cantilever test load			
10.4.21	Housing shed type	Alternate		
10.4.22	Air Vent	Yes		
10.4.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.4.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.4.25	Total Length	mm		
10.4.26	Outer diameter	mm		
10.4.27	CT Pocket Length for BCT	mm	600	
10.4.28	Oil quantity [for OIP type]	kg		
10.4.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.4.40	No. of Hole			
10.4.41	Diameter of each hole			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.42	Distance between hole			
10.4.43	Fixing nut-bolt Material	AL or SS		
10.4.44	Earthing holes M12	No.		
10.4.45	End-shielding			
10.4.46	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.4.47	Top Terminal Suitable for	AL		
10.4.48	dissipation factor			
10.4.49	Partial discharge	pC		
10.4.40	Insulation Class	F/155^0 C		
10.4.41	Total Weight	kg		
11*	**Sound**			
11.1	At No load, rated frequency, 100% rated voltage , principle tap	dB	<70	
11.2	At No load, rated frequency, 105% rated voltage, principle tap	dB		
11.3	At load, rated frequency, 100% rated voltage, principle tap	dB		
11.4	At load, rated frequency, 105% rated voltage, principle tap	dB		
11.5	Guaranteed during Testing	dB		
13	**Weights and dimensions**			
13.1	**Total weight of autotransformer, equipped for service**	kg	Insert	
13.2	Core and oil assembly	kg	Insert	
13.3	Total mass excluding oil	kg	Insert	
13.4	Tank and accessories	kg	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
13.5	Oil mass in tank	kg	Insert	
13.6	Oil mass in coolers	kg	Insert	
13.7	Oil mass total	kg	Insert	
13.8	Total mass	kg	Insert	
13.9*	**Maximum shipping weight (the heaviest item)**	kg	Insert	
13.10	**Height from foundation to:**			
13.10.1	• Highest point of HV bushing	mm	Insert	
13.10.2	• Highest point of tank	mm	Insert	
13.10.3	• Highest point of conservator	mm	Insert	
13.10.4	• Highest point of lifting hook for removal of core and oil assembly	mm	Insert	
13.11	**Outer dimensions:**			
13.11.1	• Length	mm	Insert	
13.11.2	• Width	mm	Insert	
13.12	Informative dimensional sketch		To be enclosed with bid	
13.13*	**Maximum shipping dimensions of tank:**			
13.13.1	• Outside height	mm	Insert	
13.13.2	• Outside width	mm	Insert	
13.13.3	• Outside length	mm	Insert	
13.14	**Transportation drawing**		To be enclosed with bid	
14	**Auxiliary power supply**			
14.1	Motors		3x400 V / 50 Hz	
14.2	Heaters		230 V / 50 Hz	
14.3	Control voltage		110 V DC	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14.4	Oil pump		3x400 V / 50 Hz	
15	**Current transformer incorporated into the power autotransformer**			
15.1	CT in HV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
15.2	CT in LV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
15.3	CT in neutral bushing, for protection		In all phases, 2cores characteristics shall be defined in design stage	
15.4	CT in TV bushings, for protection		In all phases, 3 cores characteristics shall be defined in design stage	
16*	**Layout**			
16.1	Primary winding bushings		Longitudinal axis	
16.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	
16.3	Conservator tank		As per spec	
16.4	Tap changer		As per spec	
16.5	Control cabinet		separate	
16.6	Coolers		Attached to Body	
16.7	Connection drawing, block diagram		To be enclosed with bid	
17	**Dehydrating breather**			
17.1	Type of dehydrating breather		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
17.2	Dehumidifying agent	kg	Insert	
18	**Autotransformer tank**			
18.1	Type of design		Welded	
18.2	**Thickness of transformer tank:**			
18.2.1	• Sides	mm	Insert	
18.2.2	• Bottom	mm	Insert	
18.2.3	• Top	mm	Insert	
18.3	Material of the autotransformer tank		Insert	
18.4	Wheels			
18.4.1	Wheel number for each rail of two pair rails		Two pairs	
18.4.2	Axial inter space in transversal direction between two pairs of rails	mm	Insert	
18.4.3	Transversal distance between wheels in pair	mm	Insert	
18.4.4	Distance between wheels in longitudinal direction	mm	Insert	
18.5	Corrosion protection of the tank		YES	
18.6	Vacuum withstand of the complete tank with cooler	mbar	1	
18.7	Over-pressure withstand of the complete autotransformer	bar	0.3	
18.8	Painting Color	Munsell no.		
19	**Conservator**			
19.1	Type		With diaphragm	
19.2	Number of compartments	pcs.	Insert	
19.3	Total volume of conservator	m^3	Insert	
19.4	Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 0°C of the volume of	%	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	autotransformer			
19.5	Pressure rise inside the tank due to oil expansion		Insert	
19.5.1	• Maximum diagraph stress at highest working pressure		Insert	
19.5.2	• Diagraph construction details		Insert	
19.5.3	• Type of diagraph material		Insert	
19.6	Corrosion protection of conservator		Insert	
19.7	Oil level indicators with alarm for minimum oil level	pcs.	2	
19.8	Membrane provided inside the conservator for ‘’breathing’’ of the transformer		Yes	
20	**Miscellaneous Item**			
20.1	AVR Relay		MR, Germany	
20.2	Bucholtz relay, Make		insert	
20.3	Control Cable, Make		insert	
20.4	WTI [Normal & Fiber Optic]		Yes, insert number	
20.5	OTI		Yes, insert number	
20.6	Remote Transformer Panel with all accessories, Make		Yes, insert	
20.7	Marshalling Cubicle with all accessories, Make		Yes, insert	
20.8	Cooling Cabinet with all accessories, Make		Yes, insert	
20.9	Material (Cooling & Marshalling Cabinet)		Insert	
20.10.	No. of PRD in Main Tank		Min 3	
20.11	No. of PRD in OLTC		Insert	
20.12	Oil Surge Relay			
20.13	Breather		Mtrab or Eq.	
20.15	Gasket Material		Nitrile Rubber	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
20.16	Nut-Bolt, Make		Insert	
20.17	Nut-Bolt, Material		SS	
20.18	LA Make		Insert	
21	**Operating conditions**			
21.1	At the altitude (above sea level)	m	≤ 1000	
21.2	Maximum ambient temperature	°C	40	
21.3	Average daily temperature	°C	35	
21.4	Average annual temperature	°C	30	
21.5	Minimum ambient temperature	°C	4	
21.6	Tertiary winding		Simultaneously load for Reactive compensation	
21.7	Parallel operation		Yes	
	Overall compliance with the requirements (yes/no)			

230/133/33 kV 350/450 MVA ONAN/ONAF Autotransformer (Not applicable)

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		Autotransformer three-phase, oil immersed, with tertiary winding, hermetically sealed, with on-load tap changer, outdoor	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60044	
1.5.1			IEC 60076	
1.5.2			IEC 60137	
1.5.3			IEC 60214	
1.5.4			IEC 60354	
1.5.5			IEC 60529	
1.5.6			IEC 60815	
1.5.7			IEC 60947	
1.5.8			NEMA TR-1	
1.5.9			CENELEC EN 50216	
1.6	Quality control		ISO 9001	
1.7	Tertiary winding function		Stabilizing winding, auxiliary power supply& Reactive compensation	
1.8	Thermal insulation class		A	
2	**Ratings and properties**			
2.1	**Rating (three phase)**		Rated power 450MVA, all taps	
2.1.1	Frequency	Hz	50	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1.2	Corresponding minimum Frequency	Hz	48	
2.1.3	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	
2.1.4	Neutral point insulation		LI325 AC140	
2.1.5	Voltage ratio (No Load)	kV	230/133/33	
2.2	**Rated power by cooling ONAN / ONAF**			
2.2.1	Primary / secondary winding	MVA	350/450	
2.2.2	Tertiary – minimum	MVA	75/100	
2.2.3	Loading Type		Simultaneous on HV-LV-TV (The 3 windings of the transformer shall be designed for **arithmetic loading** in such a way that **the tertiary winding** can be loaded continuously for the specified MVA rating)	
2.3	**Rated (highest) voltage of windings**			
2.3.1	HV winding	kV	245	
2.3.2	LV winding	kV	145	
2.3.3	TV - stabilizing winding	kV	36	
2.3.4	NV - Neutral voltage	kV	72.5	
2.4	**Tap changer**			
2.4.1	Manufacturer		Insert	
2.4.2	Manufacturer		MR/ABB	
2.4.3	Country of origin		EU	
2.4.4	Switching technology		Vacuum	
2.4.5	Model designation		Insert	
2.4.6	Type of tap changing		On-load	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.7	Electrical location of Tap winding		HV / Series Winding	
2.4.8	Geometric Location of Tap winding		[Insert]	
2.4.9	Type of voltage regulation		Constant Flux Variable Voltage (C.F.V.V.)	
2.4.10	Tapping range	% V	±10	
2.4.11	Tapping step/Size of Each tapping step	%	1.25	
2.4.12	Number of steps		17	
2.4.13	Short circuit current - time	kA-s	[Insert]	
2.4.14	Insulation level	kV	[Insert]	
2.4.15	Rated current	A	≥1600	
2.4.16	BIL to ground through the regulating coil	kV peak	Insert	
2.4.17	Power frequency withstand voltage for 1 minute through the regulating coil	kV rms	Insert	
2.4.18	Tap position indicator		Digital code matrix (BCD)	
2.4.19	Auxiliary supply		3x400 V / 230 V, 50 Hz	
2.4.20	OLTC diverter switch tank		Separate from Main tank	
2.4.21	Breathing of OLTC		Separate/Shared conservator	
2.4.22	OLTC Oil guided to Radiator for cooling		No	
2.4.23	OLTC tap change principle type		Resistance/Reactance type	
2.4.24	MVA Rating of Transformer due to OLTC operation		Rated power 450MVA, all taps	
2.4.25	Rated Voltage (No. load) due to OLTC operation	kV/kV/kV	insert	
2.4.26	Percent Impedance design due to Tap Changing		Constant Impedance	
2.4.27	OLTC Drive Type		Insert	
3	**Special technical requirements**			
3.1	**Short circuit impedance corrected to reference temperature of 75°C at rated**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	frequency and rated power			
3.1.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	13 ±10 %	
3.1.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV 31.5kArms)	
3.1.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV 31.5kArms)	
3.2	**Zero-sequence impedance, with tap changer in middle position:**			
3.2.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	Insert	
3.2.4	X/R ratio		Insert	
3.3	**Autotransformer capacity to withstand external short circuits**			
3.3.1	Short-circuit duration	sec	2	
3.3.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period:			
3.3.3	HV winding	kA	Infinite	
3.3.4	LV winding	kA	Infinite	
3.3.5	TV winding	kA	Infinite	
3.3.6	Pre-fault voltage	p.u.	1.05	
3.4	**Guaranteed losses**			
3.4.1	No-load losses with tap changer in nominal (principal) tap position at rated voltage and at rated frequency	kW	Insert	
3.4.2	No-load losses with tap changer in nominal (principal) tap position at 110 % rated voltage and at rated frequency	kW	Insert	
3.4.3	No-load losses with tap changer in nominal (principal) tap position at 90 % rated voltage and at rated frequency	kW	Insert	
3.4.4	Average of the above & No-Load Loss for Loss capitalization (N) [This value will be evaluated]	kW	Insert	
3.4.5	No-load losses capitalized value	BDT/kW	600000	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
3.4.7	On-load losses at 75°C and rated frequency, with tap changer in nominal tap position at rated tapping current (ONAF) of that tap position	kW	Insert	
3.4.8	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	
3.4.9	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	
3.4.10	Average of the above & On-load Loss for Loss capitalization (L) [This value will be evaluated]	kW	Insert	
3.4.11	On-load losses capitalized value	BDT/kW	300000	
3.4.12	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.4.13	Ancillary equipment (fans, pumps, heaters, OLTC Drives etc.) (M)			
3.4.14	Load of ancillary equipment (this value will be evaluated)	kW	Insert	
3.4.15	Capitalized valued of ancillary equipment load	BDT/kW	300000	
3.4.16	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
3.5	**Rated Insulation level**			
3.5.1	High voltage (HV)		LI 1050AC460	
3.5.2	Low voltage (LV)		LI 650 AC 275	
3.5.3	Tertiary voltage (TV)		LI 170 AC 70	
3.5.4	Neutral voltage (NV)		LI 325 AC 140	
3.5.5	Method of Neutral Earthing		Solid Ground	
3.6	**Efficiencies [HV-LV-TV loaded]**			
3.6.1	If cosφ = 1.0 and:			
3.6.1.1	• 25 % load of the rated value		Insert	
3.6.1.2	• 50 % load of the rated value		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.6.1.3	• 75 % load of the rated value		Insert	
3.6.1.4	• 100 % load of the rated value		Insert	
3.6.2	If cosφ = 0.8 (inductive) and:			
3.6.2.1	• 25 % load of the rated value		Insert	
3.6.2.2	• 50 % load of the rated value		Insert	
3.6.2.3	• 75 % load of the rated value		Insert	
3.6.2.4	• 100 % load of the rated value		Insert	
3.6.3	If cosφ = 0.9 (inductive) and:			
3.6.3.1	• 25 % load of the rated value		Insert	
3.6.3.2	• 50 % load of the rated value		Insert	
3.6.3.3	• 75 % load of the rated value		Insert	
3.6.3.4	• 100 % load of the rated value		Insert	
3.7	**Voltage drop at the terminals of secondary**			
3.7.1	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position [HV-LV loaded]**			
3.7.1.1	• cosφ = 1.00		Insert	
3.7.1.2	• cosφ = 0.95 (inductive)		Insert	
3.7.1.3	• cosφ = 0.90 (inductive)		Insert	
3.7.1.4	• cosφ = 0.80 (inductive)		Insert	
3.7.2	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position [HV-LV-TV loaded, TV at 0.95 leading pf]**			
3.7.2.1	• cosφ = 1.00		Insert	
3.7.2.2	• cosφ = 0.95 (inductive)		Insert	
3.7.2.3	• cosφ = 0.90 (inductive)		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.7.2.4	• cosφ = 0.80 (inductive)		Insert	
3.8	**No-load current at rated frequency**			
3.8.1	At 0.90 Un		Insert	
3.8.2	At 1.00 Un		Insert	
3.8.3	At 1.05 Un		Insert	
3.9	**At the emergency cases it is allowed:**	MVA	Compliant to IEC 60076-7	
	• Continuous overload at the highest winding temperature which exceeds by 2.5°C the guaranteed limit value	%		
	• Continuous voltage increase when the top oil temperature exceeds the guaranteed limit by 2.5°C at rated power (in % of the rated volt age)			
3.10	**Guaranteed value of overloads in % of the rated power**			
3.10.1	Normal overloads prediction which can occur once a day (in % of the rated power) within the winding temperature rise limit of 75°C			
3.10.1.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.2	After operation under 20 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.3	After operation under 120 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.10.2	Sudden transient overloads (in % of the rated power) with the winding temperature rise limit of 85°C			
3.10.2.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.2	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.3	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.11	**Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits:**			
3.11.1	• with all cooling groups in operation (excluding stand-by cooling group)		Insert	
3.11.2	• with one cooling group out of operation		Insert	
3.11.3	• with two cooling groups out of operation		Insert	
4	**Design & Construction**			
4.1*	**Cooling system**			
4.1.1	**Oil Flow through Windings/ windings group**			
4.1.1.1	Guided Oil Flow inside transformer	Yes/No.	Yes	
4.1.1.2	Pattern of Oil Flow through Duct	Axial/Zig-Zag	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.1.2	**Pressure drop in side transformer**			
4.1.2.1	Radial Locations with respect to core	bar	[Insert]	
4.1.2.2	Axial Locations with respect to core	bar	[Insert]	
4.1.3	**Radiators & Coolers**			
4.1.3.1	Radiator Location		A	
	Attached to Tank or Separate		Attached to Tank	
4.1.3.2	Number of cooling groups (total)	Qty.	Insert	
	Number of cooling groups (for rated power)	Qty.	Insert	
	Number of stand-by cooling groups	Qty.	Insert	
	Number of coolers in a cooling group	Qty.	Insert	
	Number of spare fans	Qty.	Insert	
	Rating of each cooler	kW	Insert	
4.1.3.3	Full vacuum withstand of complete cooler	mbar	Yes	
4.1.4	**HV side**			
4.1.4.1	No. of Radiator Bank	No.	[Insert]	
4.1.4.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.4.3	No. of Cooler Fans	No.	[Insert]	
4.1.4.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.4.5	Spare Fans in each group	No.	[Insert]	
4.1.4.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.4.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.4.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.4.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.4.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.1.4.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
4.1.4.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.4.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.5	**LV side**			
4.1.5.1	No. of Radiator Bank	No.	[Insert]	
4.1.5.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.5.3	No. of Cooler Fans	No.	[Insert]	
4.1.5.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.5.5	Spare Fans in each group	No.	[Insert]	
4.1.5.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.5.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.5.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.5.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.5.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
4.1.5.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
4.1.5.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare n+1, shall be considered)	
4.1.5.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.2*	**Oil Flow rate**			
4.2.1	**Oil Flow rate inside Transformer during ONAN Cooling**			
4.2.1.1	Highest Flow rate (Approx.)	m/s	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.2.1.2	Location at Transformer		[Insert]	
4.2.1.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.1.4	Location at Transformer		[Insert]	
4.2.1.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.2	**Oil Flow rate inside Transformer during ONAF Cooling**			
4.2.2.1	Highest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.2	Location at Transformer		[Insert]	
4.2.2.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.4	Location at Transformer		[Insert]	
4.2.2.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.3	**Predicted Hot Spot Location**			
4.2.3.1	HV Side		Insert	
4.2.3.2	LV side		Insert	
4.2.3.3	TV side		Insert	
4.2.3.4	Temperature Difference (D-Temp) between Inlet & Outlet of Radiator banks --- Design value	^{0}C	[Insert]	
4.3	**Temperature rise limits, at rated power, with complete cooling system in service and at lowest voltage tap**			
4.3.1	Average Oil Temperature rise	^{0}C		
4.3.2	Top oil	°C	≤ 50	
4.3.3	Winding	°C	≤ 55	
4.3.4	Hottest spot	°C	≤ 65	
4.3.5	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	^{0}C	65	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.3.6	Maximum hot spot temperature rises in core at rated power	^0C	Insert	
4.3.7	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	^0C	130	
4.3.8	Surface Temperature (Amb. Temp. + Top oil rise + Core surface temp.)	^0C	Insert	
4.3.9	Temperature gradient at rating specified			
4.3.10*	**Temperature rise of metallic parts**			
4.3.10.1	Tank walls	^0C		
4.3.10.2	Tie plate	^0C		
4.3.10.3	Top clamp	^0C		
4.3.10.4	Bottom clamp	^0C		
4.4	**Core Construction**			
4.4.1	Type of Transformer Core (Shell or Core)		Core	
4.4.2	No. of Core Limb		insert	
4.4.3	Core Material		CRGO Si steel, Hi-B	
4.4.4	Grade Designation		Insert	
4.4.5	Core Graining Method		Laser-beam or plasma jet irradiation	
4.4.6	Thickness of Sheet	mm		
4.4.7	Specific Loss at 1.7T,50Hz	W/kg	<0.85	
4.4.8	Insulation material & Class			
4.4.9	Safe Working Temperature of Core	^0C		
4.4.10	Whether step lap construction adopted		Yes	
4.4.11	Whether boltless construction adopted		Yes	
4.4.12	Core Material Make , Country		Insert	
4.4.13	Whether Core is pre-cut or cut at Factory		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Method of joining of legs		Insert	
	Method of joining of yokes		Insert	
	Joining material		Insert	
4.4.14	Flux density at nominal voltage and frequency and at nominalratio - (no load)			
4.4.15	Cores	T		
4.4.16	Yokes	T		
4.4.17	Volts/turn	V		
4.4.18	Over flux withstand capability of theTransformer [flux density & time]	T, Min or s		
4.4.19	Continuously 10% over voltage andfrequency and at principal tap	T, Min or s		
4.4.20	at 125% of rated Voltage	T, Min or s		
4.4.21	at 140% of rated Voltage	T, Min or s		
4.4.22	at 150% of rated Voltage	T, Min or s		
4.4.23	Magnetizing current (approx) at nominal ratio and			
4.4.23.1	at 0.90 x nominal voltage	% of FLA		
4.4.23.2	at 0.95 x nominal voltage	% of FLA		
4.4.23.3	at 1 .0 x nominal voltage	% of FLA		
4.4.23.4	at 1 .05 x nominal voltage	% of FLA		
4.4.23.5	at 1 .1 x nominal voltage	% of FLA		
4.4.24	Power factor of magnetizing current at normal voltage ratio and frequency			
4.4.25	Oil Ducts among cores		Yes	
4.5	**Winding Construction**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.1	Materials of winding		Copper	
4.5.2	Make, country			
4.5.3	Conductor Used		CTC/others	
4.5.3.1	HV		[Insert]	
4.5.3.2	RV/ tap Winding		[Insert]	
4.5.3.3	LV		[Insert]	
4.5.3.4	TV		[Insert]	
4.5.4*	**Type of Conductor Used**			
4.5.4.1	HV		Cu - 'Interleaved'Disc	
4.5.4.2	RV/ tap Winding		Insert	
4.5.4.3	LV		Cu - Interleaved / disc-transposed, cured in epoxy coating	
4.5.4.4	TV		Helical/Disk [Cu - transposed, cured in epoxy coating]	
4.5.5	**Current density, Thermal**			
4.5.5.1	HV	A/mm^2	[Insert]	
4.5.5.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.5.3	LV	A/mm^2	[Insert]	
4.5.5.4	TV	A/mm^2	[Insert]	
4.5.6	**Current Density, Short circuit**			
4.5.6.1	HV	A/mm^2	[Insert]	
4.5.6.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.6.3	LV	A/mm^2	[Insert]	
4.5.6.4	TV	A/mm^2	[Insert]	
4.5.7	Insulations at windings		Thermally Upgraded Paper	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.7.1	Insulation Class		A	
4.5.7.2	Insulation Make, Country		[Insert]	
4.5.7.3	Additional Insulations as Protection caps at windings			
4.5.7.4	HV	Yes/No		
4.5.7.5	LV	Yes/No		
4.5.7.6	TV	Yes/No		
4.5.8	Oil Ducts among windings		Yes	
4.5.9	Material of Pressboard		[Insert]	
4.5.10	Key Spacer		[Insert]	
4.5.11	**Resistance /phase [Design Value with Tolerance]**			
4.5.11.1	HV	Ω	[Insert]	
4.5.11.2	LV	Ω	[Insert]	
4.5.11.3	TV	Ω	[Insert]	
4.5.12	Connection of three-phase windings (vector group IEC 60076)		YNa0d1	
4.5.13	Tertiary winding connection (TV)		Delta made inside the tank, with three terminals brought out outside of the tank	
4.5.14	Geometric Location of windings with respect to core			
4.5.14.1	TW		[Insert]	
4.5.14.2	LW/ common winding		[Insert]	
4.5.14.3	HV/ series winding		[Insert]	
4.5.14.4	RW		[Insert]	
4.5.14.5	Winding Method		(Hor/Ver.)[Insert]	
4.5.15	**Winding connections [crimped, Brazed or others]**			
4.5.15.1	Between Windings		[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.15.2	Between Winding Layers/Disk		[Insert]	
4.5.15.3	Between Main Winding & Tap Winding		[Insert]	
4.5.15.4	Between Windings & Leads		[Insert]	
4.5.15.5	Clamping of Winding		[Insert]	
4.5.15.6	The individual winding sets clamped separately from each other and separately from the core.		Yes	
4.5.15.7	Acceptable Tangent delta of winding		Insert	
4.5.15.8	Acceptable PD level	pC		
4.6*	**Curing of Active Part**			
4.6.1	Highest temperature	^{0}C		
4.6.2	Duration	Hrs		
4.6.3	Average temperature	^{0}C		
4.6.4	Duration	Hrs		
4.6.5	Total duration	Hrs		
4.6.6	**Active Part Compression during Pressure, (approx)**	mm		
4.7	**Winding clamping for Short circuit**	Insert		
5	**Short Circuit**			
5.1	Current through windings for Terminal Fault			
5.1.1	HV	kArms		
5.1.2	LV	kArms		
5.1.3	TV	kArms		
5.1.4	Peak Factor		2.69	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2	Pre-fault voltage	p.u.	1.05	
5.3	Withstand Duration	s	2	
5.4	Similar Design Transformer (as per IEC 60076-5, Annex A) type test reference			
5.4.1	Testing Authority		STL Lab, insert Name	
5.4.2	certificate reference			
5.4.3	Contact address of test Lab			
5.4.4	Validity of test certificate			
5.5	Force [Shall be based on Highest SCC among LLG, LL, LLL, LG at each side-HV/LV/TV] of offered TR			
5. 5.1	Axial Force [CW/SW/RW/TW]	kN		
5. 5.2	Free Buckling Force [CW/SW/RW/TW]	kN		
5.5.3	Compression Force [CW/SW/RW/TW]	kN		
5. 5.4	Designed Safety Margin [CW/SW/RW/TW]			
a	For indivisual winding clamping		> 1.4	
b	For other design		>2	
5. 5.5	Offered & Reference Similar Type testedDesign transformer Short Circuit Force relationship		Within 110%	
5.6	Temperature during SC			
5. 6.1	HV Winding [Actual/Allowable]	^{0}C		
5. 6.2	LV Winding [Actual/Allowable]	^{0}C		
5. 6.3	RV Winding [Actual/Allowable]	^{0}C		
5.6.4	TV Winding [Actual/Allowable]	^{0}C		
5.7	Maximum Circulating Current in Delta tertiary for L-G fault at TV terminal	kA		
5.7.1	Winding withstand capacity of this current	Min or s		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6*	**Dielectric Design**			
6.1	Impulse Voltage At HV (LI)	kVp		
6.1.1	Maximum applied voltage at critical points	kVp		
6.1.2	Permissible Voltage	kVp		
6.1.3	Safety Factor		>2	
6.1.4	Transferred surge at LV	kVp		
6.1.5	Transferred surge at TV	kVp		
6.1.6	ZnO Block to limit distributed impulse [tap Winding/other]		At Design stage	
6.2	Impulse Voltage At HV (SI)			
6.2.1	Maximum applied voltage at critical points	kVp		
6.2.2	Permissible Voltage	kVp		
6.2.3	Safety Factor		>2	
6.2.4	Transferred surge at LV	kVp		
6.2.5	Transferred surge at TV	kVp		
6.2.6	ZnO Block to limit distributed impulse [tap Winding/other]		At Design stage	
6.3	Impulse Voltage At LV (LI)			
6.3.1	Maximum applied voltage at critical points	kVp		
6.3.2	Permissible Voltage	kVp		
6.3.3	Safety Factor		>2	
6.3.4	Transferred surge at HV	kVp		
6.3.5	Transferred surge at TV	kVp		
6.3.6	ZnO Block to limit distributed impulse		At Design stage	
6.4	**Impulse Voltage at TV (LI)**			
6.4.1	Maximum applied voltage at critical points	kVp		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.4.2	Permissible Voltage	kVp		
6.4.3	Safety Factor		>2	
6.4.4	Transferred surge at HV	kVp		
6.4.5	Transferred surge at LV	kVp		
6.4.6	ZnO Block to limit distributed impulse		No.	
7*	**Earthing**			
7.1	Neutral [with double connection], with copper conductor	sqmm		
7.2	Core , taken out			
7.3	Clamp			
7.4	Tank Body			
7.5	Cubicles			
7.6	Radiators, if separately mount /connected		NA	
7.7	Others			
8*	**Valves & Manholes**			
8.1	Type of valves used			
8.2	Valve schedule attached		Yes	
8.3	Spare Manhole for inspection & future use		Yes, insert number & size	
9*	**Oil for Transformer & Tap-Changer**			
9.1	Manufacturer, country		Insert	
9.2	Type		Insert	
9.3	Standard		IEC 60296	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
9.4	Minimum flash point	°C	>140	
9.5	Viscosity at 40°C	mm^2/s	Max 8	
9.5.1	Viscosity at -30°C	mm^2/s	Max 800	
9.6	Maximum dielectric strength before / after treatment	kV (at 2.5cm)	60/70	
9.7	Total sulphur content	%	<0.01	
9.8	Corrosive Sulphur		No	
9.9	PCB content		Without PCB	
9.10	Water Content	mg/kg	<20	
9.11	DDF at 90°C [IEC 60247]		<0.001	
9.12	Density at 20°C	Kg/dm^3	>0.7	
9.13	Stray gassing under thermooxidative stress			
	Hydrogen	µL/L	<5	
	Methane/Ethane		<1	
9.14	Sludge	wt %	<0.01	
9.15	Antioxidants	wt %	<0.24	
9.16	Total acidity [IEC 61125]	mg KOH/g	<0.05	
9.17	Data sheet attached		Yes	
10	**Bushing**		IEC60137	
10.1	**HV bushing**			
10.1.1	Quantity		03	
10.1.2	Class	kV	245	
10.1.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.4	Type		Insert	
10.1.5	Rated current	A	≥ 1600	
10.1.6	Rated short circuit current (2 s)	kA rms	50	
10.1.7	Rated lightning impulse withstand voltage	kV peak	1050	
10.1.8	Rated switching impulse withstand voltage	kV peak	850	
10.1.9	Rated power frequency withstand voltage (wet)	kV rms	460	
10.1.10	Connectors			
10.1.10.1	Shape	mm	insert	
10.1.10.2	Length	mm	insert	
10.1.10.3	Suitable for		Al wire	
10.1.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.1.12	Full vacuum withstand of complete bushing		YES	
10.1.13	Housing		Composite SiR	
10.1.14	Test tap	Yes		
10.1.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.1.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.1.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.1.18	profile factor, P.F.		insert	
10.1.19	Min. flashover distance	mm		
10.1.20	Cantilever test load	kN		
10.1.21	Housing shed type	Alternate		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.22	Air Vent	Yes		
10.1.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.1.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.1.25	Total Length	mm		
10.1.26	Outer diameter	mm		
10.1.27	CT Pocket Length for BCT	mm		
10.1.28	Oil quantity [for OIP type]	kg		
10.1.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.1.30	No. of Hole			
10.1.31	Diameter of each hole			
10.1.32	Distance between hole			
10.1.33	Fixing nut-bolt Material	AL or SS		
10.1.34	Earthing holes M12	No.		
10.1.35	End-shielding			
10.1.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.1.37	Top Terminal Suitable for	AL		
10.1.38	dissipation factor			
10.1.39	Partial discharge			
10.1.40	Insulation Class	F/155^{0} C		
10.1.41	Total Weight	kg		
10.2	**LV bushing**			
10.2.1	Quantity		03	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.2	Class	kV	145	
10.2.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.2.4	Type		Insert	
10.2.5	Rated current	A	≥ 2500	
10.2.6	Rated short circuit current (2 s)	kA rms	40	
10.2.7	Rated lightning impulse withstand voltage	kV peak	650	
10.2.8	Rated switching impulse withstand voltage	kV peak	-	
10.2.9	Rated power frequency withstand voltage (wet)	kV rms	275	
10.2.10	Connectors			
10.2.10.1	Shape	mm	insert	
10.2.10.2	Length	mm	insert	
10.2.10.3	Suitable for		Al wire	
10.2.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.2.12	Full vacuum withstand of complete bushing		YES	
10.2.13	Housing		Composite SiR	
10.2.14	Test tap	Yes		
10.2.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.2.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.2.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.2.18	profile factor, P.F.		insert	
10.2.19	Min. flashover distance	mm		
10.2.20	Cantilever test load			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.21	Housing shed type	Alternate		
10.2.22	Air Vent	Yes		
10.2.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.2.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.2.25	Total Length	mm		
10.2.26	Outer diameter	mm		
10.2.27	CT Pocket Length for BCT	mm		
10.2.28	Oil quantity [for OIP type]	kg		
10.2.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.2.30	No. of Hole			
10.2.31	Diameter of each hole			
10.2.32	Distance between hole			
10.2.33	Fixing nut-bolt Material	AL or SS		
10.2.34	Earthing holes M12	No.		
10.2.35	End-shielding			
10.2.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.2.37	Top Terminal Suitable for	AL		
10.2.38	dissipation factor			
10.2.39	Partial discharge			
10.2.40	Insulation Class	F/155^{0} C		
10.2.41	Total Weight	kg		
10.3	**TV bushing**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.1	Quantity		03	
10.3.2	Class	kV	36	
10.3.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.3.4	Type		Insert	
10.3.5	Rated current	A	≥ 2000	
10.3.6	Rated short circuit current (2 s)	kA rms	31.5	
10.3.7	Rated lightning impulse withstand voltage	kV peak	170	
10.3.8	Rated switching impulse withstand voltage	kV peak	-	
10.3.9	Rated power frequency withstand voltage (wet)	kV rms	70	
10.3.10	Connectors			
10.3.10.1	Shape	mm	insert	
10.3.10.2	Length	mm	insert	
10.3.10.3	Suitable for		Al wire	
10.3.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.3.12	Full vacuum withstand of complete bushing		YES	
10.3.13	Housing		Composite SiR	
10.3.14	Test tap	Yes		
10.3.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.3.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.3.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.3.18	profile factor, P.F.		insert	
10.3.19	Min. flashover distance	mm		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.20	Cantilever test load			
10.3.21	Housing shed type	Alternate		
10.3.22	Air Vent	Yes		
10.3.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.3.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.3.25	Total Length	mm		
10.3.26	Outer diameter	mm		
10.3.27	CT Pocket Length for BCT	mm		
10.3.28	Oil quantity [for OIP type]	kg		
10.3.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.3.30	No. of Hole			
10.3.31	Diameter of each hole			
10.3.32	Distance between hole			
10.3.33	Fixing nut-bolt Material	AL or SS		
10.3.34	Earthing holes M12	No.		
10.3.35	End-shielding			
10.3.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.3.37	Top Terminal Suitable for	AL		
10.3.38	dissipation factor			
10.3.39	Partial discharge			
10.3.40	Insulation Class	F/155^0 C		
10.3.41	Total Weight	kg		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4	**NV bushing**			
10.4.1	Quantity		01	
10.4.2	Class	kV	72.5	
10.4.4	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.4.4	Type		Insert	
10.4.5	Rated current	A	≥ 2500	
10.4.6	Rated short circuit current (2 s)	kA rms	50	
10.4.7	Rated lightning impulse withstand voltage	kV peak	325	
10.4.8	Rated switching impulse withstand voltage	kV peak	-	
10.4.9	Rated power frequency withstand voltage (wet)	kV rms	140	
10.4.10	Connectors			
10.4.10.1	Shape	mm	insert	
10.4.10.2	Length	mm	insert	
10.4.10.3	Suitable for		Al wire	
10.4.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.4.12	Full vacuum withstand of complete bushing		YES	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.13	Housing		Composite SiR	
10.4.14	Test tap	Yes		
10.4.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.4.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.4.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.4.18	profile factor, P.F.		insert	
10.4.19	Min. flashover distance	mm		
10.4.20	Cantilever test load	kN	insert	
10.4.21	Housing shed type	Alternate		
10.4.22	Air Vent	Yes		
10.4.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.4.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.4.25	Total Length	mm		
10.4.26	Outer diameter	mm		
10.4.27	CT Pocket Length for BCT	mm		
10.4.28	Oil quantity [for OIP type]	kg		
10.4.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.4.40	No. of Hole			
10.4.41	Diameter of each hole			
10.4.42	Distance between hole			
10.4.43	Fixing nut-bolt Material	AL or SS		
10.4.44	Earthing holes M12	No.		
10.4.45	End-shielding			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.46	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]			
10.4.47	Top Terminal Suitable for	AL		
10.4.48	dissipation factor			
10.4.49	Partial discharge			
10.4.40	Insulation Class	F/155^0 C		
10.4.41	Total Weight	kg		
11*	**Sound & RIV**			
11.1	At No load, rated frequency , 100% rated voltage	dB		
11.2	At No load, rated frequency, 105% rated voltage	dB		
11.5	Guaranteed during Testing	dB		
11.6	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete cooling system in service	dB	70	
11.7	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	µV	2500 max	
13	**Weights and dimensions**			
13.1	Total weight of autotransformer, equipped for service	kg	Insert	
13.2	Core and oil assembly	kg	Insert	
13.3	Total mass excluding oil	kg	Insert	
13.4	Tank and accessories	kg	Insert	
13.5	Oil mass in tank	kg	Insert	
13.6	Oil mass in coolers	kg	Insert	
13.7	Oil mass total	kg	Insert	
13.8	Total mass	kg	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
13.9*	Maximum shipping weight (the heaviest item)	kg	Insert	
13.10	Height from foundation to:			
13.10.1	• Highest point of HV bushing	mm	Insert	
13.10.2	• Highest point of tank	mm	Insert	
13.10.3	• Highest point of conservator	mm	Insert	
13.10.4	• Highest point of lifting hook for removal of core and oil assembly	mm	Insert	
13.11	Outer dimensions:			
13.11.1	• Length	mm	Insert	
13.11.2	• Width	mm	Insert	
13.12	Informative dimensional sketch		To be enclosed with bid	
13.13*	Maximum shipping dimensions of tank:			
13.13.1	• Outside height	mm	Insert	
13.13.2	• Outside width	mm	Insert	
13.13.3	• Outside length	mm	Insert	
13.14	Transportation drawing		To be enclosed with bid	
14	**Auxiliary power supply**			
14.1	Motors		3x400 V / 50 Hz	
14.2	Heaters		230 V / 50 Hz	
14.3	Control voltage		110 V DC	
14.4	Oil pump		3x400 V / 50 Hz	
15	**Current transformer incorporated into the power autotransformer**			
15.1	CT in HV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
			stage	
15.2	CT in LV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores be characteristics shall be defined in design stage	
15.3	CT in neutral bushing, for protection		In all phases, 2cores characteristics shall be defined in design stage	
15.4	CT in TV bushings, for protection		In all phases, 3 cores characteristics shall be defined in design stage	
16*	**Layout**			
16.1	Primary winding bushings		Longitudinal axis	
16.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	
16.3	Conservator tank		As per spec	
16.4	Tap changer		As per spec	
16.5	Control cabinet		Seperate	
16.6	Coolers		Attached to tank	
16.7	Connection drawing, block diagram		To be enclosed with bid	
17	**Dehydrating breather**			
17.1	Type of dehydrating breather		Insert	
17.2	Dehumidifying agent	kg	Insert	
18	**Autotransformer tank**			
18.1	Type of design			
18.2	Thickness of transformer tank:			
18.2.1	• Sides	mm	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
18.2.2	• Bottom	mm	Insert	
18.2.3	• Top	mm	Insert	
18.3	Material of the autotransformer tank		Insert	
18.4	Wheels			
18.4.1	Wheel number for each rail of two pair rails		Two pairs	
18.4.2	Axial inter space in transversal direction between two pairs of rails	mm	4520	
18.4.3	Transversal distance between wheels in pair	mm	1435	
18.4.4	Distance between wheels in longitudinal direction	mm	1435	
18.5	Corrosion protection of the tank		YES	
18.6	Vacuum withstand of the complete tank with cooler	mbar	1	
18.7	Over-pressure withstand of the complete autotransformer	bar	0.3	
18.8	Painting Color	Munsell no.		
19	**Conservator**			
19.1	Type		With diaphragm	
19.2	Number of compartments	pcs.	Insert	
19.3	Total volume of conservator	m^3	Insert	
19.4	Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 0°C of the volume of autotransformer	%	Insert	
19.5	**Pressure rise inside the tank due to oil expansion Diagraph design parameters:**		Insert	
19.5.1	• Maximum diagraph stress at highest working pressure		Insert	
19.5.2	• Diagraph construction details		Insert	
19.5.3	• Type of diagraph material		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
19.6	Corrosion protection of conservator		Insert	
19.7	Oil level indicators with alarm for minimum oil level	pcs.	2	
19.8	Membrane provided inside the conservator for ‘’breathing’’ of the transformer		Yes	
20	**Miscellaneous Item**			
20.1	AVR Relay		MR, Germany	
20.2	Bucholtz relay, Make		insert	
20.3	Control Cable , Make		insert	
20.4	WTI [Normal &Fiber Optic]		Yes, insert number	
20.5	OTI		Yes, insert number	
20.6	Remote Transformer Panel with all accessories, Make		Yes, insert	
20.7	Marshalling Cubicle with all accessories, Make		Yes, insert	
20.8	Cooling Cabinet with all accessories, Make		Yes, insert	
20.9	Material (Cooling & Marshalling Cabinet)		Insert	
20.10.	No. of PRD in Main Tank		Min 3	
20.11	No. of PRD in OLTC		Insert	
20.12	Oil Surge Relay			
20.13	Breather		Mtrab	
20.14	Gasket Material		Nitrile Rubber	
20.15	Nut-Bolt, Make		Insert	
20.16	Nut-Bolt, Material		SS	
20.17	LA Make		Insert	
20.18				

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
21	**Operating conditions**			
21.1	At the altitude (above sea level)	m	≤ 1000	
21.2	Maximum ambient temperature	°C	40	
21.3	Average daily temperature	°C	35	
21.4	Average annual temperature	°C	30	
21.5	Minimum ambient temperature	°C	4	
21.6	Tertiary winding		Reactive Compensation	
21.7	Parallel operation		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.4.3 230/138/34.5 kV 225/300 MVA ONAN/ONAF Autotransformer (Not applicable)

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		Autotransformer three-phase, oil immersed, with tertiary winding, hermetically sealed,	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
			with on-load tap changer, outdoor	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60044	
1.5.1			IEC 60076	
1.5.2			IEC 60137	
1.5.3			IEC 60214	
1.5.4			IEC 60354	
1.5.5			IEC 60529	
1.5.6			IEC 60815	
1.5.7			IEC 60947	
1.5.8			NEMA TR-1	
1.5.9			CENELEC EN 50216	
1.6	Quality control		ISO 9001	
1.7	Tertiary winding function		Stabilizing winding, auxiliary power supply& Reactive compensation	
1.8	Thermal insulation class		A	
2	**Ratings and properties**			
2.1	**Rating (three phase)**		Rated power 300MVA, all taps	
2.1.1	Frequency	Hz	50	
2.1.2	Corresponding minimum Frequency	Hz	48	
2.1.3	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	
2.1.4	Neutral point insulation		LI325 AC140	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.1.5	Voltage ratio (No Load)	kV	230/138/34.5	
2.2	**Rated power by cooling ONAN / ONAF**			
2.2.1	Primary / secondary winding	MVA	225/300	
2.2.2	Tertiary – minimum	MVA	75/100	
2.2.3	Loading Type		Simultaneous on HV-LV-TV (The 3 windings of the transformer shall be designed for **arithmetic loading** in such a way that **the tertiary winding** can be loaded continuously for the specified MVA rating)	
2.3	**Rated (highest) voltage of windings**			
2.3.1	HV winding	kV	245	
2.3.2	LV winding	kV	145	
2.3.3	TV - stabilizing winding	kV	36	
2.3.4	NV - Neutral voltage	kV	72.5	
2.4	**Tap changer**			
2.4.1	Manufacturer		Insert	
2.4.2	Manufacturer		MR/ABB	
2.4.3	Country of origin		EU	
2.4.4	Switching technology		Vacuum	
2.4.5	Model designation		Insert	
2.4.6	Type of tap changing		On-load	
2.4.7	Electrical location of Tap winding		HV / Series Winding	
2.4.8	Geometric Location of Tap winding		[Insert]	
2.4.9	Type of voltage regulation		Constant Flux Variable Voltage (C.F.V.V.)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.10	Tapping range	% V	±10	
2.4.11	Tapping step/Size of Each tapping step	%	1.25	
2.4.12	Number of steps		17	
2.4.13	Short circuit current - time	kA-s	[Insert]	
2.4.14	Insulation level	kV	[Insert]	
2.4.15	Rated current	A	≥1600	
2.4.16	BIL to ground through the regulating coil	kV peak	Insert	
2.4.17	Power frequency withstand voltage for 1 minute through the regulating coil	kV rms	Insert	
2.4.18	Tap position indicator		Digital code matrix (BCD)	
2.4.19	Auxiliary supply		3x400 V / 230 V, 50 Hz	
2.4.20	OLTC diverter switch tank		Separate from Main tank	
2.4.21	Breathing of OLTC		Separate/Shared conservator	
2.4.22	OLTC Oil guided to Radiator for cooling		No	
2.4.23	OLTC tap change principle type		Resistance/Reactance type	
2.4.24	MVA Rating of Transformer due to OLTC operation		Rated power 450MVA, all taps	
2.4.25	Rated Voltage (No. load) due to OLTC operation	kV/kV/kV	insert	
2.4.26	Percent Impedance design due to Tap Changing		Constant Impedance	
2.4.27	OLTC Drive Type		Insert	
3	**Special technical requirements**			
3.1	**Short circuit impedance corrected to reference temperature of 75°C at rated frequency and rated power**			
3.1.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	13 ±10 %	
3.1.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV 31.5kArms)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.1.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	[Insert], (Max allowable SCC at TV 31.5kArms)	
3.2	**Zero-sequence impedance, with tap changer in middle position:**			
3.2.1	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.2	HV - TV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.2.3	LV - TV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	Insert	
3.2.4	X/R ratio		Insert	
3.3	**Autotransformer capacity to withstand external short circuits**			
3.3.1	Short-circuit duration	sec	2	
3.3.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period:			
3.3.3	HV winding	kA	Infinite	
3.3.4	LV winding	kA	Infinite	
3.3.5	TV winding	kA	Infinite	
3.3.6	Pre-fault voltage	p.u.	1.05	
3.4	**Guaranteed losses**			
3.4.1	No-load losses with tap changer in nominal (principal) tap position at rated voltage and at rated frequency	kW	Insert	
3.4.2	No-load losses with tap changer in nominal (principal) tap position at 110 % rated voltage and at rated frequency	kW	Insert	
3.4.3	No-load losses with tap changer in nominal (principal) tap position at 90 % rated voltage and at rated frequency	kW	Insert	
3.4.4	Average of the above & No-Load Loss for Loss capitalization (N) [This value will be evaluated]	kW	Insert	
3.4.5	No-load losses capitalized value	BDT/kW	600000	
3.4.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
3.4.7	On-load losses at 75°C and rated frequency, with tap changer in nominal tap position at rated tapping current (ONAF) of that tap position	kW	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.8	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	
3.4.9	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	
3.4.10	Average of the above & On-load Loss for Loss capitalization (L) [This value will be evaluated]	kW	Insert	
3.4.11	On-load losses capitalized value	BDT/kW	300000	
3.4.12	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.4.13	Ancillary equipment (fans, pumps, heaters, OLTC Drives etc.)			
3.4.14	Load of ancillary equipment (M) (this value will be evaluated)	kW	Insert	
3.4.15	Capitalized valued of ancillary equipment load	BDT/kW	300000	
3.4.16	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
3.5	**Rated Insulation level**			
3.5.1	High voltage (HV)		LI 1050AC460	
3.5.2	Low voltage (LV)		LI 650 AC 275	
3.5.3	Tertiary voltage (TV)		LI 170 AC 70	
3.5.4	Neutral voltage (NV)		LI 325 AC 140	
3.5.5	Method of Neutral Earthing		Solid Ground	
3.6	**Efficiencies [HV-LV-TV loaded]**			
3.6.1	If cosφ = 1.0 and:			
3.6.1.1	• 25 % load of the rated value		Insert	
3.6.1.2	• 50 % load of the rated value		Insert	
3.6.1.3	• 75 % load of the rated value		Insert	
3.6.1.4	• 100 % load of the rated value		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.6.2	If cosφ = 0.8 (inductive) and:			
3.6.2.1	• 25 % load of the rated value		Insert	
3.6.2.2	• 50 % load of the rated value		Insert	
3.6.2.3	• 75 % load of the rated value		Insert	
3.6.2.4	• 100 % load of the rated value		Insert	
3.6.3	If cosφ = 0.9 (inductive) and:			
3.6.3.1	• 25 % load of the rated value		Insert	
3.6.3.2	• 50 % load of the rated value		Insert	
3.6.3.3	• 75 % load of the rated value		Insert	
3.6.3.4	• 100 % load of the rated value		Insert	
3.7	**Voltage drop at the terminals of secondary**			
3.7.1	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position [HV-LV loaded]**			
3.7.1.1	• cosφ = 1.00		Insert	
3.7.1.2	• cosφ = 0.95 (inductive)		Insert	
3.7.1.3	• cosφ = 0.90 (inductive)		Insert	
3.7.1.4	• cosφ = 0.80 (inductive)		Insert	
3.7.2	**Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position [HV-LV-TV loaded, TV at 0.95 leading pf]**			
3.7.2.1	• cosφ = 1.00		Insert	
3.7.2.2	• cosφ = 0.95 (inductive)		Insert	
3.7.2.3	• cosφ = 0.90 (inductive)		Insert	
3.7.2.4	• cosφ = 0.80 (inductive)		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.8	**No-load current at rated frequency**			
3.8.1	At 0.90 Un		Insert	
3.8.2	At 1.00 Un		Insert	
3.8.3	At 1.05 Un		Insert	
3.9	**At the emergency cases it is allowed:**	MVA	Compliant to IEC 60076-7	
	• Continuous overload at the highest winding temperature which exceeds by 2.5°C the guaranteed limit value	%		
	• Continuous voltage increase when the top oil temperature exceeds the guaranteed limit by 2.5°C at rated power (in % of the rated volt age)			
3.10	**Guaranteed value of overloads in % of the rated power**			
3.10.1	Normal overloads prediction which can occur once a day (in % of the rated power) within the winding temperature rise limit of 75°C			
3.10.1.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.2	After operation under 20 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.1.3	After operation under 120 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2	Sudden transient overloads (in % of the rated power) with the winding temperature rise limit of 85°C			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.10.2.1	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.2	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.10.2.3	After operation under 15 min			
	• full rated power		Insert	
	• ¾ rated power		Insert	
	• ½ rated power		Insert	
3.11	**Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits:**			
3.11.1	• with all cooling groups in operation (excluding stand-by cooling group)		Insert	
3.11.2	• with one cooling group out of operation		Insert	
3.11.3	• with two cooling groups out of operation		Insert	
4	**Design & Construction**			
4.1*	**Cooling system**			
4.1.1	**Oil Flow through Windings/ windings group**			
4.1.1.1	Guided Oil Flow inside transformer	Yes/No.	Yes	
4.1.1.2	Pattern of Oil Flow through Duct	Axial/Zig-Zag	[Insert]	
4.1.2	**Pressure drop in side transformer**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.1.2.1	Radial Locations with respect to core	bar	[Insert]	
4.1.2.2	Axial Locations with respect to core	bar	[Insert]	
4.1.3	**Radiators & Coolers**			
4.1.3.1	Radiator Location		A	
	Attached to Tank or Separate		Attached to Tank	
4.1.3.2	Number of cooling groups (total)	Qty.	Insert	
	Number of cooling groups (for rated power)	Qty.	Insert	
	Number of stand-by cooling groups	Qty.	Insert	
	Number of coolers in a cooling group	Qty.	Insert	
	Number of spare fans	Qty.	Insert	
	Rating of each cooler	kW	Insert	
4.1.3.3	Full vacuum withstand of complete cooler	mbar	Yes	
4.1.4	**HV side**			
4.1.4.1	No. of Radiator Bank	No.	[Insert]	
4.1.4.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.4.3	No. of Cooler Fans	No.	[Insert]	
4.1.4.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.4.5	Spare Fans in each group	No.	[Insert]	
4.1.4.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.4.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.4.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.4.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.4.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
4.1.4.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil	No.	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Pipes)			
4.1.4.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.4.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.1.5	**LV side**			
4.1.5.1	No. of Radiator Bank	No.	[Insert]	
4.1.5.2	No. of Fins/Plates in each Radiator	No.	[Insert]	
4.1.5.3	No. of Cooler Fans	No.	[Insert]	
4.1.5.4	No. of group of Cooler Fan	No.	[Insert]	
4.1.5.5	Spare Fans in each group	No.	[Insert]	
4.1.5.6	No. of Blower/Motor Driving a Fan	No.	1	
4.1.5.7	Mounting of Fan in the radiator-HV side	Vertical/ Horizontal	[Insert]	
4.1.5.8	No. of Plates/Fins covered by single cooler, thus, AF Cooling	No.	[Insert]	
4.1.5.9	No. of Plates/Fins Not covered by single cooler, thus, AN Cooling	No.	[Insert]	
4.1.5.10	No. of Pipes going out from Main Tank to Radiator Bank at Tank upper part (i.e. Hot Oil Pipes)	No.	[Insert]	
4.1.5.11	No. of Pipes Coming in from Radiator Bank to Tank at Main Tank Lower part (i.e. Cold Oil Pipes)	No.	[Insert]	
4.1.5.12	No. of Pipes collecting Hot Oil	No.	[Insert] (spare n+1, shall be considered)	
4.1.5.13	No. of Pipes collecting Cold Oil	No.	[Insert] (spare , n+1,shall be considered)	
4.2*	**Oil Flow rate**			
4.2.1	**Oil Flow rate inside Transformer during ONAN Cooling**			
4.2.1.1	Highest Flow rate (Approx.)	m/s	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.2.1.2	Location at Transformer		[Insert]	
4.2.1.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.1.4	Location at Transformer		[Insert]	
4.2.1.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.2	**Oil Flow rate inside Transformer during ONAF Cooling**			
4.2.2.1	Highest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.2	Location at Transformer		[Insert]	
4.2.2.3	Lowest Flow rate (Approx.)	m/s	[Insert]	
4.2.2.4	Location at Transformer		[Insert]	
4.2.2.5	Flow rate optimized to stop induced vibration at Core, Winding	Yes/No	Yes	
4.2.3	**Predicted Hot Spot Location**			
4.2.3.1	HV Side		Insert	
4.2.3.2	LV side		Insert	
4.2.3.3	TV side		Insert	
4.2.3.4	Temperature Difference (D-Temp) between Inlet & Outlet of Radiator banks --- Design value	^{0}C	[Insert]	
4.3	**Temperature rise limits, at rated power, with complete cooling system in service and at lowest voltage tap**			
4.3.1	Average Oil Temperature rise	^{0}C		
4.3.2	Top oil	°C	≤ 50	
4.3.3	Winding	°C	≤ 55	
4.3.4	Hottest spot	°C	≤ 65	
4.3.5	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	^{0}C	65	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.3.6	Maximum hot spot temperature rises in core at rated power	^{0}C	Insert	
4.3.7	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	^{0}C	130	
4.3.8	Surface Temperature (Amb. Temp. + Top oil rise + Core surface temp.)	^{0}C	Insert	
4.3.9	Temperature gradient at rating specified			
4.3.10*	**Temperature rise of metallic parts**			
4.3.10.1	Tank walls	^{0}C		
4.3.10.2	Tie plate	^{0}C		
4.3.10.3	Top clamp	^{0}C		
4.3.10.4	Bottom clamp	^{0}C		
4.4	**Core Construction**			
4.4.1	Type of Transformer Core (Shell or Core)		Core	
4.4.2	No. of Core Limb		insert	
4.4.3	Core Material		CRGO Si steel, Hi-B	
4.4.4	Grade Designation		Insert	
4.4.5	Core Graining Method		Laser-beam or plasma jet irradiation	
4.4.6	Thickness of Sheet	mm		
4.4.7	Specific Loss at 1.7T,50Hz	W/kg	<0.85	
4.4.8	Insulation material & Class			
4.4.9	Safe Working Temperature of Core	^{0}C		
4.4.10	Whether step lap construction adopted		Yes	
4.4.11	Whether boltless construction adopted		Yes	
4.4.12	Core Material Make , Country		Insert	
4.4.13	Whether Core is pre-cut or cut at Factory		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Method of joining of legs		Insert	
	Method of joining of yokes		Insert	
	Joining material		Insert	
4.4.14	Flux density at nominal voltage and frequency and at nominalratio - (no load)			
4.4.15	Cores	T		
4.4.16	Yokes	T		
4.4.17	Volts/turn	V		
4.4.18	Over flux withstand capability of theTransformer [flux density & time]	T, Min or s		
4.4.19	Continuously 10% over voltage andfrequency and at principal tap	T, Min or s		
4.4.20	at 125% of rated Voltage	T, Min or s		
4.4.21	at 140% of rated Voltage	T, Min or s		
4.4.22	at 150% of rated Voltage	T, Min or s		
4.4.23	Magnetizing current (approx) at nominal ratio and			
4.4.23.1	at 0.90 x nominal voltage	% of FLA		
4.4.23.2	at 0.95 x nominal voltage	% of FLA		
4.4.23.3	at 1 .0 x nominal voltage	% of FLA		
4.4.23.4	at 1 .05 x nominal voltage	% of FLA		
4.4.23.5	at 1 .1 x nominal voltage	% of FLA		
4.4.24	Power factor of magnetizing current at normal voltage ratio and frequency			
4.4.25	Oil Ducts among cores		Yes	
4.5	**Winding Construction**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.1	Materials of winding		Copper	
4.5.2	Make, country			
4.5.3	Conductor Used		CTC/others	
4.5.3.1	HV		[Insert]	
4.5.3.2	RV/ tap Winding			
4.5.3.3	LV		[Insert]	
4.5.3.4	TV		[Insert]	
4.5.4*	**Type of Conductor Used**			
4.5.4.1	HV		Cu - 'Interleaved'Disc	
4.5.4.2	RV/ tap Winding		Insert	
4.5.4.3	LV		Cu - Interleaved / disc-transposed, cured in epoxy coating	
4.5.4.4	TV		Helical/Disk [Cu - transposed, cured in epoxy coating]	
4.5.5	**Current density, Thermal**			
4.5.5.1	HV	A/mm^2	[Insert]	
4.5.5.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.5.3	LV	A/mm^2	[Insert]	
4.5.5.4	TV	A/mm^2	[Insert]	
4.5.6	**Current Density, Short circuit**			
4.5.6.1	HV	A/mm^2	[Insert]	
4.5.6.2	RV/ tap Winding	A/mm^2	[Insert]	
4.5.6.3	LV	A/mm^2	[Insert]	
4.5.6.4	TV	A/mm^2	[Insert]	
4.5.7	Insulations at windings		Thermally Upgraded Paper	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.7.1	Insulation Class		A	
4.5.7.2	Insulation Make, Country		[Insert]	
4.5.7.3	Additional Insulations as Protection caps at windings			
4.5.7.4	HV	Yes/No		
4.5.7.5	LV	Yes/No		
4.5.7.6	TV	Yes/No		
4.5.8	Oil Ducts among windings		Yes	
4.5.9	Material of Pressboard		[Insert]	
4.5.10	Key Spacer		[Insert]	
4.5.11	**Resistance /phase [Design Value with Tolerance]**			
4.5.11.1	HV	Ω	[Insert]	
4.5.11.2	LV	Ω	[Insert]	
4.5.11.3	TV	Ω	[Insert]	
4.5.12	Connection of three-phase windings (vector group IEC 60076)		YNa0d1	
4.5.13	Tertiary winding connection (TV)		Delta made inside the tank, with three terminals brought out outside of the tank	
4.5.14	Geometric Location of windings with respect to core			
4.5.14.1	TW		[Insert]	
4.5.14.2	LW/ common winding		[Insert]	
4.5.14.3	HV/ series winding		[Insert]	
4.5.14.4	RW		[Insert]	
4.5.14.5	Winding Method		(Hor/Ver.)[Insert]	
4.5.15	**Winding connections [crimped, Brazed or others]**			
4.5.15.1	Between Windings		[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.5.15.2	Between Winding Layers/Disk		[Insert]	
4.5.15.3	Between Main Winding & Tap Winding		[Insert]	
4.5.15.4	Between Windings & Leads		[Insert]	
4.5.15.5	Clamping of Winding		[Insert]	
4.5.15.6	The individual winding sets clamped separately from each other and separately from the core.		Yes	
4.5.15.7	Acceptable Tangent delta of winding		Insert	
4.5.15.8	Acceptable PD level	pC		
4.6*	**Curing of Active Part**			
4.6.1	Highest temperature	^{0}C		
4.6.2	Duration	Hrs		
4.6.3	Average temperature	^{0}C		
4.6.4	Duration	Hrs		
4.6.5	Total duration	Hrs		
4.6.6	**Active Part Compression during Pressure, (approx)**	mm		
4.7	**Winding clamping for Short circuit**	Insert		
5	**Short Circuit**			
5.1	Current through windings for Terminal Fault			
5.1.1	HV	kArms		
5.1.2	LV	kArms		
5.1.3	TV	kArms		
5.1.4	Peak Factor		2.69	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2	Pre-fault voltage	p.u.	1.05	
5.3	Withstand Duration	s	2	
5.4	Similar Design Transformer (as per IEC 60076-5, Annex A) type test reference			
5.4.1	Testing Authority		STL Lab, insert Name	
5.4.2	certificate reference			
5.4.3	Contact address of test Lab			
5.4.4	Validity of test certificate			
5.5	Force [Shall be based on Highest SCC among LLG, LL, LLL, LG at each side-HV/LV/TV] of offered TR			
5. 5.1	Axial Force [CW/SW/RW/TW]	kN		
5. 5.2	Free Buckling Force [CW/SW/RW/TW]	kN		
5.5.3	Compression Force [CW/SW/RW/TW]	kN		
5. 5.4	Designed Safety Margin [CW/SW/RW/TW]			
a	For indivisual winding clamping		> 1.4	
b	For other design		>2	
5. 5.5	Offered & Reference Similar Type testedDesign transformer Short Circuit Force relationship		Within 110%	
5.6	Temperature during SC			
5. 6.1	HV Winding [Actual/Allowable]	^{0}C		
5. 6.2	LV Winding [Actual/Allowable]	^{0}C		
5. 6.3	RV Winding [Actual/Allowable]	^{0}C		
5.6.4	TV Winding [Actual/Allowable]	^{0}C		
5.7	Maximum Circulating Current in Delta tertiary for L-G fault at TV terminal	kA		
5.7.1	Winding withstand capacity of this current	Min or s		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6*	**Dielectric Design**			
6.1	Impulse Voltage At HV (LI)	kVp		
6.1.1	Maximum applied voltage at critical points	kVp		
6.1.2	Permissible Voltage	kVp		
6.1.3	Safety Factor		>2	
6.1.4	Transferred surge at LV	kVp		
6.1.5	Transferred surge at TV	kVp		
6.1.6	ZnO Block to limit distributed impulse [tap Winding/other]		At Design stage	
6.2	Impulse Voltage At HV (SI)			
6.2.1	Maximum applied voltage at critical points	kVp		
6.2.2	Permissible Voltage	kVp		
6.2.3	Safety Factor		>2	
6.2.4	Transferred surge at LV	kVp		
6.2.5	Transferred surge at TV	kVp		
6.2.6	ZnO Block to limit distributed impulse [tap Winding/other]		At Design stage	
6.3	Impulse Voltage At LV (LI)			
6.3.1	Maximum applied voltage at critical points	kVp		
6.3.2	Permissible Voltage	kVp		
6.3.3	Safety Factor		>2	
6.3.4	Transferred surge at HV	kVp		
6.3.5	Transferred surge at TV	kVp		
6.3.6	ZnO Block to limit distributed impulse		At Design stage	
6.4	**Impulse Voltage at TV (LI)**			
6.4.1	Maximum applied voltage at critical points	kVp		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.4.2	Permissible Voltage	kVp		
6.4.3	Safety Factor		>2	
6.4.4	Transferred surge at HV	kVp		
6.4.5	Transferred surge at LV	kVp		
6.4.6	ZnO Block to limit distributed impulse		No.	
7*	**Earthing**			
7.1	Neutral [with double connection], with copper conductor	sqmm		
7.2	Core , taken out			
7.3	Clamp			
7.4	Tank Body			
7.5	Cubicles			
7.6	Radiators, if separately mount /connected		NA	
7.7	Others			
8*	**Valves & Manholes**			
8.1	Type of valves used			
8.2	Valve schedule attached		Yes	
8.3	Spare Manhole for inspection & future use		Yes, insert number & size	
9*	**Oil for Transformer & Tap-Changer**			
9.1	Manufacturer, country		Insert	
9.2	Type		Insert	
9.3	Standard		IEC 60296	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
9.4	Minimum flash point	°C	>140	
9.5	Viscosity at 40°C	mm^2/s	Max 8	
9.5.1	Viscosity at -30°C	mm^2/s	Max 800	
9.6	Maximum dielectric strength before / after treatment	kV (at 2.5cm)	60/70	
9.7	Total sulphur content	%	<0.01	
9.8	Corrosive Sulphur		No	
9.9	PCB content		Without PCB	
9.10	Water Content	mg/kg	<20	
9.11	DDF at 90°C [IEC 60247]		<0.001	
9.12	Density at 20°C	Kg/dm^3	>0.7	
9.13	Stray gassing under thermooxidative stress			
	Hydrogen	µL/L	<5	
	Methane/Ethane		<1	
9.14	Sludge	wt %	<0.01	
9.15	Antioxidants	wt %	<0.24	
9.16	Total acidity [IEC 61125]	mg KOH/g	<0.05	
9.17	Data sheet attached		Yes	
10	**Bushing**		IEC60137	
10.1	**HV bushing**			
10.1.1	Quantity		03	
10.1.2	Class	kV	245	
10.1.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.4	Type		Insert	
10.1.5	Rated current	A	≥ 1600	
10.1.6	Rated short circuit current (2 s)	kA rms	50	
10.1.7	Rated lightning impulse withstand voltage	kV peak	1050	
10.1.8	Rated switching impulse withstand voltage	kV peak	850	
10.1.9	Rated power frequency withstand voltage (wet)	kV rms	460	
10.1.10	Connectors			
10.1.10.1	Shape	mm	insert	
10.1.10.2	Length	mm	insert	
10.1.10.3	Suitable for		Al wire	
10.1.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.1.12	Full vacuum withstand of complete bushing		YES	
10.1.13	Housing		Composite SiR	
10.1.14	Test tap	Yes		
10.1.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.1.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.1.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.1.18	profile factor, P.F.		insert	
10.1.19	Min. flashover distance	mm		
10.1.20	Cantilever test load	kN		
10.1.21	Housing shed type	Alternate		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.1.22	Air Vent	Yes		
10.1.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.1.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.1.25	Total Length	mm		
10.1.26	Outer diameter	mm		
10.1.27	CT Pocket Length for BCT	mm		
10.1.28	Oil quantity [for OIP type]	kg		
10.1.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.1.30	No. of Hole			
10.1.31	Diameter of each hole			
10.1.32	Distance between hole			
10.1.33	Fixing nut-bolt Material	AL or SS		
10.1.34	Earthing holes M12	No.		
10.1.35	End-shielding			
10.1.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.1.37	Top Terminal Suitable for	AL		
10.1.38	dissipation factor			
10.1.39	Partial discharge			
10.1.40	Insulation Class	F/155^0 C		
10.1.41	Total Weight	kg		
10.2	**LV bushing**			
10.2.1	Quantity		03	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.2	Class	kV	145	
10.2.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.2.4	Type		Insert	
10.2.5	Rated current	A	≥ 2000	
10.2.6	Rated short circuit current (2 s)	kA rms	40	
10.2.7	Rated lightning impulse withstand voltage	kV peak	650	
10.2.8	Rated switching impulse withstand voltage	kV peak	-	
10.2.9	Rated power frequency withstand voltage (wet)	kV rms	275	
10.2.10	Connectors			
10.2.10.1	Shape	mm	insert	
10.2.10.2	Length	mm	insert	
10.2.10.3	Suitable for		Al wire	
10.2.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.2.12	Full vacuum withstand of complete bushing		YES	
10.2.13	Housing		Composite SiR	
10.2.14	Test tap	Yes		
10.2.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.2.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.2.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.2.18	profile factor, P.F.		insert	
10.2.19	Min. flashover distance	mm		
10.2.20	Cantilever test load			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.2.21	Housing shed type	Alternate		
10.2.22	Air Vent	Yes		
10.2.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.2.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.2.25	Total Length	mm		
10.2.26	Outer diameter	mm		
10.2.27	CT Pocket Length for BCT	mm		
10.2.28	Oil quantity [for OIP type]	kg		
10.2.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.2.30	No. of Hole			
10.2.31	Diameter of each hole			
10.2.32	Distance between hole			
10.2.33	Fixing nut-bolt Material	AL or SS		
10.2.34	Earthing holes M12	No.		
10.2.35	End-shielding			
10.2.36	Al-casted head [with oil expansion chamber and oil level			
	Indicator--- for OIP]			
10.2.37	Top Terminal Suitable for	AL		
10.2.38	dissipation factor			
10.2.39	Partial discharge			
10.2.40	Insulation Class	F/155^0 C		
10.2.41	Total Weight	kg		
10.3	**TV bushing**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.1	Quantity		03	
10.3.2	Class	kV	36	
10.3.3	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.3.4	Type		Insert	
10.3.5	Rated current	A	≥ 2000	
10.3.6	Rated short circuit current (2 s)	kA rms	31.5	
10.3.7	Rated lightning impulse withstand voltage	kV peak	170	
10.3.8	Rated switching impulse withstand voltage	kV peak	-	
10.3.9	Rated power frequency withstand voltage (wet)	kV rms	70	
10.3.10	Connectors			
10.3.10.1	Shape	mm	insert	
10.3.10.2	Length	mm	insert	
10.3.10.3	Suitable for		Al wire	
10.3.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.3.12	Full vacuum withstand of complete bushing		YES	
10.3.13	Housing		Composite SiR	
10.3.14	Test tap	Yes		
10.3.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.3.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.3.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.3.18	profile factor, P.F.		insert	
10.3.19	Min. flashover distance	mm		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.3.20	Cantilever test load			
10.3.21	Housing shed type	Alternate		
10.3.22	Air Vent	Yes		
10.3.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.3.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.3.25	Total Length	mm		
10.3.26	Outer diameter	mm		
10.3.27	CT Pocket Length for BCT	mm		
10.3.28	Oil quantity [for OIP type]	kg		
10.3.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.3.30	No. of Hole			
10.3.31	Diameter of each hole			
10.3.32	Distance between hole			
10.3.33	Fixing nut-bolt Material	AL or SS		
10.3.34	Earthing holes M12	No.		
10.3.35	End-shielding			
10.3.36	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]			
10.3.37	Top Terminal Suitable for	AL		
10.3.38	dissipation factor			
10.3.39	Partial discharge			
10.3.40	Insulation Class	F/155^0 C		
10.3.41	Total Weight	kg		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4	**NV bushing**			
10.4.1	Quantity		01	
10.4.2	Class	kV	72.5	
10.4.4	Manufacturer		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
10.4.4	Type		Insert	
10.4.5	Rated current	A	≥ 2000	
10.4.6	Rated short circuit current (2 s)	kA rms	50	
10.4.7	Rated lightning impulse withstand voltage	kV peak	325	
10.4.8	Rated switching impulse withstand voltage	kV peak	-	
10.4.9	Rated power frequency withstand voltage (wet)	kV rms	140	
10.4.10	Connectors			
10.4.10.1	Shape	mm	insert	
10.4.10.2	Length	mm	insert	
10.4.10.3	Suitable for		Al wire	
10.4.11	Minimum creepage distance	mm/kV	≥ 31 mm/kV	
10.4.12	Full vacuum withstand of complete bushing		YES	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.13	Housing		Composite SiR	
10.4.14	Test tap	Yes		
10.4.15	The max. test voltage of the tap for 1 minute.	at 50 Hz, kV AC	insert	
10.4.16	USCD, Unified Specific Creepage Distance	Mm/kV	insert	
10.4.17	Creepage factor ,Cf [According to IEC 60815]		insert	
10.4.18	profile factor, P.F.		insert	
10.4.19	Min. flashover distance	mm		
10.4.20	Cantilever test load	kN	insert	
10.4.21	Housing shed type	Alternate		
10.4.22	Air Vent	Yes		
10.4.23	Allowable mounting angle [with Vertical]	^{0} [deg]		
10.4.24	Mounted Angle [with Vertical] in this transformer	^{0} [deg]		
10.4.25	Total Length	mm		
10.4.26	Outer diameter	mm		
10.4.27	CT Pocket Length for BCT	mm		
10.4.28	Oil quantity [for OIP type]	kg		
10.4.29	Mounting Flange made of corrosion free aluminum alloy	Yes		
10.4.40	No. of Hole			
10.4.41	Diameter of each hole			
10.4.42	Distance between hole			
10.4.43	Fixing nut-bolt Material	AL or SS		
10.4.44	Earthing holes M12	No.		
10.4.45	End-shielding			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.46	Al-casted head [with oil expansion chamber and oil level Indicator--- for OIP]			
10.4.47	Top Terminal Suitable for	AL		
10.4.48	dissipation factor			
10.4.49	Partial discharge			
10.4.40	Insulation Class	F/155^0 C		
10.4.41	Total Weight	kg		
11*	**Sound & RIV**			
11.1	At No load, rated frequency , 100% rated voltage	dB		
11.2	At No load, rated frequency, 105% rated voltage	dB		
11.5	Guaranteed during Testing	dB		
11.6	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete cooling system in service	dB	70	
11.7	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	µV	2500 max	
13	**Weights and dimensions**			
13.1	Total weight of autotransformer, equipped for service	kg	Insert	
13.2	Core and oil assembly	kg	Insert	
13.3	Total mass excluding oil	kg	Insert	
13.4	Tank and accessories	kg	Insert	
13.5	Oil mass in tank	kg	Insert	
13.6	Oil mass in coolers	kg	Insert	
13.7	Oil mass total	kg	Insert	
13.8	Total mass	kg	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
13.9*	Maximum shipping weight (the heaviest item)	kg	Insert	
13.10	Height from foundation to:			
13.10.1	• Highest point of HV bushing	mm	Insert	
13.10.2	• Highest point of tank	mm	Insert	
13.10.3	• Highest point of conservator	mm	Insert	
13.10.4	• Highest point of lifting hook for removal of core and oil assembly	mm	Insert	
13.11	Outer dimensions:			
13.11.1	• Length	mm	Insert	
13.11.2	• Width	mm	Insert	
13.12	Informative dimensional sketch		To be enclosed with bid	
13.13*	Maximum shipping dimensions of tank:			
13.13.1	• Outside height	mm	Insert	
13.13.2	• Outside width	mm	Insert	
13.13.3	• Outside length	mm	Insert	
13.14	Transportation drawing		To be enclosed with bid	
14	**Auxiliary power supply**			
14.1	Motors		3x400 V / 50 Hz	
14.2	Heaters		230 V / 50 Hz	
14.3	Control voltage		110 V DC	
14.4	Oil pump		3x400 V / 50 Hz	
15	**Current transformer incorporated into the power autotransformer**			
15.1	CT in HV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
			stage	
15.2	CT in LV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores be characteristics shall be defined in design stage	
15.3	CT in neutral bushing, for protection		In all phases, 2cores characteristics shall be defined in design stage	
15.4	CT in TV bushings, for protection		In all phases, 3 cores characteristics shall be defined in design stage	
16*	**Layout**			
16.1	Primary winding bushings		Longitudinal axis	
16.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	
16.3	Conservator tank		As per spec	
16.4	Tap changer		As per spec	
16.5	Control cabinet		Seperate	
16.6	Coolers		Attached to tank	
16.7	Connection drawing, block diagram		To be enclosed with bid	
17	**Dehydrating breather**			
17.1	Type of dehydrating breather		Insert	
17.2	Dehumidifying agent	kg	Insert	
18	**Autotransformer tank**			
18.1	Type of design			
18.2	Thickness of transformer tank:			
18.2.1	• Sides	mm	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
18.2.2	• Bottom	mm	Insert	
18.2.3	• Top	mm	Insert	
18.3	Material of the autotransformer tank		Insert	
18.4	Wheels			
18.4.1	Wheel number for each rail of two pair rails		Two pairs	
18.4.2	Axial inter space in transversal direction between two pairs of rails	mm	4520	
18.4.3	Transversal distance between wheels in pair	mm	1435	
18.4.4	Distance between wheels in longitudinal direction	mm	1435	
18.5	Corrosion protection of the tank		YES	
18.6	Vacuum withstand of the complete tank with cooler	mbar	1	
18.7	Over-pressure withstand of the complete autotransformer	bar	0.3	
18.8	Painting Color	Munsell no.		
19	**Conservator**			
19.1	Type		With diaphragm	
19.2	Number of compartments	pcs.	Insert	
19.3	Total volume of conservator	m^3	Insert	
19.4	Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 0°C of the volume of autotransformer	%	Insert	
19.5	**Pressure rise inside the tank due to oil expansion Diagraph design parameters:**		Insert	
19.5.1	• Maximum diagraph stress at highest working pressure		Insert	
19.5.2	• Diagraph construction details		Insert	
19.5.3	• Type of diagraph material		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
19.6	Corrosion protection of conservator		Insert	
19.7	Oil level indicators with alarm for minimum oil level	pcs.	2	
19.8	Membrane provided inside the conservator for ‘’breathing’’ of the transformer		Yes	
20	**Miscellaneous Item**			
20.1	AVR Relay		MR, Germany	
20.2	Bucholtz relay, Make		insert	
20.3	Control Cable , Make		insert	
20.4	WTI [Normal &Fiber Optic]		Yes, insert number	
20.5	OTI		Yes, insert number	
20.6	Remote Transformer Panel with all accessories, Make		Yes, insert	
20.7	Marshalling Cubicle with all accessories, Make		Yes, insert	
20.8	Cooling Cabinet with all accessories, Make		Yes, insert	
20.9	Material (Cooling & Marshalling Cabinet)		Insert	
20.10.	No. of PRD in Main Tank		Min 3	
20.11	No. of PRD in OLTC		Insert	
20.12	Oil Surge Relay			
20.13	Breather		Mtrab	
20.14	Gasket Material		Nitrile Rubber	
20.15	Nut-Bolt, Make		Insert	
20.16	Nut-Bolt, Material		SS	
20.17	LA Make		Insert	
20.18				

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
21	**Operating conditions**			
21.1	At the altitude (above sea level)	m	≤ 1000	
21.2	Maximum ambient temperature	°C	40	
21.3	Average daily temperature	°C	35	
21.4	Average annual temperature	°C	30	
21.5	Minimum ambient temperature	°C	4	
21.6	Tertiary winding		Reactive Compensation	
21.7	Parallel operation		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.4.4 132/33 kV 80/120 MVA ONAN/ONAF Power transformer

Guaranteed Technical Particulars (GTP) for Auto/Power Transformer

Note:

3. 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.
4. 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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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	%	12(±10%)	
	At 70MVA base, HV-TV	%	NA	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	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			
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]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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 changer in nominal tap position at rated tapping current (ONAF) of that tap position	kW	[Insert]	
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	%	20	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	ancillary equipment load in % of the guaranteed value			
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 Duct	Axial/Zig-Zag	[Insert]	
3.1.2	Pressure drop in side 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.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	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. 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]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	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]	
	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	^{0}C	60	
3.2.2	Top Oil			
	At ONAN	^{0}C		
	At ONAF/OFAF/ODAF (as per schedule of requirement)	^{0}C		
3.2.3	Average Winding Temperature rise	^{0}C	65	
3.2.3.1	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	^{0}C	[Insert]	
3.2.4	Maximum hot spot temperature rises in core at rated power	^{0}C	[Insert]	
3.2.4.1	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	^{0}C	130	
3.2.4.2	Surface Temperature (Amb. Temp. + Top oil rise + Core	^{0}C	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	surface temp.)			
3.2.5	Temperature gradient at specified rating			
3.2.6	Temperature rise of metallic parts			
	Tank walls	^{0}C	[Insert]	
	Tie plate	^{0}C	[Insert]	
	Top clamp	^{0}C	[Insert]	
	Bottom clamp	^{0}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	^{0}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 at principal tap			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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/mm2	[Insert]	
	RV/ tap Winding	A/mm2	[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 [crimped, Brazed or others]			
	Between Windings			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	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	ºC	Insert	
	Duration	Hrs	Insert	
	Average temperature	ºC	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 cooling system in service	dB	[Insert]	
	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	μV	2500 max	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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			
3.7.1	Impulse Voltage at HV (LI)			
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	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			
3.8.1	Manufacturer		MR (EU), ABB (EU)	
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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)	
	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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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:			
	• 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			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	mm2/s	Insert	
4.7	Minimum dielectric strength	kV/cm	Insert	
5	Bushing			
	Standard		IEC 60137	
5.1	**HV bushing (145 kV)**			
5.1.1	Make/Country		ABB (Sweden/ Switzerland), Trench (France/USA), HSP (Germany), GE (Italy)	
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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.		
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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		
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		

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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)			

5.2.4.5 33/0.415kV 350kVA Earthing / Zigzag transformer (Not applicable)

No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	**Data**	
1	**General**			
1.1	Manufacturer		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.2	Type		Distribution transformer three-phase, Oil immersed , two windings, with off-load tap changer, outdoor	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60076	
1.6	Quality control		ISO 9001	
2	**Ratings and properties**			
2.1	Rated power:	kVA	350	
2.2	Type of cooling ONAN / ONAF	-	ONAN	
2.3	Rated voltage	kV/V	33 ± 2 x 2,5 % / 415	
2.4	Percent Impedance			
2.5	Tap changer:			
	• Type of tap changing		Off-load	
	• Tapping range	%	±5	
	• Tapping step	%	2.5	
	• Rating		Rated power 350 kVA, all taps	
2.6	Raed Frequency	Hz	50	
2.7	Connection of three-phase windings (group of vector IEC 60076)		ZNyn11	
3	**Special technical requirements**			
3.1	Power transformer capacity to withstand external short circuits [Three phase Fault]			
3.1.1	Short-circuit duration	s	3	
3.1.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period:			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	• HV winding	kA	Infinite	
	• LV winding	kA	Infinite	
3.1.3	Percent Impedance for above	%	5	
3.2	Power transformer capacity to withstand external short circuits [Single phase Fault at HV]			
3.2.1	Short-circuit duration	s	3	
3.2.2	Neutral current			
	• HV side	A	>1000	
	• LV side	A	Insert	
3.2.3	HV side Zero sequence Impedance for above	ohm	Insert	
3.2	Guaranteed losses			
3.2.1	Average No-load losses with tap changer in normal/high/low position, at rated voltage and rated frequency	kW	Insert	
3.2.2	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
3.2.3	Average On-load losses at 75°C, at rated voltage and rated frequency, with tap changer in normal/high/low position	kW	Insert	
3.2.4	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.3	Insulation level			
3.3.1	Medium voltage (MV)		LI 170 AC 70	
3.3.2	Low voltage (LV)		LI-AC3	
3.4	The highest voltage for equipment (effective value)			
3.4.1	Medium voltage (MV)	kV	36	
3.4.2	Low voltage (LV)	kV	1.1	
3.5	Temperature rise limits, at rated power, with complete cooling system in service and at lowest voltage tap			
3.5.1	Top oil	K	≤ 60	
3.5.2	Winding	K	≤ 65	
3.5.3	Hottest spot	K	≤ 68	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4	**Oil**		**NA**	
4.1	New		Yes	
4.2	Manufacturer		Insert	
4.3	Type		Insert	
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	>135	
4.6	Viscosity at 20°C	mm^2/s	Insert	
4.7	Minimum dielectric strength	kV/cm	Insert	
5	**Bushing**			
5.1	MV bushing (36 kV)			
5.1.1	Quantity		3 + 1	
5.1.2	Class	kV	36/170/70	
5.1.3	Manufacturer		Insert	
5.1.4	Type		OIP/Porcelain	
5.1.5	Model		Insert	
5.1.6	Rated current	A	≥ 630	
5.1.7	Rated Short Circuit Current	kA,1s	31.5	
5.1.8	Minimum creepage distance (31 mm/kV)	mm/kV	≥ 31 mm/kV	
5.2	LV bushings (3 kV)			
5.2.1	Quantity		3 + 1	
5.2.2	Class	kV	3	
5.2.3	Manufacturer		Insert	
5.2.4	Type		OIP/Porcelain	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2.5	Model		Insert	
5.2.6	Rated current	A	≥800	
5.2.7	Rated Short Circuit Current	kA,3s	15	
5.2.7	Minimum creepage distance (31 mm/kV)	mm/kV	≥ 31 mm/kV	
6	**Weights and dimensions**			
6.1	Total weight of transformer, ready for service	kg	Insert	
6.2	Outer dimensions:			
	• Length	mm	Insert	
	• Width	mm	Insert	
6.3	Informative dimensional sketch		To be enclosed with bid	
7	**Dehydrating breather**			
7.1	Type of dehydrating breather		Insert	
7.2	Dehumidifying agent	kg	Insert	
8	**Conservator**			
8.1	Type		With dehydrating breather	
8.2	Number of compartments	pcs.	1	
8.3	Oil level indicators with alarm for minimum oil level	pcs.	1	
9	**Operating conditions**			
9.1	At the altitude (above sea level)	m	≤ 1000	
9.2	Maximum ambient temperature	°C	45	
9.3	Average daily temperature	°C	35	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
9.4	Average annual temperature	°C	30	
9.5	Minimum ambient temperature	°C	4	
	Overall compliance with the requirements (yes/no)			

5.2.5 Control, Protection, Substation Automation & Metering

5.2.5.1 Line Distance Protection

No.	Description	Unit	Minimum Requirements	Guaranteed
1	Manufacturer		ABB/SIEMENS/GE/SEL	
2	Country of Origin (Place of Manufacturing)		Switzerland/Sweden/Germany/UK/USA/ France	
3	**Relay Identification**			
3.1	Relay Type & model		Insert (Main-01 & Main-02 shall be from different manufacturer)	
3.2	Relay Software version		Insert	
3.3	Relay Hardware version		Insert	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, ±5%	
8	**Current transformer requirement**			
8.1	No of Inputs	Nos.	6	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	**Voltage transformer requirement**			
9.1	No of Inputs	Nos.	6 (For Line VT & Bus VT)	
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	150	
10	**Binary input module**			
10.1	Minimum number of inputs	Nos.	10 (programmable) (Should be increased as per the scheme design)	
10.2	Minimum operating range	V	110V DC (±20% tolerance)	
11	**Binary output module**			
11.1	Minimum number of	Nos.	20 (minimum 8 Nos. high speed trip output	

No.	Description	Unit	Minimum Requirements	Guaranteed
	outputs		and 2 Nos. watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	5 (2ms for high speed contact)	
12	Number of LEDs	Nos.	15 (programmable) (Should be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, 3. disturbance handling and 4. parameterization has to be supplied 5. free of cost and without any time-bounded license	
14	GPS Time synchronization	Yes/ No	Yes	
16	**Communication interface**			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 based Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	**Main protection function**		Impedance protection	
17.1	Tripping options		Single and/or three phases	
17.2	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Number of impedance protection zones	Nos.	5	
17.5	Shape of impedance zone		Mho/Quadrilateral	
17.6	Reverse looking element		Settable in all 5 zones	
17.7	Can resistance and reactance reaches be set independent of each other	Yes/ No	Yes	
17.8	Arc forward and reverse reach setting independent of each other?	Yes/ No	Yes	
17.9	Switch on to fault	Yes/ No	Yes	

No.	Description	Unit	Minimum Requirements	Guaranteed
17.10	Out of Step	Yes/ No	Yes	
17.11	Stub Protection	Yes/ No	Yes	
17.12	Blind Fault Protection	Yes/ No	Yes	
17.13	Power swing block	Yes/ No	Yes	
17.14	Communication aided impedance protection		PUTT, POTT, CB Echo logic, Weak infeed echo logic, DTT, Zone-1 extension etc.	
17.15	Communication aided Directional Earth Fault	Yes/ No	Yes	
17.16	Impedance zone operating time	Sec	Settable between 0s and 30s (or higher range) with step size of 0.01s	
17.17	Impedance setting range	Oh m	0.1 to 1000 or higher with the step size of 0.001/In	
17.18	Relay Operating Time' i) Output contact making time ii) Relay Time	ms	Insert	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault	
19	Control functions		Synchro check and 1P/3P auto-reclose for single and multi CB arrangements	
20	**Monitoring functions**			
20.1	Fuse failure supervision, current circuit supervision	Yes/ No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/ No	Yes	
20.3	Fault locator	Yes/ No	Yes	
20.4	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

5.2.5.2 Line Differential Protection

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1	Manufacturer		ABB/SIEMENS/GE/SEL	
2	Country of Origin (Place of Manufacturing)		Switzerland/Sweden/Germany/UK/USA/ France	
3	**Relay Identification**			
3.1	Relay Type & model		Insert **(Main-01 & Main-02 shall be from**	

			different manufacturer)	
3.2	Relay Software version		Insert	
3.3	Relay Hardware version		Insert	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, ±5%	
8	**Current transformer requirement**			
8.1	No of Inputs	Nos.	8	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	**Voltage transformer requirement**			
9.1	No of Inputs	Nos.	6 (For Line VT & Bus VT)	
9.2	Nominal voltage	V AC	110	
9.3	Minimum continuous withstand voltage	V AC	220	
10	**Binary input module**			
10.1	Minimum number of inputs	Nos.	10 (programmable) (Should be increased as per the scheme design)	
10.2	Minimum operating range	V	110V DC (±20% tolerance)	
11	**Binary output module**			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	5ms & 2ms for high speed contact	
12	Number of LEDs	Nos.	15 (programmable) (Should be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license	
15	GPS Time synchronization	Yes/No	Yes	

16	**Communication interface**			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
16.3	Protection communication		Should be suitable for multiplexed, routed switched or dedicated fiber optic communication	
16.4	Binary input transfer		Should be able to transfer at least 8Nos binary signals between the IEDs	
17	**Main protection function**		Line differential protection	
17.1	Tripping options		Single and/or three phases	
17.2	Number of parameters setting groups	Nos	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Differential characteristics		Restrained biased characteristics with charging current compensations	
17.5	Harmonics blocking		2^{nd} and 5^{th} harmonics	
17.6	CT summation		Internal CT summation facility should be available for 1 and ½ CB arrangement	
17.7	Emergency protection (Should be enabled in case of differential communication failure)		Impedance protection with at least 4 mho/quadrilateral zone setting options, PSB, SOTF, VTFF and all scheme communication features[1]	
17.8	Display options		There must be provision of displaying restraining and differential current on the HMI	
17.9	Tripping time		Instantaneous	
17.10	Protected distance		Should be able to protect at least 150km of line and further facility of extending protected line length in the relay should be provided	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault	
19	Control functions		Synchrocheck and 1P/3P auto-reclose for single and multi CB arrangements	
20	**Monitoring functions**			
20.1	Fuse failure supervision, current circuit supervision	Yes/No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.3	Event records and oculographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
21	Tripping and indication logics		Programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

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

5.2.5.3 Transformer Differential Protection (3 Winding):

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1	Manufacturer		ABB/SIEMENS/GE/SEL	
2	Country of Origin (Place of Manufacturing)		Switzerland/Sweden/Germany/UK/USA/ France	
3	**Relay Identification**			
3.1	Relay Type & model		Insert **(Main-01 & Main-02 shall be from different manufacturer)**	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, ±5%	
8	**Current transformer requirement**			
8.1	No of Inputs	Nos.	12	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	**Voltage transformer requirement**			
9.1	No of Inputs		6 (For Line VT & Bus VT)	
9.2	Nominal voltage	V AC	110	
9.3	Minimum continuous withstand voltage	V AC	220	
10	**Binary input module**			
10.1	Minimum number of inputs	Nos.	20 (programmable) (Should be increased as per the scheme design)	
10.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11	**Binary output module**			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	

12	Number of LEDs	Nos.	15 (programmable) (Should be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any timebounded license.	
15	GPS Time synchronization	Yes/No	Yes	
16	**Communication interface**			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	**Main protection function**		Transformer differential protection	
17.1	Application		For 3 winding and Auto-Transformers	
17.2	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Differential characteristics		Restrained biased characteristics with stabilization during magnetizing inrush and CT saturation	
17.5	Harmonics blocking		2^{nd} and 5^{th} harmonics	
17.6	CT ratio matching and vector group compensation		Internally done, Software based	
17.7	CT connection		• CT connections from each voltage level should be connected individually without external summation	
17.8	Display options		There must be provision of displaying restraining and differential current on the HMI	
17.9	Tripping time		Instantaneous	
17.10	Restricted Earth Fault		High / low impedance type	
18	Back up protection function		Instantaneous/delayed, directional/non-directional, over	

			current and earth fault	
19	Control functions		Synchrocheck and 1P/3P auto-reclose for single and multi CB arrangements	
20	**Monitoring functions**			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	
21	Tripping and indication logics		Programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

5.2.5.4 Over current and Earth fault protection:

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1	Manufacturer		ABB/SIEMENS/GE/SEL	
2	Country of Origin (Place of Manufacturing)		Switzerland/Sweden/Germany/UK/USA/ France	
3	**Relay Identification**			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, ±5%	
8	**Current transformer requirement**			
8.1	No of Inputs	Nos.	4	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	**Voltage transformer requirement**			
9.1	No of Inputs	Nos	4	

9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	**Binary input module**			
10.1	Minimum number of inputs	Nos.	10 (programmable) (Should be increased as per the scheme design)	
10.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11	**Binary output module**			
11.1	Minimum number of outputs	Nos.	10 (minimum 6 Nos high speed trip output and 2 Nos watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	8 (programmable) (Should be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be suppliedfree of cost and without any time-bounded license.	
15	GPS Time synchronization	Yes/No	Yes	
16	**Communication interface**			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault protection with IEC and ANSI/IEEE characteristics curves	
17.1	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.2	Minimum stages in each setting groups for Over-current	Nos	3	
17.3	Minimum stages in each setting groups for Earth fault	Nos	3	
17.4	Pre-configuration		For all basic functions	

17.5	Tripping time		Settable between 0s to 150s	
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	0.1*In to at least 20*In (step size 0.01)	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	0.5*In to at least 35*In (step size 0.1)	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	0.01*In to at least 20*In (step size 0.01)	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	0.5*In to at least 35*In (step size 0.1)	
17.10	TMS setting range for IDMT		0.025 to at least 1.5 (step size 0.025)	
18	Other protection functions		Comprehensive voltage protection functionality including over-voltage, under-voltage, negative sequence overvoltage, residual over-voltage, under-frequency, over-frequency, Rate of Change of Frequency (ROCOF) protection	
19	**Monitoring functions**			
19.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
19.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 24Nos binary channels	
20	Tripping and indication logics		Should be programmable	
21	Standards		Should conform IEC-60255 in all aspects	
22	Type test certificate		Should be provided	

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

No.	Description	Unit	Minimum Requirements	Guaranteed Data
1	Manufacturer		ABB/SIEMENS/GE/SEL	
2	Country of Origin (Place of Manufacturing)		Switzerland/Sweden/Germany/UK/USA/ France	
3	**Relay Identification**			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	

4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50/60Hz, ±5%	
8	**Current transformer requirement**			
8.1	No of Inputs	Nos	4	
8.2	Nominal current	A	Operable in 1A and 5A	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	**Voltage transformer requirement**			
9.1	No of Inputs	Nos	10 (For Line voltage and Bus voltages)	
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	**Binary input module**			
10.1	Minimum number of inputs	Nos	10 (programmable) (Can be increased as per the scheme design)	
10.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11	**Binary output module**			
11.1	Minimum number of outputs	Nos	10 (minimum 5 Nos fast operating trip output and 1 Nos watchdog outputs) (Can be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC (±20% tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos	08 (programmable) (Can be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to issue close& open commands to switching devices through visual animation, access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool.	

			2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
15	GPS Time synchronization		Should be available	
16	**Communication interface**			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	**Main protection function**		Instantaneous/delayed, directional/non-directional, over current and earth fault protection with IEC and ANSI/IEEE characteristics curves	
17.1	Number of parameter setting groups	Nos	Minimum 4 (Independently settable)	
17.2	Minimum stages in each setting groups for Over-current	Nos	3	
17.3	Minimum stages in each setting groups for Earth fault	Nos	3	
17.4	Pre-configuration		For all basic functions	
17.5	Tripping time		Settable between 0s to 150s	
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	0.1*In to at least 20*In (step size 0.01)	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	0.5*In to at least 35*In (step size 0.1)	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	0.01*In to at least 20*In (step size 0.01)	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	0.5*In to at least 35*In (step size 0.1)	
17.10	TMS setting range for IDMT		0.025 to at least 1.5 (step size 0.025)	
18	Other protection functions		Comprehensive voltage protection functionality including over-voltage, under-voltage, negative sequence overvoltage and residual over-voltage protection	
19	Control functions		Synchrocheck Implementing interlocking logics Execution of close and open command for	

			switching devices coming from SAS and Device HMI	
20	**Monitoring functions**			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 10Nos previous records and disturbance recorder should handle at least 8Nos analogue channels and at least 16Nos binary channels	
21	Tripping and indication logics		Should be programmable	
22	Standards		Should conform IEC-60255 in all aspects	
23	Type test certificate		Should be provided	

5.2.5.6 Busbar and Breaker Failure Protection

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1.	**General:**			
1.1	Manufacturer		ABB/SIEMENS/GE/SEL	
1.2	Country of origin		Switzerland/Sweden/Germany/UK/USA/ France	
1.3	Type of installation		Distributed	
1.4	Standards		IEC	
1.5	**Central Unit (CU)**			
1.5.1	Terminal type		Insert	
1.5.2	Terminal version (software version)		Insert	
1.5.3	Central unit for busbar protection must be supported for min. 16 bays		Yes	
1.6	**Bay Unit (BU)**			
1.6.1	Terminal type		Insert	
1.6.2	Terminal version (software version)		Insert	
2.	**Auxiliary Circuit**			
2.1	**Auxiliary supply voltage**			
2.1.1	CU, BU Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	CU auxiliary supply redundant		Yes	
2.1.3	Interruption in auxiliary d.c. voltage: Without resetting Restart time	 ms s	 > 50 Insert	
2.2	**A.C. current inputs BU**			
2.2.1	Number of inputs		Min. 3	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	**Binary inputs CU, BU**		Min. 20 / 8	

2.3.1	Number of modules		Insert	
2.3.2	Number of inputs per module		Insert	
2.3.3	Rated voltage	V d.c.	110 ±15 %	
2.4	**Binary outputs CU, BU**		Min. 6 / 4	
2.4.1	Number of modules		Insert	
2.4.2	Number of outputs per module		Insert	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.4.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.4.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.4.6	Number of tripping contacts (high-speed output)	pcs.	Min. 3	
2.4.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.5	**LED indications CU, BU**			
2.5.1	Number of LED's		Insert	
2.5.2	Multi-colour LED's	Yes/No	Insert	
2.6	**Communication ports CU, BU**			
2.6.1	Port for front-connected PC			
2.6.1.1	Protocols supported		Insert	
2.6.1.2	Communication speed	Kbit/s	Insert	
2.6.1.3	PC connector type		Insert	
2.6.2	CU, BU communication media		FO	
2.6.3	CU rear station (system) communication ports			
2.6.3.1	Number of rear ports		Insert	
2.6.3.2	Protocols supported		IEC 61850	
2.6.3.3	Communication speed	Mbit/s	Insert	
2.6.3.4	Connector type		RJ45	
2.6.4	Time synchronisation		SNTP	
2.7	**Busbar differential protection**			
2.7.1	Operating time	ms	< 20	
2.7.2	Internal CT ratio adaptability		Yes	
2.7.3	Multiple tripping criteria, check zone and bus zone		Yes	
2.7.4	Current transformer supervision		Yes	
2.7.5	External signal of load transfer starting		Insert	
2.7.6	Busbar protection system should be suitable/adaptable for future switchgear extension or modification		Yes	
2.7.7	Bay-selective intertripping		Yes	
2.7.8	Phase-segregated measurement system		Yes	
2.8	**Breaker failure protection**			
2.8.1	Setting range	% Ir	Insert	
2.8.2	Re-trip time delay range	s	0-1	
2.8.3	Re-trip operation mode 1 & 3 phase		Yes	
2.8.4	Back-up time delay range	s	0-1	
2.8.5	Trip operating time setting resolution	ms	1	
2.8.6	Trip delay range	s	0-1	

2.8.7	Single-phase with/without current		Yes	
2.8.8	2-stage operation bay trip repeat/trip busbar		Insert	
2.8.9	Selectable operation mode (current, unbalance, low current)		Insert	
2.8.10	Independent settable delay times for all operation modes		Yes	
2.8.11	Low current mode using the circuit breaker auxiliary contact		Yes	
2.8.12	End fault protection		Yes	
2.8.13	Independent breaker failure protection per bay unit		Yes	
2.9	**Disturbance recorder CU, BU**			
2.9.1	Number of digital signals		Insert	
2.9.2	Number of analogue signals		Insert	
2.9.3	External/manual initiation of recording		Insert	
2.9.4	Sampling rate	kHz	Insert	
2.9.5	Pre-fault time	ms	≥ 300	
2.9.6	Recording time	ms	≥ 2000	
2.9.7	Number of recorded disturbances		Min. 5	
2.9.8	Total recording time with max. analogue and binary signals	s	> 10	
2.9.9	Output file comtrade format		Yes	
2.10	**Event recorder CU, BU**			
2.10.1	Max. number of events		Insert	
2.10.2	Time tagging resolution	ms	1	
2.11	Self-supervision CU, BU		Yes	
3	**Additional**			
3.1	Test socket BU		Yes	
3.2	Setting and configuration approved by Engineer		Yes	
3.4	**Centralised, user-friendly configuration and all necessary software tools for full parameterization, and (re)configuration in case of extensions should be delivered**		**Yes**	

5.2.5.7 Trip Circuit Supervision Relay

No.	Description	Unit	Minimum Requirements	Guaranteed
1.1	Manufacturer		ABB/SIEMENS/GE/SEL	
1.2	Country of origin		Switzerland/Sweden/Germany/UK/USA/ France	
1.3	Type		Insert	
1.4	Standards		IEC	
2	Standards		IEC	
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Binary outputs			

No.	Description	Unit	Minimum Requirements	Guaranteed
2.2.1	Number of outputs	NO/NC	Min. 2/2	
2.2.2	Rated voltage	V d.c.	110	
2.2.3	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.3	Supervised circuits			
2.3.1	Voltage range of supervised circuits	V d.c.	110 ±15 %	
2.3.2	Injected current of supervised circuits	mA	Insert	
2.3.3	Operating time range	s	Insert	
2.3.4	Resetting time range	s	Insert	

5.2.5.8 Tripping Relays (High Speed High Impedance Type)

No.	Description	Unit	Minimum Requirements	Guaranteed
1.1	Manufacturer		ABB/SIEMENS/GE/SEL	
1.2	Country of origin		Switzerland/Sweden/Germany/UK/USA/ France	
1.3	Type		Insert	
1.4	Standards		IEC	
2	Standards		IEC	
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Binary outputs			
2.2.1	Number of outputs	NO/NC	Min. 2/2	
2.2.2	Rated voltage	V d.c.	110	
2.2.3	Breaking capacity at inductive load with L/R < 40 ms, at rated voltage	A	Insert	
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.2.5	Make and carry continuously		Insert	
2.2.6	Make and carry for 3 sec.		Insert	
2.2.7	Break: resistive inductive	W VA	Insert	
2.3	Supervised circuits			
2.3.1	Voltage range of supervised circuits	V d.c.	110 ±15 %	
2.3.2	Injected current of supervised circuits	mA	Insert	
2.3.3	Operating time range	ms	Insert	
2.3.4	Resetting time range	s	Insert	

5.2.5.9 Test Socket

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1.1	Manufacturer		Insert	
1.2	Country of origin		Sweden/Switzerland/UK/ USA/Europe	
1.3	Type • Line main 1 and 2 • Line back-up and bus coupler • Transformer main 1 and 2 • Bay unit BBF Distance protection		Insert	
1.4	Standards		IEC	
1.5	Each protection device must have its own test socket		Yes	
1.6	Test socket must obtain safe online protection testing and maintaining, and performing whole tripping test with following AR		Yes	
1.7	Test socket should have enough contacts to: • Short-circuit current inputs from CT's • Isolate voltage inputs from VT's • Isolate trip circuit for each phase separately • Isolate CB close command • Isolate signalling voltage • Inhibit breaker failure initialising • Inhibit sending of communication signal Allow functional testing of protection		Yes	
1.8	Socket should be designed for 4 mm banana plugs access		Yes	
2.2.1	Number of outputs	NO/NC	Min. 2/2	

5.2.5.10 Overall Fault Clearance Times

No.	Description	Unit	Minimum Requirements Data	Guaranteed
1	230 kV Busbar Faults:			
	Main protection relay operating time	ms	**Insert**	
	Auxiliary and tripping relay time (where used)	ms	**Insert**	
	Circuit breaker time	ms	**Insert**	
	Total	ms	**Insert**	
2	132 kV Busbar Faults:			
	Main protection relay operating time	ms	**Insert**	
	Auxiliary and tripping relay time (where used)	ms	**Insert**	
	Circuit breaker time	ms	**Insert**	
	Total	ms	**Insert**	
3	230/135/34.5 kV Transformer Faults:			
	Main protection relay operating time	ms	Insert	
	Auxiliary and tripping relay time	ms	Insert	

	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
4	132/34.5 kV Transformer Faults:			
	Main protection relay operating time	ms	Insert	
	Auxiliary and tripping relay time	ms	Insert	
	Circuit breaker time	ms	Insert	
	Total	ms	Insert	
5	230 kV Line Faults:			
	Distance protection maximum operating time	ms	**Insert**	
	Permissive scheme time delay	ms	**Insert**	
	Auxiliary relay time (where used)	ms	**Insert**	
	Circuit breaker time	ms	**Insert**	
	Total	ms	**Insert**	
6	132 kV Line Faults:			
	Distance protection maximum operating time	ms	**Insert**	
	Permissive scheme time delay	ms	**Insert**	
	Auxiliary relay time (where used)	ms	**Insert**	
	Circuit breaker time	ms	**Insert**	
	Total	ms	**Insert**	

5.2.5.11 Multi-Phase Auto reclose

No.	**Description**	**Unit**	**Minimum Requirements** Data	**Guaranteed**
1.	Manufacturer's name and address		Insert	
2.	Country of origin		Insert	
3.	Type		Insert	
4.	Model No.		Insert	
5.	Standard		Insert	
6.	Single phase auto reclose		Insert	
7.	Three phase auto reclose		Insert	
8.	Multi-phase auto reclose		Insert	
9.	Main -1 Protection		Insert	
10.	Main -2 Protection		Insert	

5.2.5.12 Front Panel Annunciation for OHL & Power Transformers (not mandatory)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Front Panel annunciation for OHL & TR			
1.1	Panel mounting		Yes	
1.2	Number of inputs		Min. 16	
1.3	Contact type		NO/NC	
1.4	Galvanic isolation		Yes	
1.5	Self-monitoring • via front indication • via relay contact		Yes	
1.6	Response delay time		Adjustable	
1.7	Bright LED technology		Yes	
1.8	Audible device output		Yes	
1.9	Lamp test button		Yes	
1.10	Acknowledgement button		Yes	
1.11	Horn acknowledgement button		Yes	
	Overall compliance with the requirements (yes/no)			

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

5.2.5.13 Front Panel Annunciation for Control Room (optional)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Front Panel annunciation for Control Room			
1.1	Panel mounting		Yes	
1.2	Number of inputs		Min. 48	
1.3	Contact type		NO/NC	
1.4	Galvanic isolation		Yes	
1.5	Self-monitoring • via front indication • via relay contact		Yes	
1.6	Response delay time		Adjustable	
1.7	Bright LED technology		Yes	
1.8	Audible device output		Yes	
1.9	Lamp test button		Yes	
1.10	Acknowledgement button		Yes	
1.11	Horn acknowledgement button		Yes	
	Overall compliance with the requirements (yes/no)			

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

5.2.5.14 SCADA Server (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14261	SCADA Server			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
1.5	Type of housing		Industrial 19" rack	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Dual power supply		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.2	Processor type		Insert	
2.3	Processor clock	GHz	Insert	
2.4	Memory type		Insert	
2.5	Memory capacity	MB	Insert	
2.6	Video display adapter type		Insert	
2.7	Video display adapter memory		Insert	
2.8	Hard disc type		Insert	
2.9	Rotating hard disc	Yes/No	Insert	
2.10	Hard disc capacity	GB	Insert	
2.11	Number of hard discs	pcs.	Insert	
2.12	RAID controller type		Insert	
2.13	DVD RW type		Insert	
2.14	Serial interface RS232		Yes	
2.15	Number of serial interfaces		Min. 2	
2.16	Fast Ethernet network interface card type		Insert	
2.17	Number of fast Ethernet network interface cards	pcs.	4	
2.18	Fans	Yes/No	Insert	
2.19	Monitor 19"	pcs.	1	
2.19.1	Manufacturer		Insert	
2.19.2	Country of origin		Insert	
2.19.3	Type		TFT	
2.19.4	Standards		IEC	
2.19.5	Supply voltage			
2.19.5.1	Rated auxiliary supply voltage	V a.c.	110 ±15 %	
2.19.5.2	Power consumption	W	Insert	
2.20	Vertical frequency	Hz	Insert	
2.21	Max. resolution		Insert	
	Overall compliance with the requirements (yes/no)			

SCADA servers must be in hot-standby redundant configuration.

5.2.5.17 Substation Automation System (Not applicable)

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

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

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

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

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

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

5.2.5.18 Operator Workstation (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	Operator Workstation			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
1.5	Type of housing		Insert	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Processor type		Insert	
2.3	Processor clock	GHz	Insert	
2.4	Memory type		Insert	
2.5	Memory capacity	MB	Insert	
2.6	Video display adapter type		Dual head capability	
2.7	Video display adapter memory	MB	Insert	
2.8	Hard disc type		Insert	
2.9	Rotating hard disc	Yes/No	Insert	
2.10	Hard disc capacity	GB	Insert	
2.11	Number of hard discs	pcs.	Insert	
2.12	RAID controller type		Insert	
2.13	DVD RW type		Insert	
2.14	Sound card type		Insert	
2.15	Fast Ethernet network interface card type		Insert	
2.16	Number of fast Ethernet network interface cards	pcs.	4	
2.17	Fans	Yes/No	Insert	
2.18	Monitor 24"	pcs.	2	
2.18.1	Manufacturer		Insert	
2.18.2	Country of origin		Insert	
2.18.3	Type		TFT	
2.18.4	Standards		IEC	

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

5.2.5.19 Printer (Not Applicable)

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

5.2.5.20 Monitoring Workstation (Not Applicable)

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

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

5.2.5.21 Time Synchronization Device (Not Applicable)

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

5.2.5.22 Weather Station (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Weather Station			
1.1	Terminal Type		Insert	
1.2	Terminal version (software version)		Insert	
1.3	Standards		IEC	
2	Characteristics			
2.1	Hygro-thermo transmitter with weather thermal radiation shield			
2.1.1	Input	°C	–40..+60	
2.1.1.1	Output	mA	4-20	
2.1.1.2	Accuracy		1/3 Class B (±0.3 K)	
2.1.2	Input	% rel. h	0..100	
2.1.2.1	Output	mA	4-20	
2.1.2.2	Accuracy	% rel. h	±3	
2.2	Wind transmitter	Yes/No		
2.2.1	Input	m/s		
2.2.2	Output	mA		
2.2.3	Accuracy	%		
2.3	Wind direction transmitter	Yes/No		
2.3.1	Input	°		
2.3.2	Output	mA		
2.3.3	Accuracy	°		
2.4	Baro transmitter	Yes/No		
2.4.1	Input	mbar		
2.4.2	Output	mA		
2.5	Interface unit		Yes	
2.6	Overvoltage protection		Yes	
2.7	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

5.2.5.23 Ethernet Switch Process LAN (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14273	Ethernet Switch-Process LAN / Code number: 14273			

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

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Overall compliance with the requirements (yes/no)			

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

5.2.5.24 Ethernet Switch Control Room (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14274	Ethernet Switch-Control Room / Code number: 14274			
1.1	Terminal Type		Insert	
1.2	Terminal version (software version)		Insert	
1.3	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Dual power supply		Yes	
2.2	Ethernet ports			
2.2.1	Number of ports		Min. 16	
2.2.1	Type of ports		RJ45	
2.3	Immunity to EMI and heavy electrical surges		Insert	
2.4	Temperature range			
2.4.1	Operation		0..50°C	
2.4.2	Storage		–20..+70°C	
2.5	Switching method an layer		Store & Forward Layer 3 (IEC 61850), RSTP (802.1w); eRSTP^{TM} or RSTP (802.1D-2004) network fault recovery	
2.6	Switching latency		≤ 5µs	
2.7	Switching bandwidth		≤ 1.6 Gbps	
2.8	Failsafe output relay		Potential-free	
2.9	Cyber security features			
2.9.1	Multi-level passwords		Yes	
2.9.2	SSH/SSL encryption		Yes	
2.9.3	Enable/disable ports, MAC based port security		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.9.4	Port based network access control		Yes	
2.10	System features			
2.10.1	Automatic learning negotiation and crossover detection			
2.10.2	Port configuration, status, statistics, mirroring, security			
2.10.3	Network fault recovery		≤ 5 ms	
2.11	Type Test Reports		To be included with bid	
2.12	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

5.2.5.25 Protection Monitoring Software (Not Applicable)

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

5.2.5.26 SCADA Software (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	

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

5.2.5.27 Fibre Optic Cables & Terminal Equipment

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

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

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

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

5.2.5.28 Special Control Equipment and Tools

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

5.2.5.29 Protection Terminal 230 kV OHL-Main 1 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14001	Protection Terminal 230 kV OHL-Main 1 / Code number: 14001			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.3	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Minimum 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root			
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Distance protection			
2.10.1	Number of protection zones		Min. 5	
2.10.2	Basic operating time	ms	< 25	
2.10.3	Operational characteristic		Quadrilateral	
2.10.4	Zone 1 direction software selectable		Insert	
2.10.5	Zone 2 direction software selectable		Insert	
2.10.6	Zone 3 direction software selectable		Insert	
2.10.7	Zone 4 direction software selectable		Insert	
2.10.8	Zone 5 direction software selectable		Insert	
2.10.9	Minimum impedance setting	Ω	Insert	
2.10.10	Full scheme protection phase segregated		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Communication scheme logic			
2.11.1	Operational modes		Intertrip Permissive under-reach Permissive overreach Blocking	
2.12	Power swing detection		Yes	
2.13	Secondary circuits supervision: • VT circuits supervision • CT circuits supervision		 Yes Yes	
2.14	Automatic switch onto fault logic • Impedance criteria • Instantaneous overcurrent criteria		 Yes Yes	
2.15	Multistage three-phase overcurrent protection			
2.15.1	Directional		Insert	
2.15.2	Number of stages		Min. 2	
2.15.3	Setting range	% Ir	Insert	
2.15.4	Characteristics			
2.15.4.1	Definite time delayed	Yes/no	Yes	
2.15.4.2	Normal inverse	Yes/No	Yes	
2.15.4.3	Very inverse	Yes/No	Insert	
2.15.4.4	Extremely inverse	Yes/No	Insert	
2.16	Multistage earth fault overcurrent protection			
2.16.1	Directional		Insert	
2.16.2	Number of stages		Min. 2	
2.16.3	Setting range	% Ir	Insert	
2.16.4	Type of protection		Non-directional	
2.16.5	Characteristics			
2.16.5.1	Definite time delayed	Yes/no	Yes	
2.16.5.2	Normal inverse	Yes/No	Yes	
2.16.5.3	Very inverse	Yes/No	Insert	
2.16.5.4	Extremely inverse	Yes/No	Insert	
2.17	Directional earth fault protection			
2.17.1	Number of stages		Insert	
2.17.2	Setting range	% Ir	Insert	
2.17.3	Type of protection		Directional	
2.17.4	Characteristics			
2.17.4.1	Definite time delayed	Yes/no	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.17.4.2	Normal inverse	Yes/No	Yes	
2.17.4.3	Very inverse	Yes/No	Insert	
2.17.4.4	Extremely inverse	Yes/No	Insert	
2.17.5	Minimum polarizing voltage	% Ur	3 %	
2.17.6	Communication scheme logic		Yes	
2.17.6.1	Permissive and blocking		Yes	
2.17.7	Single and three-pole tripping schemes		Yes	
2.18	Current negative sequence protection			
2.18.1	Number of stages		Insert	
2.18.2	Setting range	% Ir	Insert	
2.18.3	Characteristic		Definite time	
2.19	Power system supervision			
2.19.1	Broken conductor check		Yes	
2.19.2	Overload protection			
2.19.2.1	Setting range of 1 stage	% Ir	Insert	
2.19.2.2	Time delay range of 1 stage	min	> 20	
2.19.2.3	Setting range of 2 stage	% Ir	Insert	
2.19.2.4	Time delay range of 2 stage	s	> 20	
2.19.2.5	Blocking external (system or HMI)		Yes	
2.19.3	Additional supervision functions (thermal state, etc.)		Insert	
2.20	Autoreclosing			
2.20.1	Number of shots		Min. 2	
2.20.2	AR program		1/3 pole	
2.20.3	Reclosing pulse duration	s	Insert	
2.20.4	Dead time range	s	Insert	
2.20.5	Counters for AR operation		Yes	
2.20.6	Inhibit time range	s	Insert	
2.20.7	Reclaim time range	s	Insert	
2.20.8	Synchronism & energising check during 3 ph AR		Yes	
2.20.9	Evolving faults treatment		Yes	
2.20.10	AR blocking for CB not ready		Yes	
2.20.11	AR operation 1/3ph in 1st and 2nd zone		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.21	Synchronism & energising check			
2.21.1	Frequency difference range	mHz.	Insert	
2.21.2	Voltage difference range	% Ur	Insert	
2.21.3	Phase difference range	°	Insert	
2.21.4	Operating time for synchro check function	ms	Insert	
2.21.5	Operating time for energizing check function	ms	Insert	
2.22	Disturbance recorder			
2.22.1	Number of digital signals		Min. 40	
2.22.2	Number of analogue signals		Min. 8	
2.22.3	External/manual initiation of recording		Yes	
2.22.4	Sampling rate	kHz	Insert	
2.22.5	Pre-fault time	ms	≥ 300	
2.22.6	Recording time	ms	≥ 2000	
2.22.7	Number of recorded disturbances		Min. 5	
2.22.8	Total recording time with max. analogue and binary signals	s	> 10	
2.22.9	Output file comtrade format		Yes	
2.23	Event recorder			
2.23.1	Max. number of events		Insert	
2.23.2	Time tagging resolution	ms	1	
2.24	Fault locator, measurement in (km)		Yes	
2.25	Self-supervision		Yes	
2.26	Measurement			
2.26.1	Active power measurement		Yes	
2.26.2	Reactive power measurement		Yes	
2.26.3	Voltage measurement		Yes	
2.26.4	Current measurement		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.30 14002 - Protection Terminal 230 kV OHL Main 2 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14002	Protection Terminal 230 kV OHL Main 2 / Code number: 14002			
1.1	Manufacturer		Different than Main 1	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	ms s	> 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Distance protection			
2.10.1	Number of protection zones		Min. 5	
2.10.2	Basic operating time	ms	< 25	
2.10.3	Operational characteristic		Quadrilateral	
2.10.4	Zone 1 direction software selectable		Insert	
2.10.5	Zone 2 direction software selectable		Insert	
2.10.6	Zone 3 direction software selectable		Insert	
2.10.7	Zone 4 direction software selectable		Insert	
2.10.8	Zone 5 direction software selectable		Insert	
2.10.9	Minimum impedance setting	Ω	Insert	
2.10.10	Full scheme protection phase segregated		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Communication scheme logic			
2.11.1	Operational modes		Intertrip Permissive under-reach Permissive overreach Blocking	
2.12	Power swing detection		Yes	
2.13	Secondary circuits supervision: • VT circuits supervision • CT circuits supervision		Yes Yes	
2.14	Automatic switch onto fault logic • Impedance criteria • Instantaneous overcurrent criteria		Yes Yes	
2.15	Multistage three-phase overcurrent protection			
2.15.1	Directional		Insert	
2.15.2	Number of stages		Min. 2	
2.15.3	Setting range	% Ir	Insert	
2.15.4	Characteristics			
2.15.4.1	Definite time delayed	Yes/no	Yes	
2.15.4.2	Normal inverse	Yes/No	Yes	
2.15.4.3	Very inverse	Yes/No	Insert	
2.15.4.4	Extremely inverse	Yes/No	Insert	
2.16	Multistage earth fault overcurrent protection			
2.16.1	Directional		Insert	
2.16.2	Number of stages		Min. 2	
2.16.3	Setting range	% Ir	Insert	
2.16.4	Type of protection		Non-directional	
2.16.5	Characteristics			
2.16.5.1	Definite time delayed	Yes/no	Yes	
2.16.5.2	Normal inverse	Yes/No	Yes	
2.16.5.3	Very inverse	Yes/No	Insert	
2.16.5.4	Extremely inverse	Yes/No	Insert	
2.17	Directional earth fault protection			
2.17.1	Number of stages		Insert	
2.17.2	Setting range	% Ir	Insert	
2.17.3	Type of protection		Directional	
2.17.4	Characteristics			
2.17.4.1	Definite time delayed	Yes/no	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.17.4.2	Normal inverse	Yes/No	Yes	
2.17.4.3	Very inverse	Yes/No	Insert	
2.17.4.4	Extremely inverse	Yes/No	Insert	
2.17.5	Minimum polarizing voltage	% Ur	3 %	
2.17.6	Communication scheme logic		Yes	
2.17.6.1	Permissive and blocking		Yes	
2.17.7	Single and three-pole tripping schemes		Yes	
2.18	Current negative sequence protection			
2.18.1	Number of stages		Insert	
2.18.2	Setting range	% Ir	Insert	
2.18.3	Characteristic		Definite time	
2.19	Power system supervision			
2.19.1	Broken conductor check		Yes	
2.19.2	Overload protection			
2.19.2.1	Setting range of 1 stage	% Ir	Insert	
2.19.2.2	Time delay range of 1 stage	min	> 20	
2.19.2.3	Setting range of 2 stage	% Ir	Insert	
2.19.2.4	Time delay range of 2 stage	s	> 20	
2.19.2.5	Blocking external (system or HMI)		Yes	
2.19.3	Additional supervision functions (thermal state, etc.)		Insert	
2.20	Autoreclosing			
2.20.1	Number of shots		Min. 2	
2.20.2	AR program		1/3 pole	
2.20.3	Reclosing pulse duration	s	Insert	
2.20.4	Dead time range	s	Insert	
2.20.5	Counters for AR operation		Yes	
2.20.6	Inhibit time range	s	Insert	
2.20.7	Reclaim time range	s	Insert	
2.20.8	Synchronism & energising check during 3 ph AR		Yes	
2.20.9	Evolving faults treatment		Yes	
2.20.10	AR blocking for CB not ready		Yes	
2.20.11	AR operation 1/3ph in 1st and 2nd zone		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.21	Synchronism & energising check			
2.21.1	Frequency difference range	mHz.	Insert	
2.21.2	Voltage difference range	% Ur	Insert	
2.21.3	Phase difference range	°	Insert	
2.21.4	Operating time for synchro check function	ms	Insert	
2.21.5	Operating time for energising check function	ms	Insert	
2.22	Disturbance recorder			
2.22.1	Number of digital signals		Min. 40	
2.22.2	Number of analogue signals		Min. 8	
2.22.3	External/manual initiation of recording		Yes	
2.22.4	Sampling rate	kHz	Insert	
2.22.5	Pre-fault time	ms	≥ 300	
2.22.6	Recording time	ms	≥ 2000	
2.22.7	Number of recorded disturbances		Min. 5	
2.22.8	Total recording time with max. analogue and binary signals	s	> 10	
2.22.9	Output file comtrade format		Yes	
2.23	Event recorder			
2.23.1	Max. number of events		Insert	
2.23.2	Time tagging resolution	ms	1	
2.24	Fault locator, measurement in (km)		Yes	
2.25	Self-supervision		Yes	
2.26	Measurement			
2.26.1	Active power measurement		Yes	
2.26.2	Reactive power measurement		Yes	
2.26.3	Voltage measurement		Yes	
2.26.4	Current measurement		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.31 14003 - Protection Terminal 132 kV OHL Main 1 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14003	Protection Terminal 132 kV OHL Main 1 / Code number: 14003			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16 (code 14004) Min. 24 (code 14004A)	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.3	Rated voltage	V d.c.	110 ±15 %	
2.5.5	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.6	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.7	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.8	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Line differential protection			
2.10.1	Sensitive differential current trip stage		Yes	
2.10.2	High current differential trip stage		Yes	
2.10.3	Inrush restraint 2nd harmonic		Yes	
2.10.4	Crossblock function		Yes	
2.10.5	Operating time, typical	ms	< 30	
2.10.6	Resetting time at I_{diff}=0	ms	Insert	
2.10.7	Transfer trip operating time	ms	< 40	
2.11	Remote end data communication			
2.11.1	Transmission type		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11.2	Data transfer rate	Kbit/s	Insert	
2.11.3	FO protection interface			
2.11.3.1	Type of fibre optic	µm	Insert	
2.11.3.2	Connector type		Insert	
2.11.3.3	Wavelength	nm	1300	
2.11.3.4	Optical transmitter injected power	dBm	Insert	
2.11.3.5	Optical receiver sensitivity	dBm	Insert	
2.11.3.6	Transmission distance (estimated)	km	Min. 15	
2.12	Back-up Distance protection			
2.12.1	Number of protection zones		Min. 4	
2.12.2	Operating time	ms	< 35	
2.12.3	Operating characteristic		quadrilateral	
2.12.4	Zone 1 direction software selectable		Insert	
2.12.5	Zone 2 direction software selectable		Insert	
2.12.6	Zone 3 direction software selectable		Insert	
2.12.7	Zone 4 direction software selectable		Insert	
2.12.8	Minimum impedance setting	Ω	Insert	
2.12.9	Full scheme protection phase segregated		Yes	
2.13	Communication scheme logic			
2.13.1	Operational modes		Intertrip Permissive under-reach Permissive overreach Blocking	
2.14	Power swing detection		Yes	
2.15	Secondary circuits supervision: • VT circuits supervision • CT circuits supervision		 Yes Yes	
2.16	Automatic switch onto fault logic • Impedance criteria • Instantaneous overcurrent criteria		 Yes Yes	
2.17	Multistage three-phase overcurrent protection			
2.17.1	Directional		Insert	
2.17.2	Number of stages		Min. 2	
2.17.3	Setting range	% Ir	Insert	
2.17.4	Characteristics			
2.17.4.1	Definite time delayed	Yes/no	Yes	
2.17.4.2	Normal inverse	Yes/No	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.17.4.3	Very inverse	Yes/No	Insert	
2.17.4.4	Extremely inverse	Yes/No	Insert	
2.18	Multistage earth fault overcurrent protection			
2.18.1	Directional		Insert	
2.18.2	Number of stages		Min. 2	
2.18.3	Setting range	% Ir	Insert	
2.18.4	Type of protection		Non-directional	
2.18.5	Characteristics			
2.18.5.1	Definite time delayed	Yes/no	Yes	
2.18.5.2	Normal inverse	Yes/No	Yes	
2.18.5.3	Very inverse	Yes/No	Insert	
2.18.5.4	Extremely inverse	Yes/No	Insert	
2.19	Current negative sequence protection			
2.19.1	Number of stages		Insert	
2.19.2	Setting range	% Ir	Insert	
2.19.3	Characteristic		Insert	
2.20	Directional earth fault protection			
2.20.1	Number of stages		Insert	
2.20.2	Setting range	% Ir	Insert	
2.20.3	Type of protection		Directional	
2.20.4	Characteristics			
2.20.4.1	Definite time delayed	Yes/no	Yes	
2.20.4.2	Normal inverse	Yes/No	Yes	
2.20.4.3	Very inverse	Yes/No	Insert	
2.20.4.4	Extremely inverse	Yes/No	Insert	
2.20.5	Minimum polarizing voltage	% Ur	3 %	
2.20.6	Communication scheme logic		Yes	
2.20.6.1	Permissive and blocking		Yes	
2.20.7	Single and three-pole tripping schemes		Yes	
2.21	Power system supervision			
2.21.1	Broken conductor check		Yes	
2.21.2	Overload protection			
2.21.2.1	Setting range of 1 stage	% Ir	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.21.2.2	Time delay range of 1 stage	min	> 20	
2.21.2.3	Setting range of 2 stage	% Ir	Insert	
2.21.2.4	Time delay range of 2 stage	s	> 20	
2.21.2.5	Blocking external (system or HMI)		Yes	
2.22	Autoreclosing			
2.22.1	Number of shots		Min. 2	
2.22.2	AR program		1/3 pole	
2.22.3	Reclosing pulse duration	s	Insert	
2.22.4	Dead time range	s	Insert	
2.22.5	Counters for AR operation		Yes	
2.22.6	Inhibit time range	s	Insert	
2.22.7	Reclaim time range	s	Insert	
2.22.8	Synchronism & energising check during 3 ph AR		Yes	
2.22.9	Evolving faults treatment		Yes	
2.22.10	AR blocking for CB not ready		Yes	
2.22.11	AR operation 1/3ph in 1st and 2nd zone		Yes	
2.23	Synchronism & energising check			
2.23.1	Frequency difference range	mHz.	Insert	
2.23.2	Voltage difference range	% Ur	Insert	
2.23.3	Phase difference range	°	Insert	
2.23.4	Operating time for synchro check function	ms	Insert	
2.23.5	Operating time for energising check function	ms	Insert	
2.24	Disturbance recorder			
2.24.1	Number of digital signals		Min. 40	
2.24.2	Number of analogue signals		Min. 8	
2.24.3	External/manual initiation of recording		Insert	
2.24.4	Sampling rate	kHz	Insert	
2.24.5	Pre-fault time	ms	≥ 300	
2.24.6	Recording time	ms	≥ 2000	
2.24.7	Number of recorded disturbances		Min. 5	
2.24.8	Total recording time with max. analogue and binary signals	s	> 10	
2.24.9	Output file comtrade format		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.25	Event recorder			
2.25.1	Max. number of events		Insert	
2.25.2	Time tagging resolution	ms	1	
2.26	Fault locator, measurement in (km)		Yes	
2.27	Self-supervision		Yes	
2.28	Measurement			
2.28.1	Active power measurement		Yes	
2.28.2	Reactive power measurement		Yes	
2.28.3	Voltage measurement		Yes	
2.28.4	Current measurement		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.32 14004 - Protection Terminal 132 kV OHL Main 2 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14004	Protection Terminal 132 kV OHL Main 2 / Code number: 14004			
1.1	Manufacturer		Different than Main 1	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Distance protection			
2.10.1	Number of protection zones		Min. 5	
2.10.2	Basic operating time	ms	< 30	
2.10.3	Operational characteristic		Quadrilateral	
2.10.4	Zone 1 direction software selectable		Insert	
2.10.5	Zone 2 direction software selectable		Insert	
2.10.6	Zone 3 direction software selectable		Insert	
2.10.7	Zone 4 direction software selectable		Insert	
2.10.8	Zone 5 direction software selectable		Insert	
2.10.9	Minimum impedance setting	Ω	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Communication scheme logic			
2.11.1	Operational modes		Intertrip Permissive under-reach Permissive overreach Blocking	
2.12	Power swing detection		Yes	
2.13	Secondary circuits supervision: • VT circuits supervision • CT circuits supervision		 Yes Yes	
2.14	Automatic switch onto fault logic • Impedance criteria • Instantaneous overcurrent criteria		 Yes Yes	
2.15	Multistage three-phase overcurrent protection			
2.15.1	Directional		Insert	
2.15.2	Number of stages		Min. 2	
2.15.3	Setting range	% Ir	Insert	
2.15.4	Characteristics			
2.15.4.1	Definite time delayed	Yes/no	Yes	
2.15.4.2	Normal inverse	Yes/No	Yes	
2.15.4.3	Very inverse	Yes/No	Insert	
2.15.4.4	Extremely inverse	Yes/No	Insert	
2.16	Multistage earth fault overcurrent protection			
2.16.1	Directional		Insert	
2.16.2	Number of stages		Min. 2	
2.16.3	Setting range	% Ir	Insert	
2.16.4	Type of protection		Non-directional	
2.16.5	Characteristics			
2.16.5.1	Definite time delayed	Yes/no	Yes	
2.16.5.2	Normal inverse	Yes/No	Yes	
2.16.5.3	Very inverse	Yes/No	Insert	
2.16.5.4	Extremely inverse	Yes/No	Insert	
2.17	Directional earth fault protection			
2.17.1	Number of stages		Insert	
2.17.2	Setting range	% Ir	Insert	
2.17.3	Type of protection		Directional	
2.17.4	Characteristics			
2.17.4.1	Definite time delayed	Yes/no	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.17.4.2	Normal inverse	Yes/No	Yes	
2.17.4.3	Very inverse	Yes/No	Insert	
2.17.4.4	Extremely inverse	Yes/No	Insert	
2.17.5	Minimum polarizing voltage	% Ur	3 %	
2.17.6	Communication scheme logic		Yes	
2.17.6.1	Permissive and blocking		Yes	
2.17.7	Single and three-pole tripping schemes		Yes	
2.18	Current negative sequence protection			
2.18.1	Number of stages		Insert	
2.18.2	Setting range	% Ir	Insert	
2.18.3	Characteristic		Definite time	
2.19	Power system supervision			
2.19.1	Broken conductor check		Yes	
2.19.2	Overload protection			
2.19.2.1	Setting range of 1 stage	% Ir	Insert	
2.19.2.2	Time delay range of 1 stage	min	> 20	
2.19.2.3	Setting range of 2 stage	% Ir	Insert	
2.19.2.4	Time delay range of 2 stage	s	> 20	
2.19.2.5	Blocking external (system or HMI)		Yes	
2.19.3	Additional supervision functions (thermal state, etc.)		Insert	
2.20	Autoreclosing			
2.20.1	Number of shots		Min. 2	
2.20.2	AR program		1/3 pole	
2.20.3	Reclosing pulse duration	s	Insert	
2.20.4	Dead time range	s	Insert	
2.20.5	Counters for AR operation		Yes	
2.20.6	Inhibit time range	s	Insert	
2.20.7	Reclaim time range	s	Insert	
2.20.8	Synchronism & energising check during 3 ph AR		Yes	
2.20.9	Evolving faults treatment		Yes	
2.20.10	AR blocking for CB not ready		Yes	
2.20.11	AR operation 1/3ph in 1st and 2nd zone		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.21	Synchronism & energising check			
2.21.1	Frequency difference range	mHz.	Insert	
2.21.2	Voltage difference range	% Ur	Insert	
2.21.3	Phase difference range	°	Insert	
2.21.4	Operating time for synchro check function	ms	Insert	
2.21.5	Operating time for energising check function	ms	Insert	
2.22	Disturbance recorder			
2.22.1	Number of digital signals		Min. 40	
2.22.2	Number of analogue signals		Min. 8	
2.22.3	External/manual initiation of recording		Yes	
2.22.4	Sampling rate	kHz	Insert	
2.22.5	Pre-fault time	ms	≥ 300	
2.22.6	Recording time	ms	≥ 2000	
2.22.7	Number of recorded disturbances		Min. 5	
2.22.8	Total recording time with max. analogue and binary signals	s	> 10	
2.22.9	Output file comtrade format		Yes	
2.23	Event recorder			
2.23.1	Max. number of events		Insert	
2.23.2	Time tagging resolution	ms	1	
2.24	Fault locator, measurement in (km)		Yes	
2.25	Self-supervision		Yes	
2.26	Measurement			
2.26.1	Active power measurement		Yes	
2.26.2	Reactive power measurement		Yes	
2.26.3	Voltage measurement		Yes	
2.26.4	Current measurement		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Main Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.33 14005 - Protection Terminal for Power Transformers Main 1 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14005	Protection Terminal for Power Transformers Main 1 / Code number: 14005			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 9	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0,3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Autotransformer / Transformer Differential protection			
2.10.1	Inrush restraint		Yes	
2.10.2	Over excitation restraint		Yes	
2.10.3	Basic differential current range	% Ir	Insert	
2.10.4	Operating characteristic with 2 slope		Yes	
2.10.5	High non-restraint differential current range	% Ir	Insert	
2.10.6	Operating time	ms	< 30	
2.10.7	Internal CT ratio and vector group compensation		Yes	
2.10.8	Cross block function		Yes	
2.10.9	Zero sequence subtraction		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Restricted earth fault protection for autotransformer / transformer			
2.11.1	Low Impedance		Yes	
2.11.2	Internal CT ratio vector group compensation		Yes	
2.11.3	Basic differential current range	% Ir	Insert	
2.11.4	Operating time	ms	< 30	
2.12	Current negative sequence protection			
2.12.1	Number of stages		Insert	
2.12.2	Setting range	% Ir	Insert	
2.12.3	Characteristic		Insert	
2.13	Multistage three-phase overcurrent protection	pcs.	Min. 2	
2.13.1	Instantaneous overcurrent protection with inrush restraint			
2.13.1.1	Setting range	% Ir	Insert	
2.13.1.2	Min. operating time at $I > 10*I_{set}$	ms	< 30	
2.13.2	Time delayed overcurrent protection			
2.13.2.1	Setting range	% Ir	Insert	
2.13.2.2	Type of protection		Non-directional	
2.13.2.3	Characteristics			
2.13.2.3.1	Definite time delayed	Yes/no	Yes	
2.13.2.3.2	Normal inverse	Yes/No	Yes	
2.13.2.3.3	Very inverse	Yes/No	Insert	
2.13.2.3.4	Extremely inverse	Yes/No	Insert	
2.14	Multistage earth fault overcurrent protection	pcs.	Min. 2	
2.14.1	Instantaneous earth fault overcurrent protection with inrush restraint			
2.14.1.1	Setting range	% Ir	Insert	
2.14.1.2	Min. operating time at $I > 10*I_{set}$	ms	< 30	
2.14.2	Time delayed earth fault overcurrent protection			
2.14.2.1	Setting range	% Ir	Insert	
2.14.2.2	Type of protection		Non-directional	
2.14.2.3	Characteristics			
2.14.2.3.1	Definite time delayed	Yes/no	Yes	
2.14.2.3.2	Normal inverse	Yes/No	Yes	
2.14.2.3.3	Very inverse	Yes/No	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.14.2.3.4	Extremely inverse	Yes/No	Insert	
2.15	Thermal overload protection		Yes	
2.16	Disturbance recorder			
2.16.1	Number of digital signals		Min. 40	
2.16.2	Number of analogue signals		Min. 9	
2.16.3	External/manual initiation of recording			
2.16.4	Sampling rate	kHz	Insert	
2.16.5	Pre-fault time	ms	≥ 300	
2.16.6	Recording time	ms	≥ 2000	
2.16.7	Number of recorded disturbances		Min. 5	
2.16.8	Total recording time with max. analogue and binary signals	s	> 10	
2.16.9	Output file comtrade format		Yes	
2.17	Event recorder			
2.17.1	Max. number of events		Insert	
2.17.2	Time tagging resolution	ms	1	
2.18	Self-supervision		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.34 14006 - Protection Terminal for Power Transformers Main 2 (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14006	Protection Terminal for Power Transformers Main 2 / Code number: 14006			
1.1	Manufacturer		Different than Main 1	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	ms s	> 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 9	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0,3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Autotransformer / Transformer Differential protection			
2.10.1	Inrush restraint		Yes	
2.10.2	Overexcitation restraint		Yes	
2.10.3	Basic differential current range	% Ir	Insert	
2.10.4	Operating characteristic with 2 slope		Yes	
2.10.5	High non-restraint differential current range	% Ir	Insert	
2.10.6	Operating time	ms	< 30	
2.10.7	Internal CT ratio and vector group compensation		Yes	
2.10.8	Crossblock function		Yes	
2.10.9	Zero sequence subtraction		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Restricted earth fault protection for autotransformer / transformer			
2.11.1	Low Impedance		Yes	
2.11.2	Internal CT ratio vector group compensation		Yes	
2.11.3	Basic differential current range	% Ir	Insert	
2.11.4	Operating time	ms	< 30	
2.12	Current negative sequence protection			
2.12.1	Number of stages		Insert	
2.12.2	Setting range	% Ir	Insert	
2.12.3	Characteristic		Insert	
2.13	Multistage three-phase overcurrent protection	pcs.	Min. 2	
2.13.1	Instantaneous overcurrent protection with inrush restraint			
2.13.1.1	Setting range	% Ir	Insert	
2.13.1.2	Min. operating time at $I > 10*I_{set}$	Ms	< 30	
2.13.2	Time delayed overcurrent protection			
2.13.2.1	Setting range	% Ir	Insert	
2.13.2.2	Type of protection		Non-directional	
2.13.2.3	Characteristics			
2.13.2.3.1	Definite time delayed	Yes/no	Yes	
2.13.2.3.2	Normal inverse	Yes/No	Yes	
2.13.2.3.3	Very inverse	Yes/No	Insert	
2.13.2.3.4	Extremely inverse	Yes/No	Insert	
2.14	Multistage earth fault overcurrent protection	pcs.	Min. 2	
2.14.1	Instantaneous earth fault overcurrent protection with inrush restraint			
2.14.1.1	Setting range	% Ir	Insert	
2.14.1.2	Min. operating time at $I > 10*I_{set}$	Ms	< 30	
2.14.2	Time delayed earth fault overcurrent protection			
2.14.2.1	Setting range	% Ir	Insert	
2.14.2.2	Type of protection		Non-directional	
2.14.2.3	Characteristics			
2.14.2.3.1	Definite time delayed	Yes/no	Yes	
2.14.2.3.2	Normal inverse	Yes/No	Yes	
2.14.2.3.3	Very inverse	Yes/No	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	**Data**	
2.14.2.3.4	Extremely inverse	Yes/No	Insert	
2.15	Thermal overload protection		Yes	
2.16	Disturbance recorder			
2.16.1	Number of digital signals		Min. 40	
2.16.2	Number of analogue signals		Min. 9	
2.16.3	External/manual initiation of recording			
2.16.4	Sampling rate	kHz	Insert	
2.16.5	Pre-fault time	ms	≥ 300	
2.16.6	Recording time	ms	≥ 2000	
2.16.7	Number of recorded disturbances		Min. 5	
2.16.8	Total recording time with max. analogue and binary signals	s	> 10	
2.16.9	Output file comtrade format		Yes	
2.17	Event recorder			
2.17.1	Max. number of events		Insert	
2.17.2	Time tagging resolution	ms	1	
2.18	Self-supervision		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.35 14007 - Protection Terminal for LV side of Power Transformer (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14007	Protection Terminal for LV side of Power Transformer / Code number: 14007			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Min. 16	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		< 8	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 16	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Distance protection			
2.10.1	Number of protection zones		Min. 5	
2.10.2	Basic operating time	ms	< 30	
2.10.3	Operational characteristic		Quadrilateral	
2.10.4	Zone 1 direction software selectable		Yes (F/R/ND)	
2.10.5	Zone 2 direction software selectable		Yes (F/R/ND)	
2.10.6	Zone 3 direction software selectable		Yes (F/R/ND)	
2.10.7	Zone 4 direction software selectable		Yes (F/R/ND)	
2.10.8	Zone 5 direction software selectable		Yes (F/R/ND)	
2.10.9	Minimum impedance setting	Ω	Insert	
2.10.10	Full scheme protection phase segregated		Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Power swing detection		Yes	
2.12	Secondary circuits supervision: • VT circuits supervision • CT circuits supervision		 Yes Yes	
2.13	Automatic switch onto fault logic • Impedance criteria • Instantaneous overcurrent criteria		 Yes Yes	
2.14	Multistage three-phase overcurrent protection			
2.14.1	Number of stages		Min. 2	
2.14.2	Setting range	% Ir	Insert	
2.14.3	Characteristics			
2.14.3.1	Definite time delayed	Yes/no	Yes	
2.14.3.2	Normal inverse	Yes/No	Yes	
2.14.3.3	Very inverse	Yes/No	Insert	
2.14.3.4	Extremely inverse	Yes/No	Insert	
2.15	Multistage earth fault overcurrent protection			
2.15.1	Number of stages		Min. 2	
2.15.2	Setting range	% Ir	Insert	
2.15.3	Type of protection		Non-directional	
2.15.4	Characteristics			
2.15.4.1	Definite time delayed	Yes/no	Yes	
2.15.4.2	Normal inverse	Yes/No	Yes	
2.15.4.3	Very inverse	Yes/No	Insert	
2.15.4.4	Extremely inverse	Yes/No	Insert	
2.16	Directional earth fault protection			
2.16.1	Number of stages		Insert	
2.16.2	Setting range	% Ir	Insert	
2.16.3	Type of protection		Insert	
2.16.4	Characteristics			
2.16.4.1	Definite time delayed	Yes/no	Insert	
2.16.4.2	Normal inverse	Yes/No	Insert	
2.16.4.3	Very inverse	Yes/No	Insert	
2.16.4.4	Extremely inverse	Yes/No	Insert	
2.16.5	Minimum polarizing voltage	% Ur	Insert	
2.16.6	Communication scheme logic		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.17	Power system supervision			
2.17.1	Broken conductor check		Yes	
2.18	Disturbance recorder			
2.18.1	Number of digital signals		Min. 40	
2.18.2	Number of analogue signals		Min. 8	
2.18.3	External/manual initiation of recording		Insert	
2.18.4	Sampling rate	kHz	Insert	
2.18.5	Pre-fault time	ms	≥ 300	
2.18.6	Recording time	ms	≥ 2000	
2.18.7	Number of recorded disturbances		Min. 5	
2.18.8	Total recording time with max. analogue and binary signals	s	> 10	
2.18.9	Output file comtrade format		Yes	
2.19	Event recorder			
2.19.1	Max. number of events		Insert	
2.19.2	Time tagging resolution	ms	1	
2.20	Self-supervision		Yes	
2.21	Measurement			
2.21.1	Active power measurement		Yes	
2.21.2	Reactive power measurement		Yes	
2.21.3	Voltage measurement		Yes	
2.21.4	Current measurement		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.36 Automatic Voltage Regulation

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14008	Automatic Voltage Regulation / Code number: 14008			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		1	
2.2.2	Rated current for 110 kV	A	1	
2.2.3	Permissive overload, continuous		3xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Voltage control function			
2.4.1	Set voltage range	% U_{r2}	Insert	
2.4.2	Set voltage dead-band range	% U_{r2}	Insert	
2.4.3	Upper limit busbar voltage range	% U_{r2}	Insert	
2.4.4	Lower limit busbar voltage range	% U_{r2}	Insert	
2.4.5	Line voltage drop compensation	Yes/No	Insert	
2.4.6	Regulation for capacitive load	Yes/No	Insert	
2.4.7	Undervoltage blocking range	% U_{r2}	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.8	Overcurrent blocking range	% I_r	Insert	
2.4.9	Parallel operation		Yes	
2.4.10	Parallel operation principal		Insert	
2.5	Communication ports		Yes	
2.5.1	Port for front-connected PC			
2.5.1.1	Protocols supported		Insert	
2.5.1.2	Communication speed	Kbit/s	Insert	
2.5.1.3	PC side connector type		Insert	
2.5.2	System interface			
2.5.2.1	Number of rear ports		Min. 1	
2.5.2.2	Protocols supported		IEC 61850	
2.5.2.3	Communication speed	Mbit/s	Min. 100	
2.5.2.4	Connector type		RJ45 or FO	
2.5.3	External time synchronisation		Insert	
2.6	Tap changer, tap position		BCD code	
2.7	Self-supervision		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Automatic Voltage Regulator approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.37 14009 - Protection Terminal for Bus couplers 230 kV & 132 Kv (N/A)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14009	Protection Terminal for Bus couplers 230 kV & 132 kV / Code number: 14009			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Terminal type		Insert	
1.4	Terminal version (software version)		Insert	
1.5	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs			
2.2.1	Number of inputs		Min. 4	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min. 4	
2.3.2	Rated voltage Ph-Ph Ur	V	100	
2.3.3	Permissive overload, continuous	% Ur	150	
2.3.4	Permissive overload, 1 s	% Ur	250	
2.3.5	Burden at Ur	VA	< 0.3	
2.4	Binary inputs		Min. 8	
2.4.1	Number of BI groups with common root		Insert	
2.4.2	Number of inputs per BI group with common root		Insert	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.5	Binary outputs		Min. 8	
2.5.1	Number of modules		Insert	
2.5.2	Number of outputs per group with common root		Max. 3	
2.5.3	Rated voltage	V d.c.	110 ±15 %	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.5.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.5.6	Number of tripping contacts (high-speed output)	pcs.	6	
2.5.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.6	LED indications			
2.6.1	Number of LED's		Insert	
2.6.2	Multi-colour LED's	Yes/No	Insert	
2.7	Communication ports		Yes	
2.7.1	Port for front-connected PC			
2.7.1.1	Protocols supported		Insert	
2.7.1.2	Communication speed	Kbit/s	Insert	
2.7.1.3	PC side connector type		Insert	
2.7.2	System interface			
2.7.2.1	Number of rear ports		2	
2.7.2.2	Protocols supported		IEC 61850	
2.7.2.3	Communication speed	Mbit/s	Min. 100	
2.7.2.4	Connector type		RJ45 or FO	
2.7.3	Time synchronisation		SNTP	
2.8	Human-machine interface		Yes	
2.8.1	LCD alphanumeric display, No. of rows		Insert	
2.9	Number of setting parameter groups		Min. 4	
2.10	Multistage three-phase overcurrent protection			
2.10.1	Instantaneous overcurrent protection			
2.10.1.1	Setting range	% Ir	Insert	
2.10.1.2	Min. operating time at $I > 10*I_{set}$	ms	30	
2.10.2	Time delayed overcurrent protection			
2.10.2.1	Setting range	% Ir	Insert	
2.10.2.2	Type of protection		Non-directional	
2.10.2.3	Characteristics			
2.10.2.3.1	Definite time delayed	Yes/no	Yes	
2.10.2.3.2	Normal inverse	Yes/No	Yes	
2.10.2.3.3	Very inverse	Yes/No	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.10.2.3.4	Extremely inverse	Yes/No	Insert	
2.11	Multistage earth fault overcurrent protection			
2.11.1	Instantaneous earth fault overcurrent protection			
2.11.1.1	Setting range	% Ir	Insert	
2.11.1.2	Min. operating time at I > 10*I_{set}	ms	30	
2.11.2	Time delayed earth fault overcurrent protection			
2.11.2.1	Setting range	% Ir	Insert	
2.11.2.2	Type of protection		Non-directional	
2.11.2.3	Characteristics			
2.11.2.3.1	Definite time delayed	Yes/no	Yes	
2.11.2.3.2	Normal inverse	Yes/No	Yes	
2.11.2.3.3	Very inverse	Yes/No	Insert	
2.11.2.3.4	Extremely inverse	Yes/No	Insert	
2.12	Directional earth fault protection			
2.12.1	Number of stages		Insert	
2.12.2	Setting range	% Ir	Insert	
2.12.3	Type of protection		Directional	
2.13.4	Characteristics			
2.13.4.1	Definite time delayed	Yes/no	Yes	
2.13.4.2	Normal inverse	Yes/No	Yes	
2.13.4.3	Very inverse	Yes/No	Insert	
2.13.4.4	Extremely inverse	Yes/No	Insert	
2.13.5	Minimum polarising voltage	% Ur	3 %	
2.14	Current negative sequence protection			
2.14.1	Number of stages		Insert	
2.14.2	Setting range	% Ir	Insert	
2.14.3	Characteristic		Insert	
2.15	Disturbance recorder			
2.15.1	Number of digital signals		Min. 40	
2.15.2	Number of analogue signals		Min. 8	
2.15.3	External/manual initiation of recording		Insert	
2.15.4	Sampling rate	kHz	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.15.5	Pre-fault time	ms	≥ 300	
2.15.6	Recording time	ms	≥ 2000	
2.15.7	Number of recorded disturbances		Min. 5	
2.15.8	Total recording time with max. analogue and binary signals	s	> 10	
2.15.9	Output file comtrade format		Yes	
2.16	Event recorder			
2.16.1	Max. number of events		Insert	
2.16.2	Time tagging resolution	ms	1	
2.17	Self-supervision		Yes	
3	Additional requirements			
3.1	Test socket		Yes	
3.2	Setting and configuration of Protection Terminal approved by Engineer		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.5.38 14010 - Busbar and Breaker Failure Protection for 230 and 132 kV Busbars

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14010	Busbar and Breaker failure protection for 230 and 132 kV Busbars/Code number: 14010			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type of installation		Distributed	
1.4	Standards		IEC	
1.5	Central Unit (CU)			
1.5.1	Terminal type		Insert	
1.5.2	Terminal version (software version)		Insert	
1.5.3	Central unit for busbar protection must be supported for min. 16 bays		Yes	
1.6	Bay Unit (BU)			
1.6.1	Terminal type		Insert	
1.6.2	Terminal version (software version)		Insert	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	CU, BU Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.1.2	CU auxiliary supply redundant		Yes	
2.1.3	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	 > 50 Insert	
2.2	a.c. current inputs BU			
2.2.1	Number of inputs		Min. 3	
2.2.2	Rated current Ir	A	1	
2.2.3	Permissive overload, continuous		4xIr	
2.2.4	Permissive overload, 1 s		100xIr	
2.2.5	Burden at Ir	VA	< 0.5	
2.3	Binary inputs CU, BU		Min. 20 / 8	
2.3.1	Number of modules		Insert	
2.3.2	Number of inputs per module		Insert	
2.3.3	Rated voltage	V d.c.	110 ±15 %	
2.4	Binary outputs CU, BU		Min. 6 / 4	
2.4.1	Number of modules		Insert	
2.4.2	Number of outputs per module		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.3	Rated voltage	V d.c.	110 ±15 %	
2.4.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.4.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.4.6	Number of tripping contacts (high-speed output)	pcs.	Min. 3	
2.4.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	5	
2.5	LED indications CU, BU			
2.5.1	Number of LED's		Insert	
2.5.2	Multi-colour LED's	Yes/No	Insert	
2.6	Communication ports CU, BU			
2.6.1	Port for front-connected PC			
2.6.1.1	Protocols supported		Insert	
2.6.1.2	Communication speed	Kbit/s	Insert	
2.6.1.3	PC connector type		Insert	
2.6.2	CU, BU communication media		FO	
2.6.3	CU rear station (system) communication ports			
2.6.3.1	Number of rear ports		Insert	
2.6.3.2	Protocols supported		IEC 61850	
2.6.3.3	Communication speed	Mbit/s	Insert	
2.6.3.4	Connector type		RJ45	
2.6.4	Time synchronisation		SNTP	
2.7	Busbar differential protection			
2.7.1	Operating time	ms	< 20	
2.7.2	Internal CT radio adaptability		Yes	
2.7.3	Multiple tripping criteria, check and bus zone		Yes	
2.7.4	Current transformer supervision		Yes	
2.7.5	External signal of load transfer starting		Insert	
2.7.6	Busbar protection system should be suitable/adaptable for future switchgear extension or modification		Yes	
2.7.7	Bay-selective intertripping		Yes	
2.7.8	Phase-segregated measurement system		Yes	
2.8	Breaker failure protection			
2.8.1	Setting range	% Ir	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.8.2	Re-trip time delay range	s	0-1	
2.8.3	Re-trip operation mode 1/3ph		Yes	
2.8.4	Back-up time delay range	s	0-1	
2.8.5	Trip operating time setting resolution	ms	1	
2.8.6	Trip delay range	s	0-1	
2.8.7	Single-phase with/without current		Yes	
2.8.8	2-stage operation bay trip repeat/trip busbar		Insert	
2.8.9	Selectable operation mode (current, unbalance, low current)		Insert	
2.8.10	Independent settable delay times for all operation modes		Yes	
2.8.11	Low current mode using the circuit breaker auxiliary contact		Yes	
2.8.12	End fault protection		Yes	
2.8.13	Independent breaker failure protection per bay unit		Yes	
2.9	Disturbance recorder CU, BU			
2.9.1	Number of digital signals		Insert	
2.9.2	Number of analogue signals		Insert	
2.9.3	External/manual initiation of recording		Insert	
2.9.4	Sampling rate	kHz	Insert	
2.9.5	Pre-fault time	ms	≥ 300	
2.9.6	Recording time	ms	≥ 2000	
2.9.7	Number of recorded disturbances		Min. 5	
2.9.8	Total recording time with max. analogue and binary signals	s	> 10	
2.9.9	Output file comtrade format		Yes	
2.10	Event recorder CU, BU			
2.10.1	Max. number of events		Insert	
2.10.2	Time tagging resolution	ms	1	
2.11	Self-supervision CU, BU		Yes	
3	Additional requirements			
3.1	Test socket BU		Yes	
3.2	Setting and configuration approved by Engineer		Yes	
3.4	**Centralised, user-friendly configuration and all necessary software tools for full parameterization, and (re)configuration in case of extensions should be delivered**		**Yes**	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Overall compliance with the requirements (yes/no)			

5.2.5.39 Trip Circuit Supervision Relay

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14011	Trip Circuit Supervision Relay / Code number: 14011			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Binary outputs			
2.2.1	Number of outputs	NO/NC	Min. 2/2	
2.2.2	Rated voltage	V d.c.	110	
2.2.3	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	0.1	
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.3	Supervised circuits			
2.3.1	Voltage range of supervised circuits	V d.c.	110 ±15 %	
2.3.2	Injected current of supervised circuits	mA	Insert	
2.3.3	Operating time range	s	Insert	
2.3.4	Resetting time range	s	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.5.40 Tripping Unit - High-Speed Tripping Relay

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	Trip Circuit Supervision Relay			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type		Insert	
1.4	Standards		IEC	
2	Characteristics			
2.1	Auxiliary supply voltage			
2.1.1	Rated auxiliary supply voltage	V d.c.	110 ±15 %	
2.2	Binary outputs			
2.2.1	Number of outputs	NO/NC	Min. 2/2	
2.2.2	Rated voltage	V d.c.	110	
2.2.3	Breaking capacity at inductive load with L/R < 40 ms, at rated voltage	A	0.1	
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous	A	Insert	
2.3	Supervised circuits			
2.3.1	Voltage range of supervised circuits	V d.c.	110 ±15 %	
2.3.2	Injected current of supervised circuits	mA	Insert	
2.3.3	Operating time range	s	Insert	
2.3.4	Resetting time range	s	Insert	
	Overall compliance with the requirements (yes/no)			

5.2.5.41 Test Socket

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	Test socket			
1.1	Manufacturer		Insert	
1.2	Country of origin		Insert	
1.3	Type • Line main 1 and 2 • Line back-up and bus coupler • Transformer main 1 and 2 • Bay unit BBF • Distance protection (code 14007)		Insert	
1.4	Standards		IEC	
1.5	Each protection device must have its own test socket		Yes	
1.6	Test socket must obtain safe online protection testing and maintaining, and performing whole tripping test with following AR		Yes	
1.7	Test socket should have enough contacts to: • Short-circuit current inputs from CT's • Isolate voltage inputs from VT's • Isolate trip circuit for each phase separately • Isolate CB close command • Isolate signalling voltage • Inhibit breaker failure initialising • Inhibit sending of communication signal • Allow functional testing of protection		Yes	
1.8	Socket should be designed for 4 mm banana plugs access		Yes	
	Overall compliance with the requirements (yes/no)			

5.2.6 Digital Fault and Disturbance Recorder (DFDR) (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Power supply	V, DC	DC 110 V	
1.6	Power supply - printer	V, Hz	AC 230 V, 50 Hz	
2	Analogue inputs			
2.1	Number of channels		136 for 230kV and 120 for 400kV	
2.1.1	Expandability		Min. 120	
2.2	Nominal current	Amp	1A / 5A	
2.3.1	Nominal voltage	Vac/Vdc	Insert	
2.3.2	Nominal current	mA/Amp	Insert	
2.4	Frequency response		Insert	
2.5	Cut-off frequency			
2.5.1	Bandwidth	dB	insert	
2.5.2	Attenuation at	dB	Insert	
2.5.3	Auto adjusted anti-aliasing filters for chosen sampling rate	Yes/No	Yes	
2.5.4	Simultaneously programmable sampling rate for all feeders/inputs		Min 2 for FAST and SLOW Recording	
2.5.4.1	Locally changeable		Yes	
2.5.4.2	Remotely changeable		Yes	
2.5.5	Possible sampling rates			
2.5.5.1	Slow. 1Hz-500Hz	Samples / sec	Insert	
2.5.5.2	Fast: 0.5 kHz - 6kHz	Samples / sec	Insert	
2.5.5.3	Continuous (variable rate)	Samples / sec	Insert	
2.6	DC coupled inputs	Yes/No	Yes	
2.7	Resolution	bits	12 or better	
2.8	Accuracy	%	Min 0.5	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.9	Burden			
2.9.1	• Current circuit	VA	Insert	
2.9.2	• Voltage circuit	VA	Insert	
2.10	Over load			
2.10.1	Current	% In	100% In continuously, min 600 % In for 1 sec.	
2.10.2	Voltage circuit	% Vn	2 Vn and max. 350 Vn	
3	Digital inputs			
3.1	Number of channels		408 for 230kV and 360 for 400kV	
3.1.1	Expandability		min. 360	
3.2	Selectable input level	Vdc	N/O or N/C, 110 VDC	
3.3	Type		Potential or potential free contact	
3.4	Resolution	ms	Insert	
4	Memory			
4.1	Size	MB	64 MB or higher	
4.2	Type		Solid state	
4.3	Pre-fault time (fast scanning rate)	sec	0.1-2 user programmable	
4.4	Post-fault (fast scanning rate	sec	0.1-2 user programmable	
4.5	Pre and post-fault time (slow scanning rate)	sec	min. 180 user programmable	
4.6	In-built hard disk (auto-maintained	GB	min. 4 GB	
5	Sensors / Triggering criteria			
	All sensors/triggers are preferable programmable and virtually recordable	Yes/No	Yes	
5.1.	Logical combination sensor	Yes/No	Yes	
5.2.	Three phase over or under voltage / current	Yes/No	Yes	
5.3.	Mono phase over or under voltage / current	Yes/No	Yes	
5.4.	*du/dt, dp/dt, dq/dt, [Single/3 Phases], df/dt. etc.	Yes/No	Yes	
5.5.	RMS [voltage / current]	Yes/No	Yes	
5.6.	Zero sequence	Yes/No	Yes	
5.7.	Negative, positive sequence	Yes/No	Yes	
5.8.	Frequency	Yes/No	Yes	
5.9.	DC Step	Yes/No	Yes	
5.10.	Pendling / swing	Yes/No	Yes	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.11.	Digital level and edge	Yes/No	Yes	
5.12.	Sensor trigger	Yes/No	Yes	
5.13.	Event trigger	Yes/No	Yes	
5.14.	Manual trigger	Yes/No	Yes	
5.15.	Remote trigger	Yes/No	Yes	
6	Clock System			
6.1.	Internal clock	Yes/No	Yes	
6.2.	Accuracy		Insert	
6.3.	External synchronization	Yes/No	Yes	
6.4.	Time resolution between 2 synchronized pulses		Insert	
7	Output Alarm Relay Contact			
7.1.	Max. operation voltage DC/AC	Vac / Vdc	250 Vac or above, 60 Vdc or above	
7.2.	Make and carry for 0.5 sec	A	Min 8A	
7.3.	Carry continuously	A	Min 5A	
7.4.	Break (DC) - resistive	W	Insert	
8	Interface for Data Communication			
8.1.	Full definition compression	Yes/No	Yes	
8.2.	Maximum transmission rate	bits / sec	Insert	
8.3.	Standard serial port (EIA-232-D)	Yes / No	Yes	
8.4.	Printer port	Yes/No	Yes	
8.5.	Dedicated serial port for modem	Yes/No	Yes	
9	Printer Data			
9.1.	Printer amplitude (scaling peak to peak)		Insert	
9.2.	Time scale	mm/s	Insert	
9.3.	Printer resolution	-	Insert	
9.4.	Auto printing	Yes/No	Yes	
9.5	Fault priority transmission	Yes/No	Yes	
9.6	Fault location (distance calculation)	Yes/No	Yes	
10	Communication and remote analysing unit			
10.1.	Processor Pentium	MHz	Minimum 450 MHz	
10.2.	Co-processor Pentium	Yes/No	Yes	
10.3.	Main memory capacity	Mb	Minimum 64 MB	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10.4.	Colour graphics board S-VGA	Yes/No	Yes	
10.5	Screen S-VGA	Yes/No	Yes	
10.6	Hard disk unit	GB	Minimum 40 GB	
10.7	Printer	Yes/No	Yes	
10.8	Modem	Yes/No	Yes.	
	Overall compliance with the requirements (yes/no)			

5.2.7 HV & LV Cable

5.2.7.1 230kV Power Cable (not applicable)

SI No.	Description	Unit	Requirement	Bidder's Data
1	General			
	Manufacturer		Insert	
	Type		Insert	
	Model Designation		Insert	
	Country of Origin		Insert	
	Standards		EC 62067	
	Quality Control		ISO 9001 ISO 14001 ISO 18001	
	Type of conductor		Copper	
	Type of Insulation		XLPE	
	Ambient temperature for calculation - Average daily temperature - maximum daily temperature	 °C °C	 40 50	
2	Voltage			
	Rated Voltage	kV	230kV	
	Maximum System Voltage	kV	245kV	
	Impulse withstand voltage	kV	1050	
	Power frequency withstand voltage	kV	460	
3	**Cores**			
	Number of cores		1 (one)	
4	**Conductor**			
	Standard		IEC 60228	
	Nominal Current	A	≥ 2000	
	Cross sectional area	mm^2	Insert	
	Nominal Diameter	mm	Insert	
	Material		Annealed Copper	
	Design (standard of segmental)		Milliken (4/5 segment)	
5	**Conductor Screen**			
	Material		Semi conducting tape & Extruded semiconducting compound, cross linked	
	Thickness (approx.)	mm	Insert	
	Nominal Diameter over semi-conducting layer	mm	Insert	
6	**Insulation**			
	Material		XLPE	
	Process		Triple simultaneous extrusion	
	Type of curing (dry)		Dry Curing (VCV)	
	Average Thickness		23-25 mm	
	Minimum Thickness		Insert	
	Nominal Diameter over insulation		Insert	
7	**Insulation screen**			
	Material		Extruded semi conducting compound, cross linked	
	Thickness approx.		Insert	

SI No.	Description	Unit	Requirement	Bidder's Data
	Nominal Diameter over semi conducting layer		Insert	
8	**Metallic Screen/Sheath**			
	Type		Corrugated Seamless Aluminium Sheath	
	Thickness (nominal)			
	Nominal Diameter over semi Metallic sheath	mm	Insert	
9	**Longitudinal water tightness**			
	Material		Semi-conducting swellable tape	
	Nominal thickness and width approx.		Insert	
10	**Radial moister barrier**			
	Material		Laminated plastic coated aluminium tape / lead/copper	
	Nominal thickness and width approx.		Insert	
11	**Outer Covering**			
	Material		MDPE	
	Colour		Black	
	Minimum average thickness		Insert	
	Type of termite repellent		Insert	
12	**Completed Cable**		Insert	
	Overall diameter (approx.)	mm	Insert	
	Weight per meter (approx.)	kg	Insert	
13	**Continuous Current carrying capacity based on the conditions special laid in the cable trench**		SPB * & Trefoil	
	One circuit		Insert	
	Two circuit		Insert	
	Three circuit		Insert	
	Drawn into ducts (One Cable in duct)		Insert	
	One circuit			
	Two circuit		Same as mentioned above provided the length of into the duct shall not exceed 5 % of route	
	Three Circuit		Insert	
	In Air		Insert	
14	**Max Conductor temperature**			
	Laid direct ground	°C	Insert	
	Draw into ducts	°C	Insert	
	Elected in air	°C	Insert	
15	Permissible overload in service condition		2 hrs in a day 100 hrs in a month 500 hrs in total life	

SI No.	Description	Unit	Requirement	Bidder's Data
16	Conductor short circuit current cable loaded as above prior to short circuit	KA/1sec	Insert	
	Carrying capacity for three second cable loaded	KA/3sec	Insert	
	Final conductor temperature	°C		
17	Sheath Earth Fault Current Carrying capacity for three second cable loaded as above prior to each fault	KA/1sec	50	
	Final Conductor temperature	°C	250°	
18	Max. Dielectric stress	kV/meter	Insert	
	• on the conductor screen (assumed smooth)	kV/meter	Insert	
	• on the insulation	kV/meter	Insert	
19	**Minimum radius of bend around which cable can be laid**		20 x overall diameter of cable in meters	
	Laid direct		Insert	
	In ducts		Insert	
	In air		Insert	
20	Nominal Internal diameter of pipes on ducts through which cable may be pulled (One cable in duct)		Insert	
21	**Maximum DC resistance per km of cable at 20°C**	ohm/km		
	Of conductor	ohm/km	Insert	
	Of metallic layer	ohm/km	Insert	
22	Maximum ac resistance per km of cable at maximum conductor temperature	ohm/km	Insert	
23	**Insulation Resistance per km of cable per core**			
	At 20°C	mega ohm-km	Insert	
	At maximum rated temperature	mega ohm-km	Insert	
24	Equivalent star Reactance per meter of 1 - phase circuit at nominal frequency	ohm/km	Insert	
25	Maximum electrostatic capacitance per meter of cable approx.	µF/km	Insert	
26	Maximum charging current per core per meter pf cable at nominal voltage, Uo	A/km	Insert	
27	Maximum dielectric loss cable per uncle of 3 phase circuit when laid direct in the ground ay nominal	W/m/phase	Insert	
28	Maximum induced voltage on metal sheath under fault condition (single core only)		Insert	
29	**Maximum dielectric Dissipation factor of charging of cable when laid direct in the ground at**			

SI No.	Description	Unit	Requirement	Bidder's Data
	nominal voltage Uo, normal frequency at			
	Conductor temperature of 20°C		Insert	
	Maximum conductor temperature of 90°C		Insert	
30	Sheath loss of cable per meter of phase circuit at nominal voltage Uo, normal frequency.	W/m/phase	Insert	
31	Cree page	Mm	Insert	
	Total creepage distance of outdoor sealing approx. mm and porcelain.			
32	Earth continuity copper Conductor (IF REQD)	mm^2	Insert	
33	**Condition on which current carrying capacity are based**			
	Soil thermal resistivity	°C-cm/W	Insert	
	Ground temperature	°C	Insert	
	Air temperature	°C	Insert	
	Burial depth	M	Insert	
	Axial spacing between phase cables	Mm	Insert	
	Axial spacing between circuits	Mm	Insert	
	Type of earth bonding.		Insert	

5.2.7.2 132kV Power Cable (Not applicable)

Sl No.	Description	Unit	Minimum Requirements	Guaranteed
34	General			
	Manufacturer		Insert	
	Type		Insert	
	Model Designation		Insert	
	Country of Origin		EU/UK/USA/Japan/South Korea/Thailand/Turkey	
	Standards		EC 62067	
	Quality Control		ISO 9001 ISO 14001 ISO 18001	
	Type of conductor		Copper	
	Type of Insulation		XLPE	
	Ambient temperature for calculation - Average daily temperature - maximum daily temperature	°C °C	30 45	
35	Voltage			
	Rated Voltage	kV	132kV	
	Maximum System Voltage	kV	145kV	
	Impulse withstand voltage	kV	650	
	Power frequency withstand voltage	kV	275	
36	**Cores**			
	Number of cores		1 (one)	
37	**Conductor**			
	Standard		IEC 60228	
	Nominal Current	A	≥ 1600	
	Cross sectional area	mm^2	≥ 1600	
	Nominal Diameter	mm	Insert	
	Material		Annealed Copper	
	Design (standard of segmental)		Milliken (4/5 segment)	
38	**Conductor Screen**			
	Material		Semi conducting tape & Extruded semiconducting compound, cross linked	
	Thickness (approx.)	mm	Insert	
	Nominal Diameter over semi-conducting layer	mm	Insert	
39	**Insulation**			
	Material		XLPE	
	Process		Triple simultaneous extrusion	
	Type of curing (dry)		Dry Curing (VCV)	

Sl No.	Description	Unit	Minimum Requirements	Guaranteed
	Average Thickness		23-25 mm	
	Minimum Thickness		Insert	
	Nominal Diameter over insulation		Insert	
40	**Insulation screen**			
	Material		Extruded semi conducting compound, cross linked	
	Thickness approx.		Insert	
	Nominal Diameter over semi conducting layer		Insert	
41	**Metallic Screen/Sheath**			
	Type		Corrugated Seamless Aluminium Sheath	
	Thickness (nominal)			
	Nominal Diameter over semi Metallic sheath	mm	Insert	
42	**Longitudinal water tightness**			
	Material		Semi-conducting swellable tape	
	Nominal thickness and width approx.		Insert	
43	**Radial moister barrier**			
	Material		Laminated plastic coated aluminium tape / lead/copper	
	Nominal thickness and width approx.		Insert	
44	**Outer Covering**			
	Material		MDPE (Latest generation)	
	Colour		Black	
	Minimum average thickness		Insert	
	Termite repellent		Yes	
	Type of Termite repellent		Insert	
45	**Completed Cable**		Insert	
	Overall diameter (approx.)	mm	Insert	
	Weight per meter (approx.)	kg	Insert	
46	**Continuous Current carrying capacity based on the conditions special laid in the cable trench**		SPB * & Trefoil	
	One circuit		Insert	
	Two circuit		Insert	
	Three circuit		Insert	
	Drawn into ducts (One Cable in duct)		Insert	
	One circuit			

Sl No.	Description	Unit	Minimum Requirements	Guaranteed
	Two circuit		Same as mentioned above provided the length of into the duct shall not exceed 5 % of route	
	Three Circuit		Insert	
	In Air		Insert	
	Calculation as per IEC		During Execution	
47	**Max Conductor temperature**			
	Laid direct ground	°C	Insert	
	Draw into ducts	°C	Insert	
	Elected in air	°C	Insert	
48	Permissible overload in service condition		Min 2 hrs in a day Min 100 hrs in a month Min 500 hrs in total life	
49	Conductor short circuit current cable loaded as above prior to short circuit	kA/1sec	Insert	
	Carrying capacity for three second cable loaded	kA/3sec	Insert	
	Final conductor temperature	°C	Insert	
	Calculation as per IEC		During Execution	
50	Sheath Earth Fault Current Carrying capacity	kA/3sec	40	
	Final Conductor temperature	°C	Insert	
51	Max. Dielectric stress	kV/meter	Insert	
	• on the conductor screen (assumed smooth)	kV/meter	Insert	
	• on the insulation	kV/meter	Insert	
52	**Minimum radius of bend around which cable can be laid**		20 x overall diameter of cable in meters	
	Laid direct		Insert	
	In ducts		Insert	
	In air		Insert	
53	Nominal Internal diameter of pipes on ducts through which cable may be pulled (One cable in duct)		Insert	
54	**Maximum DC resistance per km of cable at 20°C**	ohm/km		
	Of conductor	ohm/km	Insert	
	Of metallic layer	ohm/km	Insert	
55	Maximum ac resistance per km of	ohm/km	Insert	

Sl No.	Description	Unit	Minimum Requirements	Guaranteed
	cable at maximum conductor temperature			
56	**Insulation Resistance per km of cable per core**			
	At 20°C	mega ohm-km	Insert	
	At maximum rated temperature	mega ohm-km	Insert	
57	Equivalent star Reactance per meter of 1 - phase circuit at nominal frequency	ohm/km	Insert	
58	Maximum electrostatic capacitance per meter of cable approx.	µF/km	Insert	
59	Maximum charging current per core per meter pf cable at nominal voltage, Uo	A/km	Insert	
60	Maximum dielectric loss cable per uncle of 3 phase circuit when laid direct in the ground ay nominal	W/m/phase	Insert	
61	Maximum induced voltage on metal sheath under fault condition (single core only)		Insert	
62	**Maximum dielectric Dissipation factor of charging of cable when laid direct in the ground at nominal voltage Uo, normal frequency at**			
	Conductor temperature of 20°C		Insert	
	Maximum conductor temperature of 90°C		Insert	
63	Sheath loss of cable per meter of phase circuit at nominal voltage Uo, normal frequency.	W/m/phase	Insert	
64	Cree page	Mm	Insert	
	Total creepage distance of outdoor sealing approx. mm and porcelain.			
65	Earth continuity copper Conductor (IF REQD)	mm^2	Insert	
66	**Condition on which current carrying capacity are based**			
	Soil thermal resistivity	°C-cm/W	Insert	
	Ground temperature	°C	Insert	
	Air temperature	°C	Insert	
	Burial depth	M	Insert	
	Axial spacing between phase cables	Mm	Insert	
	Axial spacing between circuits	Mm	Insert	
	Type of earth bonding.		Insert	

5.2.7.3 33kV 1Cx800mm^2 XLPE Power Cable (Not applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**General**			
1.1.	Manufacturer		To be mentioned	
1.2	Type		Copper conductor XLPE insulated	
1.3	Model designation		To be mentioned + Standard according to which cable has been manufactured and tested	
1.4	Country of origin		EU/UK/USA/Japan/South Korea/Thailand/Turkey	
1.4.1	Made in		EU/UK/USA/Japan/South Korea/Thailand/Turkey	
1.5	Standards		IEC 60228 IEC 60502-2 IEC 60287 IEC 60840 IEC 60853 IEC 60949	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Rated voltage (U_o/U)	kV	19/33(36)	
1.8	Highest system voltage (U_m)	kV	36	
1.9	Power frequency withstand voltage	kV	70	
1.10	Lighting Impulse withstand voltage	kV_{peak}	170	
1.11	Rated frequency	Hz	50	
1.12	Number of cores and cross sectional area of conductor core	Nos×mm^2	1 x 800	
1.13	Continuous current carrying capacity for different laying conditions		Descriptive catalogue containing continuous	

			current carrying capacity for different laying condition with calculation shall have to be provided)	
1.14	Type of earth bonding system of metallic sheath/armor		Solid	
1.15	Maximum conductor temperature under continuous rated loading	^{0}C	≤ 90	
1.16	Rated short circuit current of conductor for			
1.16.1	1sec, cable loaded as rated prior to short circuit	kA	Insert	
1.16.2	3sec, cable loaded as rated prior to short circuit	kA	Insert	
1.16.3	Final maximum conductor temperature	^{0}C	≤ 250	
1.17	Rated short time current of metallic screen for 1sec	kA	≥ 31.5 (with screen temperature rise from 800C and 2500C) (detail calculation sheet shall have to be attached)	
1.18.1	Final maximum metallic screen temperature	^{0}C	Insert	
1.19	Permissible overload in service conditions for a period of	% Hours	Insert	
1.20	System earthing		Solidly grounded	
1.21	Maximum operating temperature of cable under continuous rated loading i) Direct buried ii) Drawn to ducts iii) Laid in air	^{0}C	Insert Insert Insert	
2.	**Core Conductor Characteristics**			
2.1	Nominal cross sectional area of conductor	mm^2	800	
2.2	Conductor material		Annealed Copper	
2.3	Shape of conductor		Stranded compacted circular	
2.4	Conductor class (According to IEC		Class 2	

	60228 clause-3)			
2.5	No. of strands	pcs	≥ 53	
2.6	Diameter of wire	mm	Insert	
2.7	DC resistance of conductor at 20^0C	Ω/km	≤ 0.0221	
2.8	Max. AC resistance of conductor at maximum conductor temperature	Ω/km	Insert	
3	**Electrical Characteristics**			
3.1	Equivalent star reactance of three phase circuit at nominal frequency	Ω/km	Insert	
3.2	Maximum Electrostatic capacitance of cable	µF/km	Insert	
3.3	Impedance of three phase circuit			
3.3.1	Positive & Negative sequence impedance	Ω/km	Insert	
3.3.2	Zero sequence impedance	Ω/km	Insert	
3.4	Maximum charging current per core per meter of cable at nominal voltage	mA	Insert	
3.5	Maximum dielectric loss of cable per three phase circuit when laid directly in the ground at nominal voltage, normal frequency at maximum conductor temperature.	W/m	Insert	
3.6	Insulation resistance per km of cable per core			
3.6.1	At 20^0C	MΩ	Insert	
3.6.2	At maximum operating temperature	MΩ	Insert	
3.7	Maximum induced voltage on metal screen/armor under fault condition	V	Insert	
3.8	Maximum dielectric dissipation factor of charging of cable when laid direct in the ground at nominal voltage & normal frequency at		Insert	
3.8.1	Conductor at temperature 20^0C		Insert	
3.8.2	Conductor at maximum operating temperature		Insert	
3.9	Sheath loss of cable per meter of 3 phase circuit at nominal voltage & normal frequency at the specified current rating	W	Insert	
4	**Mechanical Characteristics**			
4.1	Material of conductor screening		Semi conducting tape & Extruded semi-conductive thermosetting compound	
4.2	Thickness of conductor screening a) Semi conductive tape b) Extruded non-metal semi-conductive compound	mm	Insert Insert	
4.3	Diameter of conductor screen	mm	Insert	

4.4	Material of insulation		XLPE	
4.5	Nominal thickness of insulation	mm	≥ 8	
4.6	Diameter over insulation	mm	Insert	
4.7	Type of dry curing		Inert gas	
4.8	Extrusion process		VCV with triple extrusion	
4.9	Material of insulation screening		Semi conducting tape & Extruded semi-conductive thermosetting compound	
4.10	Nominal thickness of insulation screening a) Extruded non-metal semi-conductive compound b) Semi conductive tape		Insert Insert	
4.11	Diameter over insulation screen	mm	Insert	
4.12	Metallic screen		Concentric layer of copper wires with helically applied copper tape or corrugated seamless aluminum sheath or both	
4.12.1	No./diameter of each copper wire (if applicable, based on design calculation)	Nos/mm	Insert	
4.12.2	Nominal thickness of copper tape (If applicable, based on design calculation)	mm	Insert	
4.12.3	Nominal thickness of corrugated aluminum sheath (If applicable, based on design calculation)	mm	Insert	
4.13	Nominal thickness Non-woven fabrics wrapper over metallic screen (if applicable)	mm	Insert	
4.14	Material of outer sheath		Black extruded MDPE	
4.15	Minimum average thickness of outer sheath	mm	2.8	
4.16	Termite repellent		Yes	
4.17	Type of termite repellent		Insert	
4.18	Overall diameter of complete cable	mm	Insert	
4.19	Weight per meter of complete cable	Kg/m	Insert	
4.20	Method used for water blocking of cable		Insert	
4.21	Nominal thickness of layer used for water blocking	mm	Insert	
4.22	Minimum radius of bend around which cable can be laid			
4.22.1	Direct buried	mm	Insert	
4.22.2	Drawn to ducts	mm	Insert	
4.22.3	In air	mm	Insert	

4.23	Maximum pulling tension	kg	Insert	
4.24	Max. dielectric stress on all the conductor screen (assumed smooth)	V/cm	Insert	
4.25	Nominal internal diameter of pipes on ducts through which cable may be pulled	mm	Insert	
5.	**Miscellaneous**			
5.1	Cable drum			
5.1.1	Nominal drum length	m	Insert	
5.1.2	Tolerance of each drum length	%	±3% of nominal drum length	
5.1.3	Drum material		Steel	
5.1.4	Drum size (Flange x Width) approx.	mm x mm	Insert	
5.1.5	Net weight Approx.	kg	Insert	
5.1.6	Gross weight approx. (with cable)	kg	Insert	
5.1.7	Sealing of both end of cable		Both ends of every length of cable shall be sealed by means of heat shrinkable end caps.	
5.1.8	The complete cable drum shall be covered by sheet steel to protect from external thrust.		Yes	
5.1.9	Drum marking		Particulars of the Cable i.e. Voltage grade, Size & length of cable, gross weight, net weight, direction of rolling, Purchaser's name & contract number, name of manufacturer and year of manufacture etc. shall be clearly marked on one flange on the drum.	
5.2	Permanent identification marking at intervals of not more than 300mm throughout the length of the cable.		Rated voltage, conductor size, manufacturer name, year of manufacture and name of the purchaser	
5.3	Cable constructional diagram with proper legends and dimensions		To be provided with offer	
	Overall compliance with the requirements (yes/no)			

5.2.7.4 33kV 1Cx500mm^2 XLPE Power Cable

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**General**			

1.1.	Manufacturer		To be mentioned	
1.2	Type		Copper conductor XLPE insulated	
1.3	Model designation		To be mentioned + Standard according to which cable has been manufactured and tested	
1.4	Country of origin		Insert	
1.4.1	Made in		Insert	
1.5	Standards		IEC 60228 IEC 60502-2 IEC 60287 IEC 60840 IEC 60853 IEC 60949	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Rated voltage (U_o/U)	kV	19/33(36)	
1.8	Highest system voltage (U_m)	kV	36	
1.9	Power frequency withstand voltage	kV	70	
1.10	Lighting Impulse withstand voltage	kV_{peak}	170	
1.11	Rated frequency	Hz	50	
1.12	Number of cores and cross sectional area of conductor core	Nos×mm^2	1 x 500	
1.13	Continuous current carrying capacity for different laying conditions		Descriptive catalogue containing continuous current carrying capacity for different laying condition with calculation shall have to	

			be provided)	
1.14	Type of earth bonding system of metallic sheath/armor		Solid	
1.15	Maximum conductor temperature under continuous rated loading	^{0}C	≤ 90	
1.16	Rated short circuit current of conductor for			
1.16.1	1sec, cable loaded as rated prior to short circuit	kA	Insert	
1.16.2	3sec, cable loaded as rated prior to short circuit	kA	Insert	
1.16.3	Final maximum conductor temperature	^{0}C	≤ 250	
1.17	Rated short time current of metallic screen for 1sec	kA	≥ 31.5 (with screen temperature rise from 80^{0}C and 250^{0}C) (detail calculation sheet shall have to be attached)	
1.18.1	Final maximum metallic screen temperature	^{0}C	Insert	
1.19	Permissible overload in service conditions for a period of	% Hours	Insert	
1.20	System earthing		Solidly grounded	
1.21	Maximum operating temperature of cable under continuous rated loading iv) Direct buried v) Drawn to ducts vi) Laid in air	^{0}C	Insert Insert Insert	
2.	**Core Conductor Characteristics**			
2.1	Nominal cross sectional area of conductor	mm^2	500	
2.2	Conductor material		Annealed Copper	
2.3	Shape of conductor		Stranded compacted circular	
2.4	Conductor class (According to IEC 60228 clause-3)		Class 2	
2.5	No. of strands	pcs	≥ 53	
2.6	Diameter of wire	mm	Insert	
2.7	DC resistance of conductor at 20^{0}C	Ω/km	≤ 0.0366	
2.8	Max. AC resistance of conductor at maximum conductor temperature	Ω/km	Insert	

3	**Electrical Characteristics**			
3.1	Equivalent star reactance of three phase circuit at nominal frequency	Ω/km	Insert	
3.2	Maximum Electrostatic capacitance of cable	µF/km	Insert	
3.3	Impedance of three phase circuit			
3.3.1	Positive & Negative sequence impedance	Ω/km	Insert	
3.3.2	Zero sequence impedance	Ω/km	Insert	
3.4	Maximum charging current per core per meter of cable at nominal voltage	mA	Insert	
3.5	Maximum dielectric loss of cable per three phase circuit when laid directly in the ground at nominal voltage, normal frequency at maximum conductor temperature.	W/m	Insert	
3.6	Insulation resistance per km of cable per core			
3.6.1	At 20^0C	MΩ	Insert	
3.6.2	At maximum operating temperature	MΩ	Insert	
3.7	Maximum induced voltage on metal screen/armor under fault condition	V	Insert	
3.8	Maximum dielectric dissipation factor of charging of cable when laid direct in the ground at nominal voltage & normal frequency at		Insert	
3.8.1	Conductor at temperature 20^0C		Insert	
3.8.2	Conductor at maximum operating temperature		Insert	
3.9	Sheath loss of cable per meter of 3 phase circuit at nominal voltage & normal frequency at the specified current rating	W	Insert	
4	**Mechanical Characteristics**			
4.1	Material of conductor screening		Semi conducting tape & Extruded semi-conductive thermosetting compound	
4.2	Thickness of conductor screening c) Semi conductive tape d) Extruded non-metal semi-conductive compound	mm	Insert Insert	
4.3	Diameter of conductor screen	mm	Insert	
4.4	Material of insulation		XLPE	
4.5	Nominal thickness of insulation	mm	≥ 8	
4.6	Diameter over insulation	mm	Insert	
4.7	Type of dry curing		Inert gas	
4.8	Extrusion process		VCV with triple extrusion	

4.9	Material of insulation screening		Semi conducting tape & Extruded semi-conductive thermosetting compound	
4.10	Nominal thickness of insulation screening c) Extruded non-metal semi-conductive compound d) Semi conductive tape		Insert Insert	
4.11	Diameter over insulation screen	mm	Insert	
4.12	Metallic screen		Concentric layer of copper wires with helically applied copper tape or corrugated seamless aluminum sheath or both	
4.12.1	No./diameter of each copper wire (if applicable, based on design calculation)	Nos/mm	Insert	
4.12.2	Nominal thickness of copper tape (If applicable, based on design calculation)	mm	Insert	
4.12.3	Nominal thickness of corrugated aluminum sheath (If applicable, based on design calculation)	mm	Insert	
4.13	Nominal thickness Non-woven fabrics wrapper over metallic screen (if applicable)	mm	Insert	
4.14	Material of outer sheath		Black extruded MDPE	
4.15	Minimum average thickness of outer sheath	mm	2.6	
4.16	Termite repellent		Yes	
4.17	Type of termite repellent		Insert	
4.18	Overall diameter of complete cable	mm	Insert	
4.19	Weight per meter of complete cable	Kg/m	Insert	
4.20	Method used for water blocking of cable		Insert	
4.21	Nominal thickness of layer used for water blocking	mm	Insert	
4.22	Minimum radius of bend around which cable can be laid			
4.22.1	Direct buried	mm	insert	
4.22.2	Drawn to ducts	mm	Insert	
4.22.3	In air	mm	Insert	
4.23	Maximum pulling tension	kg	Insert	
4.24	Max. dielectric stress on all the conductor screen (assumed smooth)	V/cm	Insert	
4.25	Nominal internal diameter of pipes on ducts through which cable may be pulled	mm	Insert	

5.	**Miscellaneous**			
5.1	Cable drum			
5.1.1	Nominal drum length	m	Insert	
5.1.2	Tolerance of each drum length	%	±3% of nominal drum length	
5.1.3	Drum material		Steel	
5.1.4	Drum size (Flange x Width) approx.	mm x mm	Insert	
5.1.5	Net weight Approx.	kg	Insert	
5.1.6	Gross weight approx. (with cable)	kg	Insert	
5.1.7	Sealing of both end of cable		Both ends of every length of cable shall be sealed by means of heat shrinkable end caps.	
5.1.8	The complete cable drum shall be covered by sheet steel to protect from external thrust.		Yes	
5.1.9	Drum marking		Particulars of the Cable i.e. Voltage grade, Size & length of cable, gross weight, net weight, direction of rolling, Purchaser's name & contract number, name of manufacturer and year of manufacture etc. shall be clearly marked on one flange on the drum.	
5.2	Permanent identification marking at intervals of not more than 300mm throughout the length of the cable.		Rated voltage, conductor size, manufacturer name, year of manufacture and name of the purchaser	
5.3	Cable constructional diagram with proper legends and dimensions		To be provided with offer	
	Overall compliance with the requirements (yes/no)			

5.2.7.5 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 Core diameter Conductor insulation Type of filler Type of tape Sheath thickness	 mm^2 mm mm 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															

5.2.8 Batteries, Chargers and DC Distribution: (Not Applicable)

5.2.8.1 110V Battery

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	Manufacturer		Insert	
2.	Type		Insert	
3.	**Standard**		**IEC or equivalent**	
4.	Electrolyte		Insert	
5.	Nominal voltage	V	110	
6.	Capacity at 5 hour rate	Ah	-300AH @ 5 Hr (for 110 V DC,230kV S/Y) -400AH @ 5 Hr (for 110 V DC, 132kV S/Y)	
7.	Number of cells		-Not less than 94 nos. for 110V -Not less than 42 nos. for 48V	
8.	Float voltage per cell	V	1.40-1.42	
9.	Battery voltage at end of the duty cycle	V	Insert	
10.	**ECV**	**V/Cell**	**1.11**	
11.	Normal charging rate	A	Insert	
12.	Maximum charging rate	A	Insert	
13.	Ampere-hour efficiency at ten hour rate	%	Insert	
14.	Ampere-hour efficiency at one hour rate	%	Insert	
15.	Discharge voltage per cell	V	1.0	
16.	Spec. gravity of electrolyte	1	1.19±0.01	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
17.	**Sp. gravity of electrolyte (Charged)**	1	**1.19 ± 1%**	
18.	Positive plate	-	Tubular	
19.	Negative plate	-	Pasted	
20.	Type of container	-	Plastic polymer	
21.	Cell condition	-	Pre-charged	
22.	**Vent plug**		**Anti-corrosive & fire proof**	
23.	The battery stands steel frame		Yes	
24.	The battery stands earth-quake endurance type		Yes	
25.	Quantity of electrolyte per one cell	litre	Insert	
26.	Dimensions of one cell	mm	Insert	
27.	Dimensions of battery complete	mm	Insert	
28.	Weight of cell complete with electrolyte	kg	Insert	
29.	Internal resistance per cell when fully charged	ohms	Insert	
30.	Material of battery case		Insert	

5.2.8.2 Battery Charger For 110V

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**General**			
1.1	Manufacturer		Insert	
1.2	Type designation		Insert	
1.3	Type		Thyristor controlled	
1.4	Country of origin		Insert	
1.5	Standards		IEC	
1.6	Installation		Indoor	
1.7	Rectifier type		Thyristor controlled.	
1.8	Rated D.C. voltage	V	110V ±5%	
1.9	Rated output current	A	170, 150, 120A, 100A (refer to BOQ for detail)	
1.10	Charging mode		Both constant current & constant voltage	
1.11	High Voltage Insulation	V	1000 V AC for 1 minute between input to output and input to ground	
1.12	Insulation resistance	MΩ	10 MΩ with 500V DC for 1minute	
1.13	Cooling system		Self & natural air cooled.	
1.14	Relative humidity	%	Up to 98%	
1.15	Ambient temperature	°C	40 (max.)	
1.16	Noise level	db	65 (max)	
1.21	Altitude		1000 m	
1.22	Applicable Standard	Hz	IEC or equivalent	
2.	**AC Input**			
2.1	Voltage	V	415	
2.2	Phase		3	
2.3	Frequency	Hz	50±5%	
2.4	Allowable Input AC voltage variation At Charger input terminal	V	±15%	
2.5	Power factor		0.8	
2.6	Efficiency (Full load)	%	85%	
2.7	Charge Characteristics		Constant current /Constant voltage (During float charge)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.8	Current limitation	%	110%	
3	**D.C. OUTPUT**			
3.1	Voltage	V	110±5%	
3.2	Ripple Voltage (Full load)	%	±3%	
3.3	Charge modes (3 level)		Charge, Float charge & Boost charge	
3.4	Float Voltage (adjustable)	V	1.42	
3.5	Boost Voltage (adjustable)	V	1.53	
4	Measurement		Input Voltage Output Voltage Output Current Battery Current Load Current Earth-fault Voltage	
	Overall compliance with the requirements (yes/no)			

5.2.8.3 48V Battery

No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	**Data**	
1.	Manufacturer		Insert	
2.	Type		Insert	
3.	**Standard**		**IEC or equivalent**	
4.	Electrolyte		Insert	
5.	Nominal voltage	V	110	
6.	Capacity at 5 hour rate	Ah	150AH @ 5 Hr	
7.	Number of cells		-Not less than 42 nos. for 48V	
8.	Float voltage per cell	V	1.40-1.42	
9.	Battery voltage at end of the duty cycle	V	Insert	
10.	**ECV**	**V/Cell**	**1.11**	
11.	Normal charging rate	A	Insert	
12.	Maximum charging rate	A	Insert	
13.	Ampere-hour efficiency at ten hour rate	%	Insert	
14.	Ampere-hour efficiency at one hour rate	%	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
15.	Discharge voltage per cell	V	1.0	
16.	Spec. gravity of electrolyte	1	1.19±0.01	
17.	**Sp. gravity of electrolyte (Charged)**	1	**1.19 ± 1%**	
18.	Positive plate	-	Tubular	
19.	Negative plate	-	Pasted	
20.	Type of container	-	Plastic polymer	
21.	Cell condition	-	Pre-charged	
22.	**Vent plug**		**Anti-corrosive & fire proof**	
23.	The battery stands steel frame		Yes	
24.	The battery stands earth-quake endurance type		Yes	
25.	Quantity of electrolyte per one cell	litre	Insert	
26.	Dimensions of one cell	mm	Insert	
27.	Dimensions of battery complete	mm	Insert	
28.	Weight of cell complete with electrolyte	kg	Insert	
29.	Internal resistance per cell when fully charged	ohms	Insert	
30.	Material of battery case		Insert	

5.2.8.4 Battery Charger For 48V

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**General**			
1.1	Manufacturer		Insert	
1.2	Type designation		Insert	
1.3	Type		Thyristor controlled	
1.4	Country of origin		Insert	
1.5	Standards		IEC	
1.6	Installation		Indoor	
1.7	Rectifier type		Thyristor controlled.	
1.8	Rated D.C. voltage	V	110V ±5%	
1.9	Rated output current	A	150, 120A, 100A (refer to BOQ for detail)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.10	Charging mode		Both constant current & constant voltage	
1.11	High Voltage Insulation	V	1000 V AC for 1 minute between input to output and input to ground	
1.12	Insulation resistance	MΩ	10 MΩ with 500V DC for 1minute	
1.13	Cooling system		Self & natural air cooled.	
1.14	Relative humidity	%	Up to 98%	
1.15	Ambient temperature	°C	40 (max.)	
1.16	Noise level	db	65 (max)	
1.21	Altitude		1000 m	
1.22	Applicable Standard	Hz	IEC or equivalent	
2.	**AC Input**			
2.1	Voltage	V	415	
2.2	Phase		3	
2.3	Frequency	Hz	50±5%	
2.4	Allowable Input AC voltage variation At Charger input terminal	V	±15%	
2.5	Power factor	1	0.8	
2.6	Efficiency (Full load)	%	85%	
2.7	Charge Characteristics		Constant current /Constant voltage (During float charge)	
2.8	Current limitation	%	110%	
3	**D.C. OUTPUT**			
3.1	Voltage	V	110±5%	
3.2	Ripple Voltage (Full load)	%	±3%	
3.3	Charge modes (3 level)		Charge, Float charge & Boost charge	
3.4	Float Voltage (adjustable)	V	1.42	
3.5	Boost Voltage (adjustable)	V	1.53	
4	Measurement		Input Voltage Output Voltage Output Current Battery Current Load Current Earth-fault Voltage	
	Overall compliance with the requirements (yes/no)			

5.2.9 LVDC/AC Distribution Panel (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	**AC Distribution Panel**			
1.1	Manufacturer		Insert	
1.2	Manufacturer’s type designation		Insert	
1.3	Rating of Busbar	Amps	Insert	
1.4	Fault Rating for 1 sec	kA	Insert	
1.5	Incomer Breaker Rating	Amps	Insert	
1.6	Voltage	Volts	Insert	
1.7	Thickness of sheet steel	mm	Insert	
2	**Miniature Circuit Breakers**			
2.1	Manufacturer		Insert	
2.2	Type		Insert	
2.3	Rating	Amps	Insert	
2.4	Fault Rating for 1 sec	kA	Insert	

5.2.10 Telecommunication Equipment

5.2.10.1 Fibre Optic Multiplexer Equipment

No.	**Description**	**Minimum Requirements**		**Guaranteed**
		Unit	Data	
1.0	**GENERAL:**			
1.1	Type of multiplexer		SDH: ADM & PDH	
1.2	Complying to ITU-T rec.		Yes	
1.3	Transmission Capacity	Mbit/s	STM-4 & STM-16	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.4	Access capacity on 64 kbit/s	channels	Minimum 200	
1.5	Access capacity on 2 Mbit/s	channels	Minimum 40	
1.6	Redundant central processor		Shall be available	
1.7	Digital cross connect function		Fully non-blocking	
2.0	**Available AGGREGATES:**			
2.1	Optical aggregates (ITU-T G.957)		As per field requirement	
3.0	**Available TRUNK INTERFACES:**			
3.1	HDB3, 2 Mbit/s interfaces per module	Nos.	Minimum 8	
3.2	Complying to ITU-T rec.		G.703, transparent G.704, selectable	
3.3	HDSL, 2Mbit/s interface: no of copper wires Capacity on 2Mbit/s or on 1Mbit/s Capacity selectable	Nos. ch ch / pair of wire	4 or 2 30 or 15 30 / 2 pairs 30 / 1 pair 15 / 1 pair	
4.0	**Available USER INTERFACES**			
4.1	**Voice interfaces for trunk lines:**			
4.1.1	1 + 1 com path protection, available for all		yes	
4.1.2	Analogue, 4wire with E&M: Input level Output level	dBr	+7.5 .. –16 +7.0 .. –16.5	
4.1.3	Analogue, 2wire with E&M: Input level Output level	dBr	+6.5 .. –12.5 –1.0 .. -20	
4.1.4	Digital, 2Mbit/s CAS or PRI		Yes	
4.2	**Voice interfaces for remote subscriber:**			
4.2.1	2wire, subscriber side	dBr	-5 .. +4 / -7.5 .. -1	
4.2.2	2wire, PABX side	dBr	-5 .. +4 / -7.5 .. -3	
4.3	**Integrated teleprotection**			
4.3.1	**Interface for Commands:**			
4.3.1.1	Number of independent commands	Nos.	4	
4.3.1.2	Transmission time max.	ms	6	
4.3.1.3	Signal voltage	Vpeak	250	
4.3.1.4	1 + 1 com path protection		yes	
4.3.2	**Interface(s) for Differential Protection:**			
4.3.2.1	Electrical interface: G.703	kbit/s	64	
4.3.2.2	Optical Interface	kbit/s	Minimum 64	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.4	**Data: channels per module**			
4.4.1	1 + 1 com path protection, available for all		yes	
4.4.2	V.24/V.28 (RS-232): up to 38.4kbit/s	Nos.	4	
4.4.3	V.11/X.24 (RS-422): 64kbit/s	Nos.	4	
4.4.4	V.35: 64kbit/s	Nos.	4	
4.4.5	V.36 (RS-449): 64kbit/s	Nos.	2	
4.4.6	G.703: 64kbit/s	Nos.	8	
4.4.7	Ethernet: 10/100 BaseT WAN capacity Protocols	Nos. Mbit/s	1 Min: 2x 2Mbit/s Min.: IP	
4.5	**Integrated alarm gathering module:**			
4.5.1	Number of external alarms per module	Nos.	Min. 20	
4.5.2	Auxiliary power supply for ext. contacts		Yes	
4.6	**Network Management System**			
4.6.1	Type/Name of configuration tool			
4.6.2	For fault / configuration management		Yes / yes	
4.6.3	For local / remote operation		Yes / yes	
4.6.4	Data communication network (DCN)		Ethernet / IP or Ethernit / OSI	
4.7	**Ambient Conditions:**			
4.7.1	Storage: ETS 300 019-1-1, class 1.2	°C / % hum	-25 .. + 55 / class 1.2	
4.7.2	Transport: ETS 300 019-1-2, class 2.2	°C / % hum	-25 .. + 70 / class 2.2	
4.7.3	Operation: ETS 300 019-1-3, class 3.1E	°C / % hum	-5 .. +45 / class 3.1E	
4.8	**Power Supply**			
4.8.1	Operation	VDC	48 / 60 (-15/+20%)	
4.8.2	Fully redundant power supply		yes	

5.2.10.2 Power Line Carrier Equipment (Not Applicable)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.1	**Wave Trap**		Not Applicable	
1.2	**HF Coupling Unit**			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	Manufacturer/model		Insert	
2.	Type		Insert	
3.	Working temperature range	ºC	Insert	
4.	Available bandwidth		Insert	
5.	Tuning range		Insert	
6.	Composite loss over tuning range		Insert	
7.	Line side impedance range for phase/phase coupling		Insert	
8.	Equipment side impedance		Insert	
9.	Drain coil current carrying • continuous • for 1 second for 3 seconds	A	Insert	
10.	Isolation transformer voltage withstand for 1 minute	V	Insert	
11.	Main arrestor voltage	V	Insert	
12.	Earth switch interlock with door		Insert	
13.	Compatibility with IEC Recommendation 481		Insert	
1.3	**High Frequency Cable**			
1.	Manufacturer		Insert	
2.	Type		Insert	
3.	Coaxial or quad		Insert	
4.	Surge impedance		Insert	
5.	Voltage withstand: between conductors between cores and armouring	V	Insert Insert	
	Attenuation per km: • at 50 kHz at 400 kHz		Insert	
1.4	**Digital PLC Terminal**			
1.	Manufacturer/model		Insert	
2.	Type		Insert	
3.	Compliance with relevant parts of IEC62488-1		Insert	

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

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

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

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
25.	Receiver sensitivity range		Insert	
26.	Receiver alarm level or BER referred to nominal		Insert	
27.	Minimum alarm contact closure time		Insert	
28.	No. of alarm contacts		Insert	
29.	19"/ETSI rack mounting practice		Insert	
30.	Information to be submitted with the Tender (a) Technical description (b) MTBF calculations (c) Performance graphs/details		Insert	
1.7	**PAX Telephone Equipment and Subscriber Equipment**			
(a)	**Exchange equipment**			
1.	Type reference		Insert	
2.	Manufacturer		Insert	
3.	Dimensions of cubicle		Insert	
4.	Rack width		Insert	
5.	Literature reference for typical layout of cubicle		Insert	
6.	Operating temperature range		Insert	
7.	Operating relative humidity		Insert	
8.	Power requirements		Insert	
9.	Mean time between failures		Insert	
10.	Maximum number of local extensions		Insert	
11.	Maximum number of remote extensions		Insert	
12.	Maximum number of trunk lines		Insert	
13.	Maximum number of connecting circuits		Insert	
14.	Method of signalling • Local extensions • Remote extensions Trunk lines 4W		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
15.	Frequency of audible tones • Dial tone • Busy tone • Ringing tone Ringing current		Insert	
16.	Ring voltage		Insert	
17.	Type of processor		Insert	
18.	Type of memory		Insert	
(b)	**Subscriber telephone**			
1.	Type reference		Insert	
2.	Manufacturer		Insert	
3.	Type of dial (rotary/pushbutton)		Insert	
4.	Operating voltage		Insert	
5.	Outdoor bell		Insert	
6.	Type reference		Insert	
7.	Manufacturer		Insert	
8.	Operating voltage		Insert	

5.2.11 36kV Capacitor Bank, 36kV Reactor, and 36kV NCT

5.2.11.1 Deleted

5.2.11.2 36kV Reactor

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	**Inrush current limiting reactors**			
1.1	Manufacturer	-	Insert	
1.2	Applicable Standard	-	IEC 60076-6	

1.3	Type	-	Air core, Dry	
1.4	Model	-	Insert	
1.5	Rated voltage	kV	36	
1.6	Current at rated voltage	A	143% of rated current (fundamental) of capacitor bank	
1.7	Insulation class	-	Class B	
1.8	Rated reactive power	kvar	Insert	
1.9	Conductor material	-	Cu	
1.10	Inductance per phase (0.2%)	mH	Insert	
1.11	Linear range	p.u	≥2.0	
1.12	Copper loss at 75 ºC and rated current	kW	Insert	
1.13	Impedance at 75 ºC and rated power	Ohms	Insert	
1.14	Rated lightning impulse withstand voltage	kV (peak)		
1.15	Rated power frequency short duration withstand voltage, 1 s	kV (rms)	≥70	
1.16	Ambient temperature	°C	45	
1.17	Creepage distance	Mm/kV	31	
1.18	Rated inrush current	kA	Insert	
1.19	Dimensions length x width x height	mm	Insert	
1.20	Weight	kg	Insert	
1.21	Installation location		Outdoor Indoor (For Naogaon and Cox’s Bazar grid)	
1.22	Installation altitude	m	≤ 1000	
2.	**Detuning reactors**			
2.1	Manufacturer	-	Insert	
2.2	Applicable Standard	-	IEC 60076-6	

2.3	Type	-	Air core, Dry	
2.4	Model	-	Insert	
2.5	Rated voltage	kV	36	
2.6	Current at rated voltage	A	143% of rated current (fundamental) of capacitor bank	
2.7	Insulation class	-	Class B	
2.8	Rated reactive power	kvar	Insert	
2.9	Conductor material	-	Cu	
2.10	Inductance per phase (6%)	mH	Insert	
2.11	Linear range	p.u	≥2.0	
2.12	Copper loss at 75 ºC and rated current	kW	Insert	
2.13	Impedance at 75 ºC and rated power	Ohms	Insert	
2.14	Rated lightning impulse withstand voltage	kV (peak)		
2.15	Rated power frequency short duration withstand voltage, 1 s	kV (rms)	≥70	
2.16	Ambient temperature	°C	45	
2.17	Creepage distance	Mm/kV	31	
2.18	Rated inrush current	kA	Insert	
2.19	Dimensions length x width x height	mm	Insert	
2.20	Weight	kg	Insert	
2.21	Installation location		Outdoor	
2.22	Installation altitude	m	≤ 1000	
Overall compliance with the requirements (yes/no)				

5.2.11.3 36kV 20/1-1A NCT

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	**Current Transformer-General**			
1.1	Manufacturer		*insert*	
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		*insert*	
1.5	Country of Origin & Made in		Insert	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor Indoor (For Naogaon and Cox's Bazar grid)	
1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earhing		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	2	
2.7	Rated dynamic current, I_{dyn}	kA	5	
2.8.1	Rated primary current	A	400	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Electrical dissipation factor at power frequency test voltage		*insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.10	Capacitance	pF		
2.11	Maximum Allowable winding temperature	°C	*insert*	
2.12	Normal current density of primary winding		*insert*	
2.13	Rated continuous thermal current (40°C): • Core-I • Core-II	% In	120 120	
2.14	Rated Transformer ratio: • Core-I • Core-II	A/A A/A	20/1 20/1	
2.15	Accuracy Class: • Core-I • Core-II		5P 5P	
2.16	Rated Burden: • Core-I • Core-II	VA VA	15 15	
2.17	Rated Knee Point Voltage, V_k(Min) at highest ratio • Core-I • Core-II	V	*insert* *insert*	
2.18	Max. magnetizing current guaranteed at half of knee point voltage, I_{Exc} at V_k at highest ratio • Core-I • Core-II	mA	*insert* *insert*	
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	mA	*insert* *insert*	
2.20	Max. magnetizing current guaranteed at half of knee point voltage, I_{Exc} at $V_k/4$ at highest ratio • Core-I • Core-II	mA	*insert* *insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
2.21	Rated Accuracy limit Factor, ISF/ALF: • Core-I • Core-II		10 10	
2.22	Max. resistance of primary winding at 75 ^{0}C, R_{CT} for each rating:	Ohms	*insert*	
2.23	Max. resistance of secondary winding at 75 ^{0}C, R_{CT} for each rating: • Core-I • Core-II	Ohms	*insert*	
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)		*Insert*	
3.4	Type including Brand		*Insert*	
3.5	Quantity of insulating oil		*Insert*	
3.6	Porcelain Breaking Strength	kN	*Insert*	
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.	
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	*insert*	
3.13.6	MV terminals: Admissible Dynamic Load	KN	*insert*	
3.13.7	MV terminals: Cantilever test Load	KN	*insert*	
3.14	Total weight	kg	*insert*	
3.15	Total Height	mm	*insert*	
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		*insert*	
4.2	Expected Operating Life in Yrs		*insert*	
4.3	Mean time to repair in Hrs		*insert*	
4.4	Mean time between preventive maintenance in Yrs		*insert*	

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
4.5	Mean Time to (perform) preventive maintenance in Hrs		*insert*	
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 ingression 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.

5.2.11.4 36kV Capacitor Bank

No.	Description	Unit	Requirement Data	Guaranteed
1.	**Capacitor Bank and Unit**			
1.1	Manufacturer		Insert	
1.2	Model		Insert	
1.3	Applicable Standard		IEC 60871	
1.4	Nominal system voltage	kV (rms)	33	
1.5	Rated voltage of capacitor bank	kV (rms)	36	
1.6	Nominal reactive power output at 33kV	MVar	15	
1.7	Rated reactive power output	MVar	**17.85**	
1.8	Connection of capacitor bank		Double Y ungrounded neutral	
1.9	Rated lightning impulse withstand voltage (Bank)	kV (peak)	≥170	
1.10	Rated power frequency short duration	kV (rms)	≥70	

	withstand voltage, 1 s (Bank)			
1.11	Temperature category		-5 / B	
1.12	Rated frequency	Hz	50	
1.13	Creepage distance of bushings and support insulators based on pollution level	mm/kV	31	
1.14	Capacitance tolerance	%	0 to +10	
1.15.1	Discharge resistor		Built-in type	
1.15.1	Discharge requirement for unit	V/minutes	≤ 75/≤ 10	
1.16.1	Impregnant type		PCB free and biodegradable	
1.16.2	Impregnant name		Insert	
1.17	Case		Stainless steel	
1.18	Paint		Insert	
1.19	Bushing no./per unit	Nos.	2	
1.20	Bushing type		Porcelain	
1.21	Dielectric system		Polypropylene film	
1.22	Type of capacitor unit		Single Phase	
1.23	Rating plate provided as per IEC		Yes	
1.24.1	Rated kVAR of each capacitor unit, Q_N	kVAR	Insert	
1.24.2	Rated voltage of each capacitor unit, U_N	kV	Insert	
1.24.3	Rated capacitance of each capacitor unit, C_N	μF	Insert	
1.24.4	Rated lightning impulse withstand voltage (capacitor unit)	kV (peak)	≥38	
1.24.5	Rated power frequency short duration withstand voltage, 1 s (capacitor unit)	kV (rms)	≥95	
1.25.1	No. of capacitor unit in series per leg of single Y	Nos.	Insert	
1.25.2	No. of capacitor unit in parallel per leg of single Y	Nos.	Insert	
1.26	Fusing type		Internal	
1.27	Power loss (Tandelta) including loss in fuse and internal resistor* **(This item shall be used in evaluation)**	w/kVAR	≤ 0.2	
1.28	Installation location		Outdoor Indoor (For Naogaon and Cox's Bazar	

			grid)	
1.20	Installation altitude	m	≤ 1000	
1.30	Average annual failure rae		Insert	
	Overall compliance with the requirements (yes/no)			

5.2.12 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	^oC	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-m2	Insert	
3.1.2	**Aluminium Tubular Conductors for Busbar**			

No	Description	Unit	Minimum Requirements	Guaranteed
3.1.2.1	Type and standard specification		Insert	
3.1.2.2	Manufacturer and country		Insert	
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	ºC	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-m2	Insert	
3.1.2.11	Temperature rise at rated current	ºC	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	mm2	Insert	
3.1.3.8	Rated continuous current (site rating)	A rms	Insert	
3.1.3.9	Temperature rise at rated current	ºC	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	

No	Description	Unit	Minimum Requirements	Guaranteed
3.1.4	**Shield Wire**			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Dia. of galvanized steel wire	mm	Insert	
	Stranding - No. of Al wires Dia. Of each wire	 mm	Insert	
	Grade of wire		Insert	
	Weight of wire	kg/km	Insert	
	Minimum breaking strength of wire	kN	Insert	
3.2	**Insulators**			
3.2.1	**Station Post Type (for rigid Busbar)**			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Insulator unit, length/height	mm	Insert	
	No. of units in each insulator		Insert	
	Power frequency flashover voltage - Dry Wet	 kV kV	Insert	
	Impulse flashover voltage - Positive Negative	 kV kV	Insert	
	Power frequency withstand voltage - 1 min. dry 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 1.1xUr//3 line to ground voltage, when tested as per IEC 60694	 kV rms micro V	Insert	
	Leakage distance	mm	Insert	
	Mechanical values, failing load (min.) - Cantilever strength - Tensile strength - Torsional strength - Compressional strength	 N N N-m	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	- Combined electrical and mechanical strength Impact strength	N N 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 1.1xUr//3 line to ground voltage, when tested as per IEC 60694	 kV rms micro V	Insert	
	Leakage distance	mm	Insert	
	Mechanical values, failing load (min.) - Tensile strength - Torsional strength - Compressional strength - Combined electrical and mechanical strength Impact strength	 N N-m N N N-m	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
3.3	**Clamps and Fittings**			
	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		

Ref.	Description	Denomination / Description of Material in the Bid	Reference in the Bid
4.4	Drawing		
4.5	List of performed type tests		
4.6	Type test certificates		
4.7	Descriptive catalogue		
4.8	Reference list for the last five years for the offered type		
4.9	List of mandatory special tools		
4.10	List of mandatory spare parts		
4.11	List of recommended spare parts		
4.12	Training plan and program		
5	**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		

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

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

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

6. Schedule F: Subcontractors

The following form shall be filled and attached to the bid.
Bidders are free to propose/list more than one Subcontractor for each item.
Quoted rates and prices shall be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.
In case that more than one Subcontractor has been proposed, the Employer have right to choose one or more of them, or can ask for replacement
Should a Subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to substitute an acceptable Subcontractor without any change to the bid price.
Prior to signing the Contract, the corresponding Appendix to the Contract Agreement shall be completed, listing the approved Subcontractor for each item concerned.

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

Subcontractors

The following Subcontractors are proposed for carrying out the facilities:

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

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

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

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

Specified Standard	Alternative Standard	
	Number	Title

8. Schedule H: Proposed Contract & Site Organization

Personnel

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

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

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

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

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

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

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

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

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

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

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

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

From	To	Company / Project / Position / Relevant technical and management experience

10. Schedule I: Drawings and Documents to Be Submitted with Bid and After Contract

10.1 Drawing and Documents to be Submitted with BID

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

1. Typical single line, layout & sectional drawings of substation showing details of construction and dimensions.

2. Outline drawings of all switchgear equipment:-

   (a) Showing installed components, dimensions and weights;
   (b) Showing transport dimensions and weights;

3. Outline drawings of all power transformers, auxiliary transformers and Shunt Reactor (if any):-

   (a) Showing installed components, dimensions and weights;
   (b) Showing transport dimensions and weights;

4. Typical drawing of transformer remote control panel.

5. For furnishing Type Test Certificates of equipment, Please see "Type Test Requirement", clause 1.3, Section 6: Employer's Requirement, Volume 01 of 03.

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

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

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

   (i) Power transformer
   (ii) Switchgears (CB, DS/ES) &
   (iii) Instrument Transformer

- (iv) Relays& substation Automation System
- (v) Fibre Optic Multiplexer Equipment for protection and communication
- (vi) GIL / Underground power cables
- (vii) Surge arrester
- (viii) Wave trap (N/A)
- (ix) Bus Reactor (N/A)
- (x) DFDR
- (xi) Battery & charger
- (xii) Insulator

10.2 Drawings and Documents to be Submitted after Contract

Technical Drawings/Documents

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

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

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

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

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

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

The Technical documents shall have the followings features:
a) Units:
International System of Units (SI) shall be applied to all works.
b) Language:
English shall be the formal language, hence all documents, correspondences, drawings, reports, schedules, instructions, name plates, rating plates, caution plates and notices shall be written in English.
c) Symbols, Marks and Abbreviations:
All symbols, marks and abbreviations, etc., used on any documents shall be clearly explained by a legend on the same document or on separate sheets.

The abbreviations and marks used for an individual device shall be identical throughout whole documentation so as to avoid confusion and misunderstanding.
d) Sizes and Identifications of Documents:
The size of the drawings shall be standardized as follows:
- Al (594 mm x 841 mm)
- A2 (420 mm x 594 mm)
- A3 (297 mm x 420 mm)
- A4 (210 mm x 297 mm)

Design calculations, specifications, lists, instruction manuals and other documents shall preferably be prepared and submitted in A4 size.
All documents shall have a uniform title block at the bottom right hand corner, inclusive of the origin of the documents. The title block shall show the drawing title with main ratings such as capacity or voltage etc., drawing number, revision number or letter, date to have been prepared, name of the Contractor and/or manufacturer and the signature of the Contractor's authorized representative. Project title block will be informed from Engineer after contract. A spare blank space shall be provided above the title block of each document for the Employer comments.

Typical Technical Documents Required to be Submitted to the Employer:

The Bidder/Contractor shall submit the following technical documents and drawings:
A) With the Bid: (Refer to also Item 10.1 above)
The following drawings shall be submitted with the Bid:

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

B) After Contract Award Stage:
The followings are minimum requirement. Additional documents/drawings shall be submitted to the Employer, when required by the Employer.

a) Master List of Drawings and Documents (Master Document List):
After contract signing, the Contractor shall create and submit a master list of drawings and documents to the Employer for approval, for the purpose of monitoring and smooth processing of document approval, which shall contain document title and number, date to be submitted, re-submission date, approval date etc. underneath each column of relevant document classification or category.
i) Single Line diagram (SLD) for main circuits and secondary circuits.
ii) Layout drawings of the substation showing buildings/rooms, equipment arrangement, overall dimensions of equipment bays, cable routes or connections between equipment, internal/access roads and phase-phase and phase-earth clearances where applicable.
iii) Outline drawings of switchgear bays, circuit breakers, disconnecting switches, earthing switches and other main plant showing overall dimensions and weights, including details for shipping.
iv) General arrangement for transformers and shunt reactors.
v) Bushings or cable termination details for switchgears and transformers/reactors.
vi) Descriptive information and drawings for transformers, dealing with tank, core and winding arrangements including type of coils, insulation, use of grading, on-load tap-changing equipment and location of all ancillary devices, these drawings shall show masses crane lift necessary for un-tanking and size of lifting lugs.
vii) Typical drawings of protection equipment, relay panels, and associated equipment enclosures.
viii) SAS system configuration and related drawings

ix) AC/DC system and panels arrangement drawing
x) Telecommunication equipment system diagram & panel arrangement
xi) Detailed schematic diagram for all equipment
Xii) Interconnection/Wiring Diagrams, Cables route & Cable schedule between panels/equipment
xiii) Civil Engineering/design drawings
xiv) Details of Building services equipment and system arrangement/calculations
xv) Others, when required

- The contractor shall include any other drawings, catalogues, descriptions and photographs necessary to present a clear picture of the type and class of equipment to be provided under the contract.
- Project Implementation Schedule/Program shall be submitted to the Employer for approval within one month after signing the contract, showing the detailed program time schedule in bar/Gantt chart or equivalent for design, manufacturing, civil works, factory testing, delivery to substations, installation, site tests/commissioning and energization.
- The project organization chart including site organization shall also be submitted to the Employer for approval within one month after signing the contract.

b) Subcontractors & manufacturers:
Summary list of the final selected subcontractors/manufacturers shall be submitted for Approval s howing materials/equipment, place of manufacturing and testing etc.

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

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

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

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

i) 230/33kV/LV cable sizing calculation
ii) CT/VT ratings and sizing calculation (Burden, Class, Knee point voltage, Secondary resistance etc)
iii) Batteries and Battery Charger capacity
iv) Auxiliary Transformer capacity calculation
v) Earthing system, conductor sizing and safety of personnel and equipment calculations
vi) Detailed civil structural design calculations.
vii) Protective Relay settings calculations and recommendations
viii) Insulation coordination study

e) Lists:
The following lists shall be submitted for approval:
- Cable Lists
  - List of site installation equipment
  - List of Test Equipment and Special Tools.
  - List of Spare Parts

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

Required Numbers of Drawings/Documents:
Numbers of the documents to be submitted to Engineer shall be as follows:
a) During the Design/ Manufacturing stage:

- Documents for approval : 6 copies.
- Reference documents : 6 copies

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b) Before energizing stage:
- Red mark corrected drawings : 4 copies.

c) After commissioning test:
- Complete sets of bound prints of As-built drawings : 4 copies.

d) After Final Acceptance:
- Complete sets of bound prints of As-built documents : 4 copies.
- CD ROM containing as-built documents : 4 sets as PDF.

Corresponding Letters:

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

11. Schedule J: Departures from The Specification

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

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

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

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

Item	Volume	Clause	Detail of Departure from Specification
			NOT APPLICABLE

Attachment-Price Schedule