

POWER GRID BANGLADESH PLC



Bidding Document For Procurement of

**Design, Supply, Installation, Testing & Commissioning of
132/33 kV AIS Substations at Dhupchanchia, Kumarkhali,
Matlab North and Chatkhil including associated 132KV
bay extension at Kachua Substation on turnkey basis
(Package-4)**

Under

**Power Transmission Strengthening and Integration of
Renewable Energy Project (PTSIREP)**

Volume 3 of 3

Invitation for Bids No. : 27.21.0000.101.07.434.26.2175, dated May 10, 2026
Bid Identification No. : POWERGRID/ADB/PTSIREP/Package-4
Employer : POWER GRID BANGLADESH PLC
Country : Peoples Republic of Bangladesh

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Contents of the Tender documents

VOLUME 1

Section I.	Instructions to Bidders (ITB)
Section II.	Bid Data Sheet (BDS)
Section III.	Evaluation and Qualification Criteria
Section IV.	Bidding Forms
Section V.	Eligible Countries
Section VI.	Employer's Requirements
Section VII.	General Conditions of Contract (GCC)
Section VIII.	Special Conditions of Contract (PCC)
Section IX.	Contract Forms

VOLUME 2

Scope of Works
Technical Specifications
Drawings forming Part of the Specification

VOLUME 3

Schedule A: Introduction & Preamble to the Price & Technical Schedules
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

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT

FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]

SCHEDULE A

INTRODUCTION & PREAMBLE TO THE PRICE & TECHNICAL SCHEDULES

BRIEF DESCRIPTION OF THE WORKS

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

The scope of works under this turnkey contract is: design, supply, manufacture, quality assurance, inspection and testing, delivery, new packing for export, insurance, shipment & transport to the site, complete construction and installation, jointing, terminating, bonding, earthing, painting, setting to work, site testing and commissioning, defect liability for all equipment, including all civil works of new 132/33KV AIS substations.

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

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

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

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

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

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

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

In case of extension and renovation works, not all required as-built drawings may be available for the existing plant and equipment, which required modification/renovation; the Contractor is also responsible to make drawings as required to complete the works.

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

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

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

All necessary materials, adjustments, dismantling, remedial and tidying-up work in order to complete the work specified shall be included in the contract price.

The bid price shall include supply and delivery of mandatory spare parts.

The bid price shall include all other miscellaneous works required.

The programme of works shall be as shown in Schedule C - Times for Delivery and Completion. Within one month of acceptance of the bid, the Contractor shall submit a programme chart detailing times required for the design, supply, delivery, installation, testing and commissioning for the complete work.

The "Schedule of Requirements" for equipment, materials and services and the guaranteed technical particulars of equipment and materials will be stated in Schedule A of this bidding document shall be read in conjunction with the detailed technical specifications of equipment and materials described in Volume 2 of the bidding documents.

The "Price Schedule" for equipment, materials and services will be stated in Schedule B of this bidding document shall be read in conjunction with the detailed technical specifications of equipment and materials described in Volume 2 of the bidding documents

The scope of work comprises the following: -

DESCRIPTION OF WORKS

1. Dhupchanchia 132/33kV AIS Substation

The scope of work under this turnkey Bid is design, supply, delivery, installation, testing & commissioning of a new Air Insulated Switchgear (AIS) substation. The configuration of the 132KV busbar shall be double Busbar scheme.

The scope of work also includes associated control, protection, fiber optic multiplexer equipment for communication & protection, substation automation, digital fault & disturbance recorder (DFDR), station power facilities, including towers and gantry structures, a new two storied Main Control Room Building to accommodate protection and control IED and associated equipment, local control kiosks, 33kV equipment, cable trenches, water supply & sewerage, fences, access road & internal roads, security guard stations, and all other necessary substation facilities and supply of mandatory spare parts and maintenance & special tools.

132kV Air Insulated Switchgears (AIS)

New 132kV AIS switchyard for four 132kV line bays to connect Line in-out of existing 132kV Bogra (S)-Naogaon double circuit overhead line (Bogra (S) 1 & 2, Naogaon 1 & 2); Two 132kV transformer bays for HV side of two 132/33kV transformer; two 33kV transformer bays for LV side of two 132/33kV transformer; one 132kV bus-coupler bay; additional bus skeleton, gantry column and beam including earth mat shall be made for future extension of three overhead 132kV line/ transformer bays.

33kV Air Insulated Switches and Connection

New 33kV AIS switchyard and switches for 132/33kV LV side / incomer connection and station power service facilities;

Incomer side connection between 33kV terminal to 33kV Bus including switches, necessary fittings, structures, conductors for 132/33 transformers. 33KV Bus skeleton shall be built for

eight (08) nos of 33KV bays including incomer bays. The auxiliary transformer shall be connected to the LV side of two new 132/33kV three phase transformers.

132/33kV three phase 3 phase transformer

Two 132/33kV 50/75 MVA three phase transformers.

33/0.415kV earthing/auxiliary transformer

Two 33/0.415kV, 300kVA, outdoor type earthing/auxiliary transformers to supply the substation auxiliary loads. The auxiliary transformer shall be connected to the LV side of two new 132/33kV three phase transformers.

Control, Protection, Substation Automation, Metering & DFDR

Associated local & Remote control panel, metering panel, protection equipment, synchronizing scheme and substation automation system (SAS) & DFDR for complete substation. Monitoring of status of Bus PT & Bus ES need to be included in the SAS. Necessary works to be performed so that Air temperature in the control building can be controlled and monitored through SAS. RTCC, LVAC, LVDC, Tariff metering panel & other panels shall be monitored by SAS.

Fibre Optic Multiplexer Equipment for Communication and Protection

Indoor type Fibre Optic Multiplexer Equipment for protection & communication.

DC and LVAC System

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board.

Civil Works, Building and Foundation

Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

Complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit; approach, entrance & internal roads; cable trenches, septic tank, surfacing, drainage, fences, guard house including earthing & lightning protection, switchyard lighting, etc.

Complete design, supply and construction of all civil items including all necessary architecture & structural requirements; cable trays, fittings and flooring & finishes; air-conditioning and lighting for a new two storied Main Control Room Building.

SCADA system for Telecontrol and Telemetry

Complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Dispatch Center(NLDC) at Rampura for integration of complete new 132/33kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-101 protocol. All necessary modification works in the software of the master station of NLDC are to be carried out.

Mandatory Spare parts including Maintenance Equipment

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment. Printed catalogue, operation and service manual are to be provided. Spare materials shall be supplied as per approved model/design. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

2. Kumarkhali 132/33kV AIS Substation

The scope of work under this turnkey Bid is design, supply, delivery, installation, testing & commissioning of a new Air Insulated Switchgear (AIS) substation. The configuration of the 132kV busbar shall be double Busbar scheme.

The scope of work also includes associated control, protection, fiber optic multiplexer equipment for communication & protection, substation automation, digital fault & disturbance recorder (DFDR), station power facilities, including towers and gantry structures, a new two storied Main Control Room Building in 132kV switchyard to accommodate protection and control IED and associated equipment, local control kiosks, 33kV tertiary equipment, cable trenches, water supply & sewerage, fences, access road & internal roads, security guard stations, and all other necessary substation facilities and supply of mandatory spare parts and maintenance & special tools.

132kV Air Insulated Switchgears (AIS)

New 132kV AIS switchyard for four 132kV line bays to connect Line in-out of existing 132kV Bheramara-Rajbari double circuit overhead line (Bheramara 1 & 2, Rajbari 1 & 2);Two 132kV transformer bays for HV side of two 132/33kV transformer; two 33kV transformer bays for LV

side of two 132/33kV transformer; one 132kV bus-coupler bay; additional bus skeleton, gantry column and beam including earth mat shall be made for future extension of three overhead 132kV line/ transformer bays.

33kV Air Insulated Switches and Connection

New 33kV AIS switchyard and switches for 132/33kV LV side / incomer connection and station power service facilities;

Incomer side connection between 33kV terminal to 33kV Bus including switches, necessary fittings, structures, conductors for 132/33 transformers. 33KV Bus skeleton shall be built for eight (08) nos of 33KV bays including incomer bays. The auxiliary transformers shall be connected to the LV side of two new 132/33kV three phase transformers.

132/33kV three phase 3 phase transformer

Two 132/33kV 50/75 MVA three phase transformers.

33/0.415kV earthing/auxiliary transformer

Two 33/0.415kV, 300kVA, outdoor type earthing/auxiliary transformers to supply the substation auxiliary loads. The auxiliary transformer shall be connected to the LV side of two new 132/33kV three phase transformers.

Control, Protection, Substation Automation, Metering & DFDR

Associated local & Remote control panel, metering panel, protection equipment, synchronizing scheme and substation automation system (SAS) & DFDR for complete substation. Monitoring of status of Bus PT & Bus ES need to be included in the SAS. Necessary works to be performed so that Air temperature in the control room can be controlled and monitored through SAS. RTCC, LVAC, LVDC, Tariff metering panel & other panel shall be monitored by SAS.

Fibre Optic Multiplexer Equipment for Communication and Protection

Indoor type Fibre Optic Multiplexer Equipment for protection & communication.

DC and LVAC System

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board.

Civil Works, Building and Foundation

Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

Complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit; approach, entrance & internal roads; cable trenches, septic tank, surfacing, drainage, fences, guard house including earthing & lightning protection, switchyard lighting, etc.

Complete design, supply and construction of all civil items including all necessary architecture & structural requirements; cable trays, fittings and flooring & finishes; air-conditioning and lighting for a new two storied Main Control Room Building.

SCADA system for Telecontrol and Telemetry

Complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Dispatch Center (NLDC) at Rampura for integration of complete new 132/33 kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC are to be carried out.

Mandatory Spare parts including Maintenance Equipment

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

3. Matlab North 132/33kV AIS Substation

The scope of work under this turnkey Bid is design, supply, delivery, installation, testing & commissioning of a new Air Insulated Switchgear (AIS) substation. The configuration of the 132kV busbar shall be double Busbar scheme.

The scope of work also includes associated control, protection, fiber optic multiplexer equipment for communication & protection, substation automation, digital fault & disturbance recorder (DFDR), station power facilities, including towers and gantry structures, a new two storied Main Control Room Building in 132kV switchyard to accommodate protection and

control IED and associated equipment, local control kiosks, 33kV tertiary equipment, cable trenches, water supply & sewerage, fences, access road & internal roads, security guard stations, and all other necessary substation facilities and supply of mandatory spare parts and maintenance & special tools.

132kV Air Insulated Switchgears (AIS)

New 132kV AIS switchyard for two 132kV line bays to connect Kachua 132/33kV AIS Substation (Kachua 1 & 2);Two 132kV transformer bays for HV side of two 132/33kV transformer; two 33kV transformer bays for LV side of two 132/33kV transformer; one 132kV bus-coupler bay; additional bus skeleton, gantry column and beam including earth mat shall be made for future extension of three overhead 132kV line/ transformer bays.

33kV Air Insulated Switches and Connection

New 33kV AIS switchyard and switches for 132/33kV LV side / incomer connection and station power service facilities;

Incomer side connection between 33kV terminal to 33kV Bus including switches, necessary fittings, structures, conductors for 132/33 transformers. 33KV Bus skeleton shall be built for eight (08) nos of 33KV bays including incomer bays. The auxiliary transformers shall be connected to the LV side of two new 132/33kV three phase transformers.

132/33kV three phase 3 phase transformer

Two 132/33kV 50/75 MVA three phase transformers.

33/0.415kV earthing/auxiliary transformer

Two 33/0.415kV, 300kVA, outdoor type earthing/auxiliary transformers to supply the substation auxiliary loads. The auxiliary transformer shall be connected to the LV side of two new 132/33kV three phase transformers.

Control, Protection, Substation Automation, Metering & DFDR

Associated local & Remote control panel, metering panel, protection equipment, synchronizing scheme and substation automation system (SAS) & DFDR for complete substation. Monitoring of status of Bus PT & Bus ES need to be included in the SAS. Necessary works to be performed so that Air temperature in the control room can be controlled and monitored through SAS. RTCC, LVAC, LVDC, Tariff metering panel & other panel shall be monitored by SAS.

Fibre Optic Multiplexer Equipment for Communication and Protection

Indoor type Fibre Optic Multiplexer Equipment for protection & communication.

DC and LVAC System

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board.

Civil Works, Building and Foundation

Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

Complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit; approach, entrance & internal roads; cable trenches, septic tank, surfacing, drainage, fences, guard house including earthing & lightning protection, switchyard lighting, etc.

Complete design, supply and construction of all civil items including all necessary architecture & structural requirements; cable trays, fittings and flooring & finishes; air-conditioning and lighting for a new two storied Main Control Room Building.

SCADA system for Telecontrol and Telemetry

Complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Dispatch Center (NLDC) at Rampura for integration of complete new 132/33 kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC are to be carried out.

Mandatory Spare parts including Maintenance Equipment

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

4. Chatkhil 132/33kV AIS Substation

The scope of work under this turnkey Bid is design, supply, delivery, installation, testing & commissioning of a new Air Insulated Switchgear (AIS) substation. The configuration of the 132kV busbar shall be double Busbar scheme.

The scope of work also includes associated control, protection, fiber optic multiplexer equipment for communication & protection, substation automation, digital fault & disturbance recorder (DFDR), station power facilities, including towers and gantry structures, a new two storied Main Control Room Building in 132kV switchyard to accommodate protection and control IED and associated equipment, local control kiosks, 33kV tertiary equipment, cable trenches, water supply & sewerage, fences, access road & internal roads, security guard stations, and all other necessary substation facilities and supply of mandatory spare parts and maintenance & special tools.

132kV Air Insulated Switchgears (AIS)

New 132kV AIS switchyard for four 132kV line bays to connect Line in-out of existing 132kV Choumuhani-Ramganj double circuit overhead line (Choumuhani 1 & 2, Ramganj 1 & 2);Two 132kV transformer bays for HV side of two 132/33kV transformer; two 33kV transformer bays for LV side of two 132/33kV transformer; one 132kV bus-coupler bay; additional bus skeleton, gantry column and beam including earth mat shall be made for future extension of three overhead 132kV line/ transformer bays.

33kV Air Insulated Switches and Connection

New 33kV AIS switchyard and switches for 132/33kV LV side / incomer connection and station power service facilities;

Incomer side connection between 33kV terminal to 33kV Bus including switches, necessary fittings, structures, conductors for 132/33 transformers. 33KV Bus skeleton shall be built for eight (08) nos of 33KV bays including incomer bays. The auxiliary transformers shall be connected to the LV side of two new 132/33kV three phase transformers.

132/33kV three phase 3 phase transformer

Two 132/33kV 80/120 MVA three phase transformers.

33/0.415kV earthing/auxiliary transformer

Two 33/0.415kV, 300kVA, outdoor type earthing/auxiliary transformers to supply the substation auxiliary loads. The auxiliary transformer shall be connected to the LV side of two new 132/33kV three phase transformers.

Control, Protection, Substation Automation, Metering & DFDR

Associated local & Remote control panel, metering panel, protection equipment, synchronizing scheme and substation automation system (SAS) & DFDR for complete substation. Monitoring of status of Bus PT & Bus ES need to be included in the SAS. Necessary works to be performed so that Air temperature in the control room can be controlled and monitored through SAS. RTCC, LVAC, LVDC, Tariff metering panel & other panel shall be monitored by SAS.

Fibre Optic Multiplexer Equipment for Communication and Protection

Indoor type Fibre Optic Multiplexer Equipment for protection & communication.

DC and LVAC System

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board.

Civil Works, Building and Foundation

Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

Complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit; approach, entrance & internal roads; cable trenches, septic tank, surfacing, drainage, fences, guard house including earthing & lightning protection, switchyard lighting, etc.

Complete design, supply and construction of all civil items including all necessary architecture & structural requirements; cable trays, fittings and flooring & finishes; air-conditioning and lighting for a new two storied Main Control Room Building.

SCADA system for Telecontrol and Telemetry

Complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Dispatch Center (NLDC) at Rampura for integration of complete new 132/33 kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC are to be carried out.

Mandatory Spare parts including Maintenance Equipment

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

5. 132 kV Bay Extension at Kachua Substation:

The scope of work under this turnkey Bid is design, supply, delivery, installation, testing & commissioning of two (02) new outdoor type 132KV AIS bay extension at existing 230/132kV Kachua Grid substation (Matlab North 1 & 2).

132kV Switchyard (Double Busbar scheme)

Two 132kV line bays to connect Matlab North 132/33KV Sub-station

The scope of work also includes associated control, protection, fibre optic multiplexer equipment for communication & protection, substation automation, SCADA integration, station power facilities, and associated civil works for accommodating protection and control IEDs and associated equipment, outdoor switchyards, cable trenches, water supply & sewerage, security wall, access road & internal roads, etc.

The “Schedule of Requirements” for equipment, materials and services and the detailed technical specifications of equipment and materials of the Bidding Document shall be read in conjunction with the scope of work described herein. The drawings provided in the Bidding Document are indicative only and hence the entire scope of work is not fully reflected in those drawings.

In addition, the scope of work of this contract includes:

Redesign, relocation, modification and reconnection and testing of the two (2) existing 132 kV overhead line bay (Comilla South & Comilla North) for connection of the new 132kV Matlab (N)-1 & Matlab (N)-2 double circuit line. The existing 132KV Comilla South & Comilla North circuit shall be connected with two (2) new 132 kV bays.

The existing Comilla-Kachua 132kV TL shall be terminated at new gantry from new Terminal Tower. Shifting of the Comilla-Kachua TL, necessary bypass, new tower installation and existing tower dismantling etc. shall be in the scope of this contract.

Dismantling of existing structure and road in the area of scope is also included.

6. O & M training for new substations:

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

Local Training: On-site instruction by the manufacturer's engineer on operations and maintenance of the (i) HV switchgears & transformers (ii) protection & Substation automation system (iii) fiber optic multiplexer. Each program shall be arranged for a period of two (2) weeks and for fifteen (15) PGCB engineers.

For on-site instruction training, the contractor shall not be responsible for any costs for trainees except meal and the aforementioned onsite training shall have to be arranged at any Substation's respective local Grid Circle or GMD area with the consultation of Superintending Engineer, Grid Circle, PGCB.

For Transformer & HV substation training, the trainer shall have experience of at least 400kV Class, 520MVA Substation & transformer design experience for at least 5 years. For other training, the trainer shall have experience of related field experience for at least 5 years. The CV of proposed trainers shall be submitted to the employer & taken approval during execution. If the proposed trainer does not meet the minimum requirements mentioned here, the Employer shall preserve the right to ask the contractor to change the trainer as per requirement. All the trainers shall be certified by OEM.

The Contractor shall have to submit the Schedule of each Training and take approval from the Employer prior 3 months before conducting each Training.

7. Factory acceptance tests:

The Contract Price shall include all costs of factory acceptance tests at the manufacturers' works and the instruction of staff on site for the following:

SL	Description
1.	Transformers
2.	Circuit Breaker
3.	Disconnecter
4.	Instrument Transformer (PT)
5.	Instrument Transformer (CT)
6.	Lightning Arrester
7.	Control, protection & SAS
8.	DC system
9.	Communication

The Contractor shall have to submit the Schedule and factory acceptance test format of each stated above and take approval from the Employer prior 3 months before conducting each factory acceptance test.

SCHEDULE A

REQUIREMENTS

Section-I Dhupchanchia 132/33kV AIS Substation

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

Item	Description
1C	145kV Air Insulated Switchgear (AIS)
1C1	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for Transformer bay).
1C2	Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, single-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for T/L bay).
1C3	One (1) set of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for bus coupler).
1C4	Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors without earthing switch (for Transformer bay).
1C5	Eight (8) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor-operated disconnectors without earthing switch (for T/L bay).

- 1C6 Two (2) sets of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for bus coupler).
- 1C7 Six (6) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for T/L bay).
- 1C8 Six (6) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Transformer bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 1C9 Twelve (12) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Line bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 1C10 Three (3) nos. of single-phase,145kV, 40kA/1sec, 50Hz, 650kVp BIL, post-type current transformer for bus coupler bay.
145kV, 40kA/1sec single phase, 4-core, current transformer with cores as follows:
- 3000-1500/1A, class 0.2S, 15VA for measuring, BCU
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class 5P20, 30-60VA for Protection
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]

- 1C11 Twenty Four (24) nos. of single-phase, 3-core, 132/ $\sqrt{3}$ / 110/ $\sqrt{3}$ / 110/ $\sqrt{3}$ / 110/ $\sqrt{3}$ kV/V/V/V, 3P/3P/0.2, 20-50/20-50/10-20 VA 145kV, 40kA/1sec, 50Hz, 650kVp BIL, inductive type voltage transformers.
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 1C12 Eighteen (18) nos. of 120kV rated voltage, 102kV(rms) continuous operating voltage at 50⁰c, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.
- 1C13 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 145kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
- 1C14 One (1) lot of steel structures for gantry and equipment supports required for completing 145kV busbar and switchgear as specified in the technical specifications and bid drawings.
- 1D 36kV AIS Switches and Connection**
- 1D1 36kV Switches and Connection for Auxiliary Transformers**
- 1D1.1 Deleted
- 1D1.2 Two (2) sets of 36kV, 800A, 31.5 kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with dropout fuse.
- 1D2 36kV Switches & connection for Incomer/ LV side of 132/33 kV Transformer**
- 1D2.1 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, SF6/vacuum circuit breakers with spring-stored energy operating mechanism
- 1D2.2 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors.
- 1D2.3 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with motor-operated earthing switch.
- 1D2.4 Twelve (12) nos. of single-phase, 2-core, 33/ $\sqrt{3}$ / 110/ $\sqrt{3}$ / 110/ $\sqrt{3}$ kV/V/V/V, 3P/0.2, 20-50/10-20VA 36kV, 31.5kA/1 sec, 50Hz, 170kVp BIL, inductive type voltage transformers.

[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]

- 1D2.5 Six (6) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arresters.
- 1D2.6 One (1) lot of LV side connection between 36kV terminal of 132/33 kV transformer to 36 kV switchyard including necessary fittings, structures and conductors. Gantry Structure of 36 kV shall be considered for 8 (eight) nos. feeder including incomer and each bay width shall be 6(six) meter. Whole bus and Bus sectionalizer DS of rating 3000A shall be considered.
- 1D2.7 Six (6) nos. of 36kV, 31.5 kA/1 sec, 50Hz, 170kVp BIL, post type current transformer.
2400-1600-800/1A, Class 5P20, 30VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 1D2.8 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 36kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
- 1D2.9 One (1) lot of steel structures for gantry and equipment supports required for completing 36kV busbar and switchgear as specified in the technical specifications and bid drawings.

1E Power Transformers & Earthing/Auxiliary Transformers

- 1E1 Two (2) sets of 132/33 kV, 50/75 MVA (ONAN/ONAF), three phase outdoor type power transformers.
- 1E2 Two (2) sets 33/0.415 kV, 300kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers associated with Bushing & outdoor neutral CTs and steel support structures including all necessary connections.

1F Control, Protection, Monitoring, Substation Automation & Metering

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-

145 kV Circuits

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of :-

- 1F1 Control, Protection & Monitoring including BCU for four (4) sets of overhead line circuits bays.
- 1F2 Control, Protection & Monitoring including BCU for two (2) sets of 132/33 kV power transformer circuits.
- 1F3 Complete Control, Protection & Monitoring including BCU for bus coupler circuit.
- 1F4 Complete Busbar protection for 132kV system
- 1F5 Complete Independent standalone Digital Fault and Disturbance recorder (DFDR) with PMU functionality to monitor 132kV bays and 33kV incomer bays. Engineering workstation shall be supplied. DFDR should be integrated with central client station. The Engineering workstation PCs shall have minimum configuration of core i7(latest generation), 16GB RAM, 1TB SSD with RAID1, and 27' display.
- 1F6 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 132 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.
- 1F7 Two (2) sets of SAS System including Operator Workstations and related software with all licenses (shall be perpetual and sufficient for all future bays), Necessary Ethernet switches and GPS for the SAS system, 55 inch LED Monitor, Color Laser Printers, Common alarm unit with hooter/buzzer, BCU for all common signals of the substation.

Additional 05 (five) No.'s of BCU for controlling 05 (five) No's of 33kV Load Shed Feeders shall be supplied. All five BCUs with required I/O shall be placed in one panel tested with SAS, NLDC . One (1) set of Engineering Workstation and all engineering software with licenses (shall not be time bound) shall be supplied. Two nos. 3KVA Inverter (as shown in LVAC and DCDB drawing) for the SAS system shall be included in the scope. The Engineering/Workstation PCs shall

have minimum configuration of core i7(latest generation), minimum clock speed of 3.4 GHz,16GB RAM, 1TB SSD with RAID1, and 27' displays.

- 1F8 Two (2) sets of Complete RTCC systems including transformer tap changer control, fan control & AVR as per 4.15(N) of section 4 in volume 2 of 3.

36kV Circuit

- 1F9 Deleted

- 1F10 Two (2) sets of Control, Protection & Monitoring including BCU for two 33kV circuits connected to the LV side of 132/33kV Power transformers. 33 kV DS with dropout fuse for Auxiliary Transformer shall be added in the control panel including mimic.

- 1F11 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 33 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Space provision for another meter shall be kept in metering panel. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.

1G Multicore Cables

- 1G1 One (1) lot complete set of multicore low voltage XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, landed, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided. Necessary Sizing calculation shall have to be submitted for approval during the execution stage. The Bidder may use a fully computerized system for rating, and routing of cables,

1H Earthing and Lightning Protection

- 1H1 One (1) lot of design, supply and installation of earthing system for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this contract arrangement. Calculation and GPR shall have to be shown using software like CYMGRD.

1H2 One (1) lot of design, supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in the Rolling Sphere method.

1I Batteries, Chargers and DC Distribution

1I1 110V substation Nickel Cadmium (NiCd) batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment being supplied.

The system shall generally be as shown in bid drawing and shall include:

a) 132KV System:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 300Ah, M-Class, at the 5-hour rate of discharge for 132kV system.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii)Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC.for 132kV system.

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future use.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

1I2 48V DC system and distribution equipment to be supplied, installed and commissioned in the main control building for the new fiber optic multiplexer equipment for communication and protection. One set shall be used as standby supply. 48V DC system and distribution equipment shall be located in the Main Control Building.

The system shall generally be as shown in bid drawing and shall include:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 250Ah, L-Class, at the 5-hour rate of discharge for communication and protection.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii) Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC..

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future extension.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

1J LVAC Distribution

1J1 One (1) lot of LVAC switchboard for substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey Bid.

All AC status including control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in the substation automation system.

The requirements shall generally be as shown in Bid drawing and technical specification of Volume 2 and shall include two nos. of 125A outdoor weather-proof 3-phase with neutral & earth switched socket outlet and plug as per IEC 309; to be installed, cabled (120sqmm xlpe cu) and connected adjacent to the both type of Power Transformer and shall be connected from auxiliary transformers with required size of MCCB and cable.

1J2 One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for two 33/0.415 kV station auxiliary transformer feeder circuits. For

each feeder minimum two meters (main & check) shall have to be supplied. Tariff meter shall be made of BPDB approved.

- 1J3 One (1) lot of Power Factor Correction Plant. PFI plant shall be designed as per attached drawing and capacity of PFI plant shall be not less than 2X40KVAR. (KVAR=2X16% of each Aux Transformer Capacity or KVAR=2X60% of connected load in each 415V bus including future load)

1K Civil Works, Building and Foundation

- 1K1 Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.
- 1K2 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches, septic tank, surfacing, drainage, fences, guard house, boundary wall, gravel laying, sentry post, ansar barrack etc.
- 1K3 One (1) lot of complete design, supply and construction of all civil items and facilities required for a new two storied Main Control Room Building, one (1) nos one storied switchyard panel room in 132kV switchyard.
- 1K4 Testing of pile Foundation, Compression & uplift on random basis.
- 1K5 One (1) lot of complete design, supply and construction of firefighting system for transformers including water pipe network and reservoir at normal pressure. Necessary Sizing calculation shall have to be submitted for approval during the execution stage.

1L Lighting, Small Power, Air Conditioning and Ventilation

- 1L1 One (1) lot of complete design, supply, installation and commissioning of equipment to provide lighting, LV power supply, air conditioning system, ventilation system and emergency DC lighting system for the main control building. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage except for the air conditioning system.

Minimum requirement of air conditioning system capacity shall be 50 Ton. Each air conditioner unit for the control room shall not be less than 5 Ton and for other rooms (Office/archive/prayer) shall not be less than 2 Ton. **The air conditioning system shall be of industrial grade, cassette type and inverter system.**

Such Provision shall be made available that the Air Conditioning Device shall be remotely monitored & controlled. (vol 2 sec 13.30).

- 1L2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting for security, roadway (internal and approach road), switchyard and emergency DC lighting system at strategic locations for equipment operation and inspection. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage.
- 1L3 One (1) lot of Complete Solar system (10KW AC output) with inverter & changeover facilities including other accessories for substation use. The solar system shall be grid tied, net-metering and installed at the rooftop of the control building.
- 1L4 One (1) lot of complete CCTV Camera system for control building, switchgear area, and other area to monitor full substation with NVR and other required accessories.

1M Fibre Optic Multiplexer Equipment for Communication and Protection

The equipment to be supplied, installed and commissioned shall be as shown on bid drawing.

- 1M1 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system is to be provided for:
- 87 or 21 relay (main and back-up) for each transmission line protection
 - 21 relay tele-protection signal (main1 and main2/back-up)
 - SCADA data from switchgear and control system
 - Hot-line telephone system
 - IP Telephony
- 1M2 Underground optical fibre cables (48 cores 132kV switchyard) from terminal box gantry structure at each 132kV double circuit transmission line termination point to MDF /ODF (Main/Optical distribution Frame) to be installed in the control room. The Contract includes supply and installation of MDF/ODF and pigtail cables with adequate length.
- 1M3 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system for all remote end substations. All existing services shall be replaced with the new multiplexer equipment including teleprotection services. Existing multiplexer equipment shall be removed and handed over to the respective department.

1N SCADA system for Telecontrol and Telemetry

- 1N.1 One (1) lot of complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC and BNLDC) at Rampura and Shiddirganj for integration of complete new 132/33kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC & BNLDC are to be carried out.

Section II Kumarkhali 132/33kV AIS Substation

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

Item	Description
2C	145kV Air Insulated Switchgear (AIS)
2C1	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for Transformer bay).
2C2	Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, single-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for T/L bay).
2C3	One (1) set of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for bus coupler).
2C4	Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors without earthing switch (for Transformer bay).

- 2C5 Eight (8) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor-operated disconnectors without earthing switch (for T/L bay).
- 2C6 Two (2) sets of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for bus coupler).
- 2C7 Six (6) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for T/L bay).
- 2C8 Six (6) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Transformer bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 2C9 Twelve (12) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Line bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 2C10 Three (3) nos. of single-phase,145kV, 40kA/1sec, 50Hz, 650kVp BIL, post-type current transformer for bus coupler bay.
145kV, 40kA/1sec single phase, 4-core, current transformer with cores as follows:
- 3000-1500/1A, class 0.2S, 15VA for measuring, BCU
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class PX, for Busbar Differential Protection

- 3000-1500/1A, class 5P20, 30-60VA for Protection

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

2C11 Twenty Four (24) nos. of single-phase, 3-core, 132/√3 / 110/√3 / 110/√3 / 110/√3 kV/V/V/V, 3P/3P/0.2, 20-50/20-50/10-20 VA 145kV, 40kA/1sec, 50Hz, 650kVp BIL, inductive type voltage transformers.

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

2C12 Eighteen (18) nos. of 120kV rated voltage, 102kV(rms) continuous operating voltage at 50°C, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.

2C13 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 145kV busbar and switchgear connection as specified in the technical specifications and bid drawings.

2C14 One (1) lot of steel structures for gantry and equipment supports required for completing 145kV busbar and switchgear as specified in the technical specifications and bid drawings.

2D 36kV AIS Switches and Connection

2D1 36kV Switches and Connection for Auxiliary Transformers

2D1.1 Deleted

2D1.2 Two (2) sets of 36kV, 800A, 31.5 kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with dropout fuse.

2D2 36kV Switches & connection for Incomer/ LV side of 132/33 kV Transformer

2D2.1 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, SF6/vacuum circuit breakers with spring-stored energy operating mechanism

2D2.2 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors.

2D2.3 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with motor-operated earthing switch.

- 2D2.4 Twelve (12) nos. of single-phase, 2-core, $33/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V, 3P/0.2, 20-50/10-20VA 36kV, 31.5kA/1 sec, 50Hz, 170kVp BIL, inductive type voltage transformers.
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 2D2.5 Six (6) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arresters.
- 2D2.6 One (1) lot of LV side connection between 36kV terminal of 132/33 kV transformer to 36 kV switchyard including necessary fittings, structures and conductors. Gantry Structure of 36 kV shall be considered for 8 (eight) nos. feeder including incomer and each bay width shall be 6(six) meter. Whole bus and Bus sectionalizer DS of rating 3000A shall be considered.
- 2D2.7 Six (6) nos. of 36kV, 31.5 kA/1 sec, 50Hz, 170kVp BIL, post type current transformer.
2400-1600-800/1A, Class 5P20, 30VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 2D2.8 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 36kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
- 2D2.9 One (1) lot of steel structures for gantry and equipment supports required for completing 36kV busbar and switchgear as specified in the technical specifications and bid drawings.

2E Power Transformers & Earthing/Auxiliary Transformers

- 2E1 Two (2) sets of 132/33 kV, 50/75 MVA (ONAN/ONAF), three phase outdoor type power transformers.
- 2E2 Two (2) sets 33/0.415 kV, 300kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers associated with Bushing & outdoor neutral CTs and steel support structures including all necessary connections.

2F Control, Protection, Monitoring, Substation Automation & Metering

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-

145 kV Circuits

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of :-

- 2F1 Control, Protection & Monitoring including BCU for four (4) sets of overhead line circuits bays.
- 2F2 Control, Protection & Monitoring including BCU for two (2) sets of 132/33 kV power transformer circuits.
- 2F3 Complete Control, Protection & Monitoring including BCU for bus coupler circuit.
- 2F4 Complete Busbar protection for 132kV system
- 2F5 Complete Independent standalone Digital Fault and Disturbance recorder (DFDR) with PMU functionality to monitor 132kV bays and 33kV incomer bays. Engineering workstation shall be supplied. DFDR should be integrated with central client station. The Engineering workstation PCs shall have minimum configuration of core i7(latest generation), 16GB RAM, 1TB SSD with RAID1, and 27' display.
- 2F6 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 132 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.
- 2F7 Two (2) sets of SAS System including Operator Workstations and related software with all licenses (shall be perpetual and sufficient for all future bays), Necessary Ethernet switches and GPS for the SAS system, 55 inch LED Monitor, Color Laser Printers, Common alarm unit with hooter/buzzer, BCU for all common signals of the substation.

Additional 05 (five) No.'s of BCU for controlling 05 (five) No's of 33kV Load Shed Feeders shall be supplied. All five BCUs with required I/O shall be placed in one panel tested with SAS, NLDC . One (1) set of Engineering Workstation and all

engineering software with licenses (shall not be time bound) shall be supplied. Two nos. 3KVA Inverter (as shown in LVAC and DCDB drawing) for the SAS system shall be included in the scope. The Engineering/Workstation PCs shall have minimum configuration of core i7(latest generation), minimum clock speed of 3.4 GHz,16GB RAM, 1TB SSD with RAID1, and 27' displays.

- 2F8 Two (2) sets of Complete RTCC systems including transformer tap changer control, fan control & AVR as per 4.15(N) of section 4 in volume 2 of 3.

36kV Circuit

- 2F9 Deleted
- 2F10 Two (2) sets of Control, Protection & Monitoring including BCU for two 33kV circuits connected to the LV side of 132/33kV Power transformers. 33 kV DS with dropout fuse for Auxiliary Transformer shall be added in the control panel including mimic.
- 2F11 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 33 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Space provision for another meter shall be kept in metering panel. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.

2G Multicore Cables

- 2G1 One (1) lot complete set of multicore low voltage XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, landed, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided. Necessary Sizing calculation shall have to be submitted for approval during the execution stage. The Bidder may use a fully computerized system for rating, and routing of cables,

2H Earthing and Lightning Protection

2H1 One (1) lot of design, supply and installation of earthing system for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this contract arrangement. Calculation and GPR shall have to be shown using software like CYMGRD.

2H2 One (1) lot of design, supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in the Rolling Sphere method.

2I Batteries, Chargers and DC Distribution

2I1 110V substation Nickel Cadmium (NiCd) batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment being supplied.

The system shall generally be as shown in bid drawing and shall include:

a) 132KV System:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 300Ah, M-Class, at the 5-hour rate of discharge for 132kV system.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii)Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC.for 132kV system.

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future use.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

2I2 48V DC system and distribution equipment to be supplied, installed and commissioned in the main control building for the new fiber optic multiplexer

equipment for communication and protection. One set shall be used as standby supply. 48V DC system and distribution equipment shall be located in the Main Control Building.

The system shall generally be as shown in bid drawing and shall include:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 250Ah, L-Class, at the 5-hour rate of discharge for communication and protection.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii) Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC..

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future extension.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

2J LVAC Distribution

2J1 One (1) lot of LVAC switchboard for substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey Bid.

All AC status including control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in the substation automation system.

The requirements shall generally be as shown in Bid drawing and technical specification of Volume 2 and shall include two nos. of 125A outdoor weather-proof 3-phase with neutral & earth switched socket outlet and plug as per IEC 309; to be installed, cabled (120sqmm xlpe cu) and connected adjacent to the both type of Power Transformer and shall be connected from auxiliary transformers with required size of MCCB and cable.

2J2 One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for two 33/0.415 kV station auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check) shall have to be supplied. Tariff meter shall be made of BPDB approved.

2J3 One (1) lot of Power Factor Correction Plant. PFI plant shall be designed as per attached drawing and capacity of PFI plant shall be not less than 2X40KVAR. (KVAR=2X16% of each Aux Transformer Capacity or KVAR=2X60% of connected load in each 415V bus including future load)

2K Civil Works, Building and Foundation

2K1 Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

2K2 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches, septic tank, surfacing, drainage, fences, guard house, boundary wall, gravel laying, sentry post, ansar barrack etc.

2K3 One (1) lot of complete design, supply and construction of all civil items and facilities required for a new two storied Main Control Room Building, one (1) nos one storied switchyard panel room in 132kV switchyard.

2K4 Testing of pile Foundation, Compression & uplift on random basis.

2K5 One (1) lot of complete design, supply and construction of firefighting system for transformers including water pipe network and reservoir at normal pressure. Necessary Sizing calculation shall have to be submitted for approval during the execution stage.

2L Lighting, Small Power, Air Conditioning and Ventilation

2L1 One (1) lot of complete design, supply, installation and commissioning of equipment to provide lighting, LV power supply, air conditioning system, ventilation system and emergency DC lighting system for the main control building. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage except for the air conditioning system.

Minimum requirement of air conditioning system capacity shall be 50 Ton. Each air conditioner unit for the control room shall not be less than 5 Ton and for other

rooms (Office/archive/prayer) shall not be less than 2 Ton. **The air conditioning system shall be of industrial grade, cassette type and inverter system. Such Provision shall be made available that the Air Conditioning Device shall be remotely monitored & controlled. (vol 2 sec 13.30).**

2L2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting for security, roadway (internal and approach road), switchyard and emergency DC lighting system at strategic locations for equipment operation and inspection. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage.

2L3 One (1) lot of Complete Solar system (10KW AC output) with inverter & changeover facilities including other accessories for substation use. The solar system shall be grid tied, net-metering and installed at the rooftop of the control building.

2L4 One (1) lot of complete CCTV Camera system for control building, switchgear area, and other area to monitor full substation with NVR and other required accessories.

2M Fibre Optic Multiplexer Equipment for Communication and Protection

The equipment to be supplied, installed and commissioned shall be as shown on bid drawing.

2M1 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system is to be provided for:

- 87 or 21 relay (main and back-up) for each transmission line protection
- 21 relay tele-protection signal (main1 and main2/back-up)
- SCADA data from switchgear and control system
- Hot-line telephone system
- IP Telephony

2M2 Underground optical fibre cables (48 cores 132kV switchyard) from terminal box gantry structure at each 132kV double circuit transmission line termination point to MDF /ODF (Main/Optical distribution Frame) to be installed in the control room. The Contract includes supply and installation of MDF/ODF and pigtail cables with adequate length.

2M3 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system for all remote end substations. All existing services shall be replaced with

the new multiplexer equipment including teleprotection services. Existing multiplexer equipment shall be removed and handed over to the respective department.

2N SCADA system for Telecontrol and Telemetry

- 2N.1 One (1) lot of complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC and BNLDC) at Rampura and Shiddirganj for integration of complete new 132/33kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC & BNLDC are to be carried out.

Section-III Matlab North 132/33kV AIS Substation

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

Item	Description
3C	145kV Air Insulated Switchgear (AIS)
3C1	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for Transformer bay).
3C2	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, single-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for T/L bay).
3C3	One (1) set of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for bus coupler).

- 3C4 Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors without earthing switch (for Transformer bay).
- 3C5 Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor-operated disconnectors without earthing switch (for T/L bay).
- 3C6 Two (2) sets of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for bus coupler).
- 3C7 Four (4) of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for T/L bay).
- 3C8 Six (6) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Transformer bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 3C9 Six (6) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Line bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 3C10 Three (3) nos. of single-phase,145kV, 40kA/1sec, 50Hz, 650kVp BIL, post-type current transformer for bus coupler bay.
145kV, 40kA/1sec single phase, 4-core, current transformer with cores as follows:

- 3000-1500/1A, class 0.2S, 15VA for measuring, BCU
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class 5P20, 30-60VA for Protection

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

3C11 Eighteen (18) nos. of single-phase, 3-core, $132/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V/V, 3P/3P/0.2, 20-50/20-50/10-20 VA 145kV, 40kA/1sec, 50Hz, 650kVp BIL, inductive type voltage transformers.

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

3C12 Twelve (12) nos. of 120kV rated voltage, 102kV(rms) continuous operating voltage at 50°C, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.

3C13 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 145kV busbar and switchgear connection as specified in the technical specifications and bid drawings.

3C14 One (1) lot of steel structures for gantry and equipment supports required for completing 145kV busbar and switchgear as specified in the technical specifications and bid drawings.

3D 36kV AIS Switches and Connection

3D1 36kV Switches and Connection for Auxiliary Transformers

3D1.1 Deleted

3D1.2 Two (2) sets of 36kV, 800A, 31.5 kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with dropout fuse.

3D2 36kV Switches & connection for Incomer/ LV side of 132/33 kV Transformer

3D2.1 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, SF6/vacuum circuit breakers with spring-stored energy operating mechanism

3D2.2 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors.

- 3D2.3 Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with motor-operated earthing switch.
- 3D2.4 Twelve (12) nos. of single-phase, 2-core, $33/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V, 3P/0.2, 20-50/10-20VA 36kV, 31.5kA/1 sec, 50Hz, 170kVp BIL, inductive type voltage transformers.
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 3D2.5 Six (6) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arresters.
- 3D2.6 One (1) lot of LV side connection between 36kV terminal of 132/33 kV transformer to 36 kV switchyard including necessary fittings, structures and conductors. Gantry Structure of 36 kV shall be considered for 8 (eight) nos. feeder including incomer and each bay width shall be 6(six) meter. Whole bus and Bus sectionalizer DS of rating 3000A shall be considered.
- 3D2.7 Six (6) nos. of 36kV, 31.5 kA/1 sec, 50Hz, 170kVp BIL, post type current transformer.
2400-1600-800/1A, Class 5P20, 30VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 3D2.8 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 36kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
- 3D2.9 One (1) lot of steel structures for gantry and equipment supports required for completing 36kV busbar and switchgear as specified in the technical specifications and bid drawings.

3E Power Transformers & Earthing/Auxiliary Transformers

- 3E1 Two (2) sets of 132/33 kV, 50/75 MVA (ONAN/ONAF), three phase outdoor type power transformers.

3E2 Two (2) sets 33/0.415 kV, 300kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers associated with Bushing & outdoor neutral CTs and steel support structures including all necessary connections.

3F Control, Protection, Monitoring, Substation Automation & Metering

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-

145 kV Circuits

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of :-

- 3F1 Control, Protection & Monitoring including BCU for two (2) sets of overhead line circuits bays.
- 3F2 Control, Protection & Monitoring including BCU for two (2) sets of 132/33 kV power transformer circuits.
- 3F3 Complete Control, Protection & Monitoring including BCU for bus coupler circuit.
- 3F4 Complete Busbar protection for 132kV system
- 3F5 Complete Independent standalone Digital Fault and Disturbance recorder (DFDR) with PMU functionality to monitor 132kV bays and 33kV incomer bays. Engineering workstation shall be supplied. DFDR should be integrated with central client station. The Engineering workstation PCs shall have minimum configuration of core i7(latest generation), 16GB RAM, 1TB SSD with RAID1, and 27' display.
- 3F6 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for each 132 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.
- 3F7 Two (2) sets of SAS System including Operator Workstations and related software with all licenses (shall be perpetual and sufficient for all future bays), Necessary Ethernet switches and GPS for the SAS system, 55 inch LED

Monitor, Color Laser Printers, Common alarm unit with hooter/buzzer, BCU for all common signals of the substation.

Additional 05 (five) No.'s of BCU for controlling 05 (five) No's of 33kV Load Shed Feeders shall be supplied. All five BCUs with required I/O shall be placed in one panel tested with SAS, NLDC . One (1) set of Engineering Workstation and all engineering software with licenses (shall not be time bound) shall be supplied. Two nos. 3KVA Inverter (as shown in LVAC and DCDB drawing) for the SAS system shall be included in the scope. The Engineering/Workstation PCs shall have minimum configuration of core i7(latest generation), minimum clock speed of 3.4 GHz, 16GB RAM, 1TB SSD with RAID1, and 27' displays.

3F8 Two (2) sets of Complete RTCC systems including transformer tap changer control, fan control & AVR as per 4.15(N) of section 4 in volume 2 of 3.

36kV Circuit

3F9 Deleted

3F10 Two (2) sets of Control, Protection & Monitoring including BCU for two 33kV circuits connected to the LV side of 132/33kV Power transformers. 33 kV DS with dropout fuse for Auxiliary Transformer shall be added in the control panel including mimic.

3F11 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for each 33 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Space provision for another meter shall be kept in metering panel. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.

3G Multicore Cables

3G1 One (1) lot complete set of multicore low voltage XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, landed, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided. Necessary Sizing calculation shall have to be submitted for approval during the execution stage. The Bidder may use a fully computerized system for rating, and routing of cables,

3H Earthing and Lightning Protection

- 3H1 One (1) lot of design, supply and installation of earthing system for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this contract arrangement. Calculation and GPR shall have to be shown using software like CYMGRD.
- 3H2 One (1) lot of design, supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in the Rolling Sphere method.

3I Batteries, Chargers and DC Distribution

- 3I1 110V substation Nickel Cadmium (NiCd) batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment being supplied.

The system shall generally be as shown in bid drawing and shall include:

a) 132KV System:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 300Ah, M-Class, at the 5-hour rate of discharge for 132kV system.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii)Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC.for 132kV system.

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future use.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail

alarm etc.) control & protection shall be incorporated in the substation automation system.

- 3I2 48V DC system and distribution equipment to be supplied, installed and commissioned in the main control building for the new fiber optic multiplexer equipment for communication and protection. One set shall be used as standby supply. 48V DC system and distribution equipment shall be located in the Main Control Building.

The system shall generally be as shown in bid drawing and shall include:

- i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 250Ah, L-Class, at the 5-hour rate of discharge for communication and protection.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

- ii) Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC..

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

- iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future extension.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

3J LVAC Distribution

- 3J1 One (1) lot of LVAC switchboard for substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey Bid.

All AC status including control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in the substation automation system.

The requirements shall generally be as shown in Bid drawing and technical specification of Volume 2 and shall include two nos. of 125A outdoor weather-

proof 3-phase with neutral & earth switched socket outlet and plug as per IEC 309; to be installed, cabled (120sqmm xlpe cu) and connected adjacent to the both type of Power Transformer and shall be connected from auxiliary transformers with required size of MCCB and cable.

3J2 One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for two 33/0.415 kV station auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check) shall have to be supplied. Tariff meter shall be made of BPDB approved.

3J3 One (1) lot of Power Factor Correction Plant. PFI plant shall be designed as per attached drawing and capacity of PFI plant shall be not less than 2X40KVAR. (KVAR=2X16% of each Aux Transformer Capacity or KVAR=2X60% of connected load in each 415V bus including future load)

3K Civil Works, Building and Foundation

3K1 Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

3K2 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches, septic tank, surfacing, drainage, fences, guard house, boundary wall, gravel laying, sentry post, ansar barrack etc.

3K3 One (1) lot of complete design, supply and construction of all civil items and facilities required for a new two storied Main Control Room Building, one (1) nos one storied switchyard panel room in 132kV switchyard.

3K4 Testing of pile Foundation, Compression & uplift on random basis.

3K5 One (1) lot of complete design, supply and construction of firefighting system for transformers including water pipe network and reservoir at normal pressure. Necessary Sizing calculation shall have to be submitted for approval during the execution stage.

3L Lighting, Small Power, Air Conditioning and Ventilation

3L1 One (1) lot of complete design, supply, installation and commissioning of equipment to provide lighting, LV power supply, air conditioning system, ventilation system and emergency DC lighting system for the main control

building. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage except for the air conditioning system.

Minimum requirement of air conditioning system capacity shall be 50 Ton. Each air conditioner unit for the control room shall not be less than 5 Ton and for other rooms (Office/archive/prayer) shall not be less than 2 Ton. **The air conditioning system shall be of industrial grade, cassette type and inverter system. Such Provision shall be made available that the Air Conditioning Device shall be remotely monitored & controlled. (vol 2 sec 13.30).**

3L2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting for security, roadway (internal and approach road), switchyard and emergency DC lighting system at strategic locations for equipment operation and inspection. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage.

3L3 One (1) lot of Complete Solar system (10KW AC output) with inverter & changeover facilities including other accessories for substation use. The solar system shall be grid tied, net-metering and installed at the rooftop of the control building.

3L4 One (1) lot of complete CCTV Camera system for control building, switchgear area, and other area to monitor full substation with NVR and other required accessories.

3M Fibre Optic Multiplexer Equipment for Communication and Protection

The equipment to be supplied, installed and commissioned shall be as shown on bid drawing.

3M1 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system is to be provided for:

- 87 or 21 relay (main and back-up) for each transmission line protection
- 21 relay tele-protection signal (main1 and main2/back-up)
- SCADA data from switchgear and control system
- Hot-line telephone system
- IP Telephony

3M2 Underground optical fibre cables (48 cores 132kV switchyard) from terminal box gantry structure at each 132kV double circuit transmission line termination point to MDF /ODF (Main/Optical distribution Frame) to be installed in the control room.

The Contract includes supply and installation of MDF/ODF and pigtail cables with adequate length.

3M3 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system for all remote end substations. All existing services shall be replaced with the new multiplexer equipment including teleprotection services. Existing multiplexer equipment shall be removed and handed over to the respective department.

3N SCADA system for Telecontrol and Telemetry

3N.1 One (1) lot of complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC and BNLDC) at Rampura and Shiddirganj for integration of complete new 132/33kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC & BNLDC are to be carried out.

Section-IV Chatkhil 132/33kV AIS Substation

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

Item	Description
4C	145kV Air Insulated Switchgear (AIS)
4C1	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for Transformer bay).

- 4C2 Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, single-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for T/L bay).
- 4C3 One (1) set of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, gang operated, SF6 gas circuit breakers with spring-stored energy operating mechanism (for bus coupler).
- 4C4 Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors without earthing switch (for Transformer bay).
- 4C5 Eight (8) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor-operated disconnectors without earthing switch (for T/L bay).
- 4C6 Two (2) sets of 145kV, 3150A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for bus coupler).
- 4C7 Six (6) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post-type, motor-operated disconnectors with motor-operated earthing switch (for T/L bay).
- 4C8 Six (6) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Transformer bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU
2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 4C9 Twelve (12) nos. of single-phase, 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL, post type current transformer for Line bay.
145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows:
2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection
2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection,
2400-1600-800/1A, Class 0.2S,15VA for Metering 1
2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU

2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure
[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

4C10 Three (3) nos. of single-phase,145kV, 40kA/1sec, 50Hz, 650kVp BIL, post-type current transformer for bus coupler bay.
145kV, 40kA/1sec single phase, 4-core, current transformer with cores as follows:

- 3000-1500/1A, class 0.2S, 15VA for measuring, BCU
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class PX, for Busbar Differential Protection
- 3000-1500/1A, class 5P20, 30-60VA for Protection

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

4C11 Twenty Four (24) nos. of single-phase, 3-core, $132/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V/V, 3P/3P/0.2, 20-50/20-50/10-20 VA 145kV, 40kA/1sec, 50Hz, 650kVp BIL, inductive type voltage transformers.

[Actual Burden shall be finalized at execution time based on sizing calculation.
Accuracy & VA shall have to be defined for all ratio]

4C12 Eighteen (18) nos. of 120kV rated voltage, 102kV(rms) continuous operating voltage at 50⁰c, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.

4C13 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 145kV busbar and switchgear connection as specified in the technical specifications and bid drawings.

4C14 One (1) lot of steel structures for gantry and equipment supports required for completing 145kV busbar and switchgear as specified in the technical specifications and bid drawings.

4D 36kV AIS Switches and Connection

4D1 36kV Switches and Connection for Auxiliary Transformers

4D1.1 Deleted

4D1.2 Two (2) sets of 36kV, 800A, 31.5 kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with dropout fuse.

4D2	36kV Switches & connection for Incomer/ LV side of 132/33 kV Transformer
4D2.1	Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, SF6/vacuum circuit breakers with spring-stored energy operating mechanism
4D2.2	Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors.
4D2.3	Two (2) sets of 36kV, 2500A, 31.5kA/1 sec, 50Hz, 170kVp BIL, single vertical break, post type, motor operated disconnectors with motor-operated earthing switch.
4D2.4	Twelve (12) nos. of single-phase, 2-core, $33/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V, 3P/0.2, 20-50/10-20VA 36kV, 31.5kA/1 sec, 50Hz, 170kVp BIL, inductive type voltage transformers. [Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
4D2.5	Six (6) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arresters.
4D2.6	One (1) lot of LV side connection between 36kV terminal of 132/33 kV transformer to 36 kV switchyard including necessary fittings, structures and conductors. Gantry Structure of 36 kV shall be considered for 8 (eight) nos. feeder including incomer and each bay width shall be 6(six) meter. Whole bus and Bus sectionalizer DS of rating 3000A shall be considered.
4D2.7	Six (6) nos. of 36kV, 31.5 kA/1 sec, 50Hz, 170kVp BIL, post type current transformer. 2400-1600-800/1A, Class 5P20, 30VA for Main 1 Protection 2400-1600-800/1A, Class 5P20, 30VA for Main 2 Protection, 2400-1600-800/1A, Class 0.2S,15VA for Metering 1 2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU [Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
4D2.8	One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 36kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
4D2.9	One (1) lot of steel structures for gantry and equipment supports required for completing 36kV busbar and switchgear as specified in the technical specifications and bid drawings.

4E Power Transformers & Earthing/Auxiliary Transformers

- 4E1 Two (2) sets of 132/33 kV, 80/120 MVA (ONAN/ONAF), three phase outdoor type power transformers.
- 4E2 Two (2) sets 33/0.415 kV, 300kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers associated with Bushing & outdoor neutral CTs and steel support structures including all necessary connections.

4F Control, Protection, Monitoring, Substation Automation & Metering

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-

145 kV Circuits

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of :-

- 4F1 Control, Protection & Monitoring including BCU for four (4) sets of overhead line circuits bays.
- 4F2 Control, Protection & Monitoring including BCU for two (2) sets of 132/33 kV power transformer circuits.
- 4F3 Complete Control, Protection & Monitoring including BCU for bus coupler circuit.
- 4F4 Complete Busbar protection for 132kV system
- 4F5 Complete Independent standalone Digital Fault and Disturbance recorder (DFDR) with PMU functionality to monitor 132kV bays and 33kV incomer bays. Engineering workstation shall be supplied. DFDR should be integrated with central client station. The Engineering workstation PCs shall have minimum configuration of core i7(latest generation), 16GB RAM, 1TB SSD with RAID1, and 27' display.
- 4F6 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVARh meters (accuracy class 0.2) for each 132 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord.

Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.

- 4F7 Two (2) sets of SAS System including Operator Workstations and related software with all licenses (shall be perpetual and sufficient for all future bays), Necessary Ethernet switches and GPS for the SAS system, 55 inch LED Monitor, Color Laser Printers, Common alarm unit with hooter/buzzer, BCU for all common signals of the substation.

Additional 05 (five) No.'s of BCU for controlling 05 (five) No's of 33kV Load Shed Feeders shall be supplied. All five BCUs with required I/O shall be placed in one panel tested with SAS, NLDC . One (1) set of Engineering Workstation and all engineering software with licenses (shall not be time bound) shall be supplied. Two nos. 3KVA Inverter (as shown in LVAC and DCDB drawing) for the SAS system shall be included in the scope. The Engineering/Workstation PCs shall have minimum configuration of core i7(latest generation), minimum clock speed of 3.4 GHz,16GB RAM, 1TB SSD with RAID1, and 27' displays.

- 4F8 Two (2) sets of Complete RTCC systems including transformer tap changer control, fan control & AVR as per 4.15(N) of section 4 in volume 2 of 3.

36kV Circuit

- 4F9 Deleted
- 4F10 Two (2) sets of Control, Protection & Monitoring including BCU for two 33kV circuits connected to the LV side of 132/33kV Power transformers. 33 kV DS with dropout fuse for Auxiliary Transformer shall be added in the control panel including mimic.
- 4F11 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 33 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Space provision for another meter shall be kept in metering panel. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.

4G Multicore Cables

4G1 One (1) lot complete set of multicore low voltage XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, landed, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided. Necessary Sizing calculation shall have to be submitted for approval during the execution stage. The Bidder may use a fully computerized system for rating, and routing of cables,

4H Earthing and Lightning Protection

4H1 One (1) lot of design, supply and installation of earthing system for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this contract arrangement. Calculation and GPR shall have to be shown using software like CYMGRD.

4H2 One (1) lot of design, supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in the Rolling Sphere method.

4I Batteries, Chargers and DC Distribution

4I1 110V substation Nickel Cadmium (NiCd) batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment being supplied.

The system shall generally be as shown in bid drawing and shall include:

a) 132KV System:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 300Ah, M-Class, at the 5-hour rate of discharge for 132kV system.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii)Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC.for 132kV system.

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future use.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

4I2 48V DC system and distribution equipment to be supplied, installed and commissioned in the main control building for the new fiber optic multiplexer equipment for communication and protection. One set shall be used as standby supply. 48V DC system and distribution equipment shall be located in the Main Control Building.

The system shall generally be as shown in bid drawing and shall include:

i) Two (2) sets of 100% batteries complete, each capacity shall not be less than 250Ah, L-Class, at the 5-hour rate of discharge for communication and protection.

During the execution stage the battery capacity shall be confirmed with calculation by the contractor considering international standards for the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the bidding document. The battery with higher capability if required after calculation shall be supplied by the Contractor within the same Contract price.

ii) Two (2) sets of battery chargers complete, each charge shall not be less than 100A rating and input voltage three phase 50Hz, 415V AC..

The charger rating shall be based on the load & boost charging rate and during execution stage after calculation if the higher charging charger is found to be required, it shall be supplied by the Contractor within the same Contract price.

iii) One (1) lot of DC distribution board. The DC distribution board shall be with overall spare switches for future extension.

All DC status including (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

4J LVAC Distribution

4J1 One (1) lot of LVAC switchboard for substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey Bid.

All AC status including control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in the substation automation system.

The requirements shall generally be as shown in Bid drawing and technical specification of Volume 2 and shall include two nos. of 125A outdoor weather-proof 3-phase with neutral & earth switched socket outlet and plug as per IEC 309; to be installed, cabled (120sqmm xlpe cu) and connected adjacent to the both type of Power Transformer and shall be connected from auxiliary transformers with required size of MCCB and cable.

4J2 One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for two 33/0.415 kV station auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check) shall have to be supplied. Tariff meter shall be made of BPDB approved.

4J3 One (1) lot of Power Factor Correction Plant. PFI plant shall be designed as per attached drawing and capacity of PFI plant shall be not less than 2X40KVAR. (KVAR=2X16% of each Aux Transformer Capacity or KVAR=2X60% of connected load in each 415V bus including future load)

4K Civil Works, Building and Foundation

4K1 Land development of complete switchyard area by cutting, land filling, compacting up to a suitable level including slope protection.

4K2 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches, septic tank, surfacing, drainage, fences, guard house, boundary wall, gravel laying, sentry post, ansar barrack etc.

4K3 One (1) lot of complete design, supply and construction of all civil items and facilities required for a new two storied Main Control Room Building, one (1) nos one storied switchyard panel room in 132kV switchyard.

4K4 Testing of pile Foundation, Compression & uplift on random basis.

4K5 One (1) lot of complete design, supply and construction of firefighting system for transformers including water pipe network and reservoir at normal pressure. Necessary Sizing calculation shall have to be submitted for approval during the execution stage.

4L Lighting, Small Power, Air Conditioning and Ventilation

4L1 One (1) lot of complete design, supply, installation and commissioning of equipment to provide lighting, LV power supply, air conditioning system, ventilation system and emergency DC lighting system for the main control building. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage except for the air conditioning system.

Minimum requirement of air conditioning system capacity shall be 50 Ton. Each air conditioner unit for the control room shall not be less than 5 Ton and for other rooms (Office/archive/prayer) shall not be less than 2 Ton. **The air conditioning system shall be of industrial grade, cassette type and inverter system. Such Provision shall be made available that the Air Conditioning Device shall be remotely monitored & controlled. (vol 2 sec 13.30).**

4L2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting for security, roadway (internal and approach road), switchyard and emergency DC lighting system at strategic locations for equipment operation and inspection. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage.

4L3 One (1) lot of Complete Solar system (10KW AC output) with inverter & changeover facilities including other accessories for substation use. The solar system shall be grid tied, net-metering and installed at the rooftop of the control building.

4L4 One (1) lot of complete CCTV Camera system for control building, switchgear area, and other area to monitor full substation with NVR and other required accessories.

4M Fibre Optic Multiplexer Equipment for Communication and Protection

The equipment to be supplied, installed and commissioned shall be as shown on bid drawing.

4M1 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system is to be provided for:

- 87 or 21 relay (main and back-up) for each transmission line protection
- 21 relay tele-protection signal (main1 and main2/back-up)
- SCADA data from switchgear and control system
- Hot-line telephone system
- IP Telephony

4M2 Underground optical fibre cables (48 cores 132kV switchyard) from terminal box gantry structure at each 132kV double circuit transmission line termination point to MDF /ODF (Main/Optical distribution Frame) to be installed in the control room. The Contract includes supply and installation of MDF/ODF and pigtail cables with adequate length.

4M3 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system for all remote end substations. All existing services shall be replaced with the new multiplexer equipment including teleprotection services. Existing multiplexer equipment shall be removed and handed over to the respective department.

4N SCADA system for Telecontrol and Telemetry

4N1 One (1) lot of complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetry facilities required at the existing National Load Despatch Center (NLDC and BNLDC) at Rampura and Shiddirganj for integration of complete new 132/33kV substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of the master station of NLDC & BNLDC are to be carried out

Section V 132 kV Bay extension at Kachua Substation

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

Item	Description
5C	145kV Air Insulated Switchgear (AIS)
5C1	Deleted
5C2	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, live tank type, single-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for T/L bay).
5C3	Deleted
5C4	Deleted
5C5	Four (4) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors without earthing switch (for T/L bay).
5C6	Deleted
5C7	Two (2) sets of 145kV, 1600A, 40kA/1sec, 50Hz, 650kVp BIL, double side break, post type, motor operated disconnectors with motor-operated earthing switch (for T/L bay).
5C8	Deleted
5C9	Six (6) nos. of single-phase, , 5-core, 145kV, 40kA/1sec, 50Hz, 650kVp BIL , post type current transformer for Line bay. 145kV, 40kA/1sec single phase, 5-core, current transformer with cores as follows: 2400-1600-800/1A, Class 5P20, 30-60VA for Main 1 Protection 2400-1600-800/1A, Class 5P20, 30-60VA for Main 2 Protection, 2400-1600-800/1A, Class 0.2S,15VA for Metering 1 2400-1600-800/1A, Class 0.2S,15VA for Metering 2, BCU 2400-1600-800/1A, PX, for Busbar Differential Protection and Breaker Failure [Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
5C10	Deleted

- 5C11 Six (6) nos. of single-phase, 3-core, $132/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ / $110/\sqrt{3}$ kV/V/V/V, 3P/3P/0.2, 20-50/20-50/10-20VA 145kV, 40kA/1sec, 50Hz, 650kVp BIL,inductive type voltage transformers.
[Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]
- 5C12 Six (6) nos. of 120kV rated voltage, 102kV(rms) continuous operating voltage at 50^oc, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.
- 5C13 One (1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 132kV two bay extension and one new tower installation as specified in the technical specifications and bid drawings.
- 5C14 One (1) lot of steel structures for gantry and equipment supports required for completing 145kV busbar and switchgear as specified in the technical specifications and bid drawings.

5F Control, Protection, Monitoring, Substation Automation & Metering

145 kV Circuits

The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of :-

- 5F1 Control, Protection & Monitoring including BCU for two (2) sets of overhead line circuits bays.
- 5F2 Complete Tariff metering panel to accommodate programmable & recordable digital 3-phase, 4-wire import and export MWh and MVarh meters (accuracy class 0.2) for each 132 kV line and transformer feeder. For each feeder one meter shall be supplied including one set software and communication cord. Tariff Metering is to be supplied from Europe, Canada, USA or Japan make. Printed catalogue, operation and service manual are to be provided.
- 5F3 One (1) lot of extension of existing Busbar protection for 132kV system.
- 5F4 One (1) lot of extension of existing Independent standalone Digital Fault and Disturbance recorder (DFDR) with PMU functionality to monitor 132kV bays and 33kV incomer bays. DFDR should be integrated with central client station.

5G Multicore Cables

- 5G1 One (1) lot complete set of multicore low voltage XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, landed, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided. Necessary Sizing calculation shall have to be submitted for approval during the execution stage.

5H Earthing and Lightning Protection

- 5H1 One (1) lot of design, supply and installation of extension of earthing system for two new bay with necessary connectors and clamps, with design to suit the work under this contract arrangement. Calculation and GPR shall have to be shown using software like CYMGRD.
- 5H2 One (1) lot of design, supply and installation of lightning protection screen for two new bay with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in the Rolling Sphere method.

5I Batteries, Chargers and DC Distribution

- 5I1 One (1) lot of extension of 110 V DC distribution panels & others. The DC distribution board shall be with overall spare switches for future use.
All DC status excluding (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.
- 5I2 One (1) lot of extension of 48V DC distribution panels & others. The DC distribution board shall be with overall spare switches for future use.
All DC status excluding (DC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of DC MCB/MCCB at SPR with fail alarm etc.) control & protection shall be incorporated in the substation automation system.

5J LVAC Distribution

- 5J1 One (1) lot of extension of LVAC switchboard for substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey Bid.

All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in the substation automation system.

- 5J2 One (1) lot of Power Factor Correction Plant. PFI plant shall be designed as per attached drawing and capacity of PFI plant shall be not less than 2X20KVAR. (KVAR=2X16% of each Aux Transformer Capacity or KVAR=2X60% of connected load in each 415V bus including future load)

5K Civil Works, Building and Foundation

- 5K1 One (1) lot of complete design, supply and construction of all civil items required for the outdoor works for two new bays suitable for switchyard gantry & equipment foundations, cable trenches, surfacing, drainage, gravel laying etc.

- 5K2 Testing of pile Foundation, Compression & uplift on random basis for civil works.

- 5K3 Miscellaneous works including dismantling of existing tin-shed building and existing internal road, reconstruction of internal road, construction of slope protection with CC block.

- 5K4 Geotechnical Investigations including taking samples, logging and lab testing

- 5K5 Foundations for towers (tower type 1DT6) including all setting out, Concrete, Reinforcement, Excavation, Pumping, Stub-cutting, Geotechnical Investigation (Level 2), Shuttering, Leveling, Timbering, supply & Installation of foundation steelwork, Earthing Materials, Backfilling & site clearing etc.

- 5K6 Testing of pile Foundation, Compression, uplift & Pile Integrity test on random basis for the new tower construction.

- 5K7 Erection of 132kV double circuit & four circuit towers complete with all stubs, nuts, bolts, locking nuts, washers, phase conductor and earthwire attachment plates, swivels/shackles, step bolts, tower notice and identification plates, ACDs, earthing etc.

- 5K8 Dismantling and bypass work as specified in Schedule-4 of Price Schedule.

5K9 One (1) lot of stringing of double circuit line, one conductors per phase and 1 OPGW and 1 earthwire, Installation of insulator strings, compressed dead-ends, compression junction sleeves,OPGW joint box/junction boxes, including:Tension and semi-tension joints, suspension clamps, armour rods and dampers, suspension clamps, Pilot strings and jumpers, Sagging and clipping, and any other works required as per requirement of shifting the Comilla-Kachua 132kV TL to new Terminal Tower (TT) and Gantry.

5L Lighting, Small Power, Air Conditioning and Ventilation

5L1 Deleted

5L2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light; sodium/mercury) for security, switchyard and emergency DC lighting system at strategic locations for equipment operation and inspection. Necessary Sizing calculation with software shall have to be submitted for approval during the execution stage.

5M Fibre Optic Multiplexer Equipment for Communication and Protection

5M1 The equipment to be supplied, installed and commissioned shall be as shown on bid drawing.
Extension of existing/ upgradation of Indoor Fibre Optic Multipexer Equipment (if alternate proposal other than existing multiplexer, bidder shall include one set of 48V battery and charger)

5M2 One (1) lot of Underground optical fibre cables (48 cores) from terminal box gantry structure at each 32kV double circuit transmission line termination point to MDF/ODF (Main/Optical distribution Frame) to be installed in the control room. The Contract includes supply and installation of MDF/ODF and pigtail cables with adequate length.

5M3 One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment including necessary works to interface with existing system for all remote end substations. All existing services shall be replaced with the new multiplexer equipment including teleprotection services. Existing multiplexer equipment shall be removed and handed over to the respective department.

5N SCADA system for Telecontrol and Telemetry

5N1 One (1) lot of complete design, supply, delivery, installation, testing & commissioning of hardware and software to provide the telecontrol & telemetering facilities required at the existing National Load Despatch Center (NLDC) at Rampura and backup National Load Despatch Center (BNLDC) at Siddirganj for integration of two new 132KV line bay in Bhandaria grid substation.

All required electrical signals (as per signal list provided by SCADA Division) shall be integrated to RTU and transmitted to the NLDC through the RTU / Gateway of the substation. All HV breakers, motorized disconnectors etc. shall be controlled from NLDC through the RTU / Gateway of the substation using IEC 60870-5-104 protocol.

All necessary modification works in the software of the master station of NLDC are to be carried out.

Section-VI Mandatory Spare parts including Maintenance Equipment

Supply of complete spares and spare parts of transformer, switchgear, control equipment, protection relays, meters, & erection as per quantity mentioned in Schedule B of price schedule. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

Spare item shall be supplied from the make of approved main item in this scope and the same ordering code shall be followed.

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT

FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]

SCHEDULE B

BID PRICE SCHEDULE

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]

SCHEDULE B (PRICE SCHEDULES)

PREAMBLE

General

The Price Schedules are divided into separate Schedules & added in Section 4 of Volume 1.

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]

SCHEDULE C

Bar Chart Program of Key Activities-Delivery & Completion Time Schedule

The Bidder shall fill, sign and stamp the attached time schedule and shall attach it to the tender. Time for completion of the whole facilities is 900 (Nine Hundred) days from the effective date as described in Section 8 - Special Conditions of Contract, Sub-Clause 8.2.

The Bidder shall provide

- filled general time schedule, provided below and as Appendix 4 to the Section 9: Contract Forms,
- 5.3. and a detailed proposal for mobilization schedule, Section 4: Tendering forms, item
- 5.4. a detailed proposal for the construction schedule, Section 4: Tendering forms, item 5.4.

Please find the time schedule and equipment delivery schedule attached.

SCHEDULE C: TIMES FOR DELIVERY AND COMPLETION

[illegible]

Equipment Delivery Schedule (Show Activity in Bar Chart for required months in relation with time schedule).

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)	Duration	Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	..	..	..	..	..	..	..	..	..	..
Transformer																									
Circuit Breaker																									
DS																									
DS/ES																									
CT																									
PT																									
DFDR																									
SAS																									
CRP																									
Communication																									
SCADA																									
Gantry Structure																									
Equipment Support Structure																									
Conductor																									
.. .. .																									
.. .. .																									

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]SCHEDULE D

MANUFACTURERS, PLACES OF MANUFACTURE

The following Subcontractors and/or manufacturers are proposed for carrying out the item of the facilities indicated.

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

For all proposed manufacturers, bidders are requested to complete the corresponding technical particular forms.

Item	Description	Proposed Subcontractors/ Manufacturers	Place of Manufacture
1	145 kV AIS SWITCHGEAR (As per Volume 1: Section 3 -EQC) AIS Circuit Breaker AIS Disconnect Switch Current Transformer Inductive Voltage Transformer Surge Arrester		

Item	Description	Proposed Subcontractors/ Manufacturers	Place of Manufacture
2	33kV AIS SWITCHGEAR AIS Circuit Breaker AIS Disconnect Switch Current Transformer Voltage Transformer Surge Arrester		
3	132/33 kV POWER TRANSFORMERS (As per Volume 1: Section 3 -EQC) Complete [except bushing and OLTC] On Load Tap Changer (OLTC) [as per specification requirement] Bushing [as per specification requirement]		
4	PROTECTION, METERING AND CONTROL (As per specification requirement and Volume 1: Section 3 -EQC) Line Protection relays (Main-1) Line Protection relays (Main-2) Transformer protection relay (Main-1) Transformer protection relay (Main-2) Busbar protection relay (Main-1) Busbar protection relay (Main-2) Bay Control Unit (BCU), Switches, Servers, OWS, EWS, Gateway,		

Item	Description	Proposed Subcontractors/ Manufacturers	Place of Manufacture
5	Communication Equipment (As per specification requirement and Volume 1: Section 3 -EQC) Fiber Optic Multiplexer Power Line Carrier (PLC) Line Matching Unit (LMU) Tele-protection		
6	Digital Fault and Disturbance Recorder (DFDR) (As per specification requirement and Volume 1: Section 3 -EQC)		
7	Disc Insulator (As per Volume 1: Section3 -EQC)		
8	Battery (As per Volume 1: Section 3 -EQC)		
9	Battery Charger (As per Volume 1: Section 3 -EQC)		
10	Energy (Tariff) meter (As per specification requirement)		

For remaining items, the bidders shall propose reputed make with supply record and type test report (if applicable) during Contract execution stage.

POWER GRID BANGLADESH PLC

BIDDING DOCUMENT

FOR

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

[Contract No.: POWERGRID/ADB/PTSIREP/Package-4]

SCHEDULE E

1. TECHNICAL PARTICULARS AND GUARANTEES

PART 1 - SWITCHGEAR

1.1 EHV OUTDOOR AIS CIRCUIT BREAKERS

1.1.1 420KV CIRCUIT BREAKERS (NOT APPLICABLE)

[Technical particulars and guarantees shall be filled separately for different manufacturers]

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
1.	Manufacturer [also mentioned in Schedule D]		[insert]	
2.	Manufacturer's country of origin [also mentioned in Schedule D]		[insert]	
3.	Manufacturer Address		[insert]	
4.	Model Reference (Manufacturer's designation)		[insert]	
5.	Type		Outdoor, SF6 insulated, live tank type	
6.	Applicable Standard		IEC 62271-100	IEC 62271-100
7.	System Earthing		Effectively earthing	Effectively earthing
8.	Max System Voltage (Um)	kV rms	420 kV	
9.	Nominal Voltage	kV rms	400 kV	
10.	Min. Rated voltage (Ur)	kV rms	420 kV	
11.	Min. Rated short-duration power frequency withstand voltage (Ud)			
	(a) Phase to-earth and between phases	kV rms	520 kV rms	

SE-1

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
	(b) Across open switching device and/or isolating distance	kV rms	610 kV rms	
12.	Min. Rated switching impulse withstand voltage (Us)			
	(a) Phase-to earth and across open switching Device	kV peak	1050	
	(b) Across isolating distance	kV peak	900 (+345) kV peak	
13.	Min. Rated lightning impulse withstand voltage (Up)			
	(a) Phase-to earth and between phases	kV peak	1425	
	(b) Between terminals with CB open	kV peak	1425 (+240)	
14.	Rated frequency (fr)	Hz	50	50
15.	Min. Rated continuous current (Ir)			
	(a) Line bay	A	4000	
	(b) Transformer bay	A	4000	
	(c) Bus coupler/ sectionalizer/Mid breaker	A	4000	
16.	Min. Rated short-time withstand current (Ik)	kA rms	63	
17.	Min. Rated duration of short-circuit (tk)	s	1	
18.	Min. Rated peak withstand current (Ip)	kA peak	157.5	
19.	Rated First pole to clear factor (kpp)		1.3	
20.	Min. Rated short circuit breaking current	kA rms	63	
21.	Min. Rated short circuit making current	kA peak	157.5	
22.	Max. radio interference voltage	uv	1000	
23.	Mechanical Endurance Class		M2	
24.	Total closing time	Ms	Not more than 150 ms	
25.	Total breaking time	ms	Not more than 45 ms	
26.	Operating mechanism		Motor spring stored energy	
27.	Rated operating sequence		O-0.3s-CO-3min-CO	
28.	Reclosing		Single phase & Three phase auto-reclosing	
29.	Trip free/or fixed trip		Trip free	
30.	Insulator type		Porcelain	
31.	Min. Insulator Creepage distance		25 mm/kV	
32.	Number of closing coils	No.	1	
	Supply voltage	V	110V DC	
	Power	W	[insert]	
33.	Number of tripping coils	No.	2	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
	Supply voltage	V	110V DC	
	Power	W	[insert]	
34.	Number of auxiliary switch contacts - normally open - normally closed - adjustable		Min. 12 Min. 12 [insert]	
35.	Ingression Protection class		IP55	
36.	Number of Poles in set (3 phase)	No.	3	
37.	Number of interrupter /poles	No.	2	
38.	Rated breaking currents: Line charging Cable charging Small inductive	kA rms kA rms kA rms	As per IEC	
39.	Rated transient recovery voltage for terminal faults if other than standard	kV	As per IEC	
40.	Rated characteristics for short-line faults		As per IEC	
41.	Rated out of phase breaking current	kA	As per IEC	
42.	Is circuit-breaker re-strike free?	Yes/No	Yes	
43.	Rated supply pressure of gas for interruption	MPa (g)	[insert]	
44.	Limits for correct operation max min	MPa (g) MPa (g)	[insert] [insert]	
45.	Is lockout facility fitted?	Yes/No	Yes	
46.	Other auxiliary loads (Heater and Light): Voltage: Power	V W	230V AC [insert]	
47.	Minimum clearances in air: (a) between phases (b) phases to earth (c) across interrupters (d) live parts to ground level	mm mm mm mm	[insert] [insert] [insert] [insert]	
48.	Guaranteed maximum gas leakage	% per annum	[insert]	
49.	Weight of circuit-breaker unit complete	kg	[insert]	
50.	Grading capacitance included		Yes/No	
51.	Value of grading capacitance	pF	[insert]	
52.	Value Pre insertion Resistor (PIR) [if applicable for 400kV as per schedule A and SLD]	Ohm/phase	400	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
53.	Min Pre-insertion time for PIR) [if applicable for 400kV as per schedule A and SLD]	ms	8	
54.	Model of CSD (Control Switching Device) [if applicable for 400kV as per schedule A and SLD]		[insert]	
55.	Operating Voltage of CSD (Control Switching Device) [if applicable for 400kV as per schedule A and SLD]	V DC	110	

1.1.2 245KV CIRCUIT BREAKERS (NOT APPLICABLE)

[Technical particulars and guarantees shall be filled separately for different manufacturers]

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
1.	Manufacturer [also mentioned in Schedule D]		[insert]	
2.	Manufacturer's country of origin [also mentioned in Schedule D]		[insert]	
3.	Manufacturer Address		[insert]	
4.	Model Reference (Manufacturer's designation)		[insert]	
5.	Type		Outdoor, SF6 insulated, live tank type	
6.	Applicable Standard		IEC 62271-100	IEC 62271-100
7.	System Earthing		Effectively earthing	Effectively earthing
8.	Max System Voltage (Um)	kV rms	245 kV	
9.	Nominal Voltage	kV rms	230 kV	
10.	Min. Rated voltage (Ur)	kV rms	245 kV	
11.	Min. Rated short-duration power frequency withstand voltage (Ud)			
	(c) Phase to-earth and between phases	kV rms	460 kV rms	
	(d) Across open switching device and/or isolating distance	kV rms	460 kV rms	
12.	Min. Rated lightning impulse withstand voltage (Up)			
	(c) Phase-to earth and between phases	kV peak	1050	
	(d) Between terminals with CB open	kV peak	1050	
13.	Rated frequency (fr)	Hz	50	50
14.	Min. Rated continuous current (Ir)			
	(d) Line bay	A	2000	

SE-4

Design, Supply, Installation, Testing & Commissioning of 132/33 kV AIS Substations at Dhupchanchia, Kumarkhali, Matlab North and Chatkhil including associated 132KV bay extension at Kachua Substation on turnkey basis (Package-4)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
	(e) Transformer bay	A	2000	
	(f) Bus coupler/ sectionalizer/ Mid breaker	A	3150	
15.	Min. Rated short-time withstand current (Ik)	kA rms	50	
16.	Min. Rated duration of short-circuit (tk)	s	1	
17.	Min. Rated peak withstand current (Ip)	kA peak	125	
18.	Rated First pole to clear factor (kpp)		1.3	
19.	Min. Rated short circuit breaking current	kA rms	50	
20.	Min. Rated short circuit making current	kA peak	125	
21.	Max. radio interference voltage	uv	1000	
22.	Total closing time	Ms	Not more than 200 ms	
23.	Total breaking time	ms	Not more than 65 ms	
24.	Mechanical Endurance Class		M2	
25.	Operating mechanism		Motor spring stored energy	
26.	Rated operating sequence		O-0.3s-CO-3min-CO	
27.	Reclosing		Single phase & Three phase auto-reclosing	
28.	Trip free/or fixed trip		Trip free	
29.	Insulator type		Porcelain	
30.	Min. Insulator Creepage distance		25 mm/kV	
31.	Number of closing coils	No.	1	
	Supply voltage	V	110V DC	
	Power	W	[insert]	
32.	Number of tripping coils	No.	2	
	Supply voltage	V	110V DC	
	Power	W	[insert]	
33.	Number of auxiliary switch contacts - normally open - normally closed - adjustable		Min. 12 Min. 12 [insert]	
34.	Ingression Protection class		IP55	
35.	Number of Poles in set (3 phase)	No.	3	
36.	Number of interrupter /poles	No.	1	
37.	Rated breaking currents: Line charging Cable charging Small inductive	kA rms kA rms kA rms	As per IEC	
38.	Rated transient recovery voltage for terminal faults if other than standard	kV	As per IEC	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
39.	Rated characteristics for short-line faults		As per IEC	
40.	Rated out of phase breaking current	kA	As per IEC	
41.	Is circuit-breaker re-strike free?	Yes/No	Yes	
42.	Rated supply pressure of gas for interruption	MPa (g)	[insert]	
43.	Limits for correct operation max min	MPa (g) MPa (g)	[insert] [insert]	
44.	Is lockout facility fitted?	Yes/No	Yes	
45.	Other auxiliary loads (Heater and Light): Voltage: Power	V W	230V AC [insert]	
46.	Minimum clearances in air: (a) between phases (b) phases to earth (c) across interrupters (d) live parts to ground level	mm mm mm mm	[insert] [insert] [insert] [insert]	
47.	Guaranteed maximum gas leakage	% per annum	[insert]	
48.	Weight of circuit-breaker unit complete	kg	[insert]	

1.1.3 145KV CIRCUIT BREAKERS

[Technical particulars and guarantees shall be filled separately for different manufacturers]

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
1.	Manufacturer [also mentioned in Schedule D]		[insert]	
2.	Manufacturer's country of origin [also mentioned in Schedule D]		[insert]	
3.	Manufacturer Address		[insert]	
4.	Model Reference (Manufacturer's designation)		[insert]	
5.	Type		Outdoor, SF6 insulated, live tank type	
6.	Applicable Standard		IEC 62271-100	IEC 62271-100

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
7.	System Earthing		Effectively earthing	Effectively earthing
8.	Max System Voltage (Um)	kV rms	145 kV	
9.	Nominal Voltage	kV rms	132 kV	
10.	Min. Rated voltage (Ur)	kV rms	145 kV	
11.	Min. Rated short-duration power frequency withstand voltage (Ud)			
	(e) Phase to-earth and between phases	kV rms	275 kV rms	
	(f) Across open switching device and/or isolating distance	kV rms	275 kV rms	
12.	Min. Rated lightning impulse withstand voltage (Up)			
	(e) Phase-to earth and between phases	kV peak	650	
	(f) Between terminals with CB open	kV peak	650	
13.	Rated frequency (fr)	Hz	50	50
14.	Min. Rated continuous current (Ir)			
	(g) Line bay	A	1600	
	(h) Transformer bay	A	1600	
	(i) Bus coupler/ sectionalizer/Mid breaker	A	3150	
15.	Min. Rated short-time withstand current (Ik)	kA rms	40	
16.	Min. Rated duration of short-circuit (tk)	s	1	
17.	Min. Rated peak withstand current (Ip)	kA peak	100	
18.	Rated First pole to clear factor (kpp)		1.3	
19.	Min. Rated short circuit breaking current	kA rms	50	
20.	Min. Rated short circuit making current	kA peak	100	
21.	Max. radio interference voltage	uv	1000	
22.	Mechanical Endurance Class		M2	
23.	Total closing time	Ms	Not more than 200 ms	
24.	Total breaking time	ms	Not more than 65 ms	
25.	Operating mechanism		Motor spring stored energy	
26.	Rated operating sequence		O-0.3s-CO-3min-CO	
27.	Reclosing		Single phase & Three phase auto-reclosing	
28.	Trip free/or fixed trip		Trip free	
29.	Insulator type		Porcelain	
30.	Min. Insulator Creepage distance		25 mm/kV	
31.	Number of closing coils	No.	1	
	Supply voltage	V	110V DC	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
	Power	W	[insert]	
32.	Number of tripping coils	No.	2	
	Supply voltage	V	110V DC	
	Power	W	[insert]	
33.	Number of auxiliary switch contacts - normally open - normally closed - adjustable		Min. 12 Min. 12 [insert]	
34.	Ingression Protection class		IP55	
35.	Number of Poles in set (3 phase)	No.	3	
36.	Number of interrupter /poles	No.	1	
37.	Rated breaking currents: Line charging Cable charging Small inductive	kA rms kA rms kA rms	As per IEC	
38.	Rated transient recovery voltage for terminal faults if other than standard	kV	As per IEC	
39.	Rated characteristics for short-line faults		As per IEC	
40.	Rated out of phase breaking current	kA	As per IEC	
41.	Is circuit-breaker re-strike free?	Yes/No	Yes	
42.	Rated supply pressure of gas for interruption	MPa (g)	[insert]	
43.	Limits for correct operation max min	MPa (g) MPa (g)	[insert] [insert]	
44.	Is lockout facility fitted?	Yes/No	Yes	
45.	Other auxiliary loads (Heater and Light): Voltage: Power	V W	230V AC [insert]	
46.	Minimum clearances in air: (a) between phases (b) phases to earth (c) across interrupters (d) live parts to ground level	mm mm mm mm	[insert] [insert] [insert] [insert]	
47.	Guaranteed maximum gas leakage	% per annum	[insert]	
48.	Weight of circuit-breaker unit complete	kg	[insert]	

1.1.4 33KV CIRCUIT BREAKERS

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/ 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	

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	
2.25	Number of operations without maintenance - CO at no-load - CO at rated current - CO at rated breaking current I_{sc}	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	$\varnothing 14$	
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.	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	
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 μ m zinc layer		Yes	
	Overall compliance with the requirements (yes/no)			

1.2 DISCONNECTORS AND EARTHING SWITCHES

1.2.1 420KV DISCONNECTORS AND EARTHING SWITCHES (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
			420kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Type		Outdoor, Horizontal double break	
4.	Standard		IEC 62271-102	
5.	Rated voltage		420 kV	
6.	Rated short-duration power frequency withstand voltage (1 min.) To earth Across isolating distance		520 kV rms 610 kV rms	
7.	Rated switching impulse withstand voltage To earth		1050 kV peak	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
			420kV	
	Across isolating distance		900 (+345) kV peak	
8.	Rated lightning impulse withstand voltage - To earth Across isolating distance		1425 kV peak 1425 (+240) kV peak	
9.	Corona extinction voltage		320 kV rms	
10.	Rated short circuit current (I _{th}), 1s		63 kA rms	
11.	Rated short circuit current (I _{dyn})		158 kA peak	
12.	Operating mechanism of isolator / earthing switch		AC motor operated	
13.	Number of auxiliary contacts for main switch - Making - Breaking Middle position		Min. 12 Min. 12 Min. 1	
14.	Number of auxiliary contacts for earthing switch - Making - Breaking Middle position		Min. 12 Min. 12 Min. 1	
15.	Radio interference level for 0.5 MHz to 2 MHz		1000 micro V (at 266 kV rms)	
16.	Type Number			
17.	Operating type			
18.	(a) horizontal/vertical break			
19.	(b) Pantograph			
20.	(c) Number of support insulation for pole			
21.	(d) Number of breaks per pole			
22.	(e) Material of contact surfaces			
23.	(f) Type of Contacts			
24.	Rated normal current	A		
25.	Rated short time withstand current	kA, rms		
26.	Rated duration of short time current	s		
27.	Rated peak withstand current	kA pk		
28.	Rated insulation levels:			

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
			420kV	
29.	Lightning impulse withstand to earth (waveshape: 1.2/50 μ s)	kV pk		
30.	Lightning impulse withstand across open contacts (waveshape: 1.2/50 μ s)	kV pk		
31.	Power frequency voltage withstand to earth	kV rms		
32.	Power frequency voltage withstand across open contacts	kV rms		
33.	Contact Resistance			
34.	Method of operation			
35.	Type of operating mechanism manual/power			
36.	Operating power			
37.	Voltage/pressure rated max min	V/MPa(g) V/MPa(g) V/MPa(g)		
38.	Auxiliary Consumption	A		
39.	Operating time: open max min	ms ms		
40.	Operating time: close max min	ms ms		
41.	Manual operating torque	kNm		
42.	Load switching capability Inductive Capacitive	A		
43.	Mechanical Terminal Load	N		
44.	Insulator Creepage (25mm/kV)	mm		
45.	Radio interference voltage	mV		
46.	Number of auxiliary switches - normally open - normally closed - adjustable			

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical particulars
			420kV	
47.	Other auxiliary loads - voltage - current			
48.	Mechanical endurance:			
49.	Number of operations carried out for mechanical operation test			
50.	Degree of protection for 1) auxiliary circuits 2) moving parts			
51.	Total weight of three pole disconnector complete	kg		
52.	Type test certificate date/reference			
53.	Period of time equipment has been in commercial operation			
54.	Number of the same type of disconnectors supplied to date			

1.2.2 245KV DISCONNECTORS AND EARTHING SWITCHES (NOT APPLICABLE)

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			245KV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Type		Outdoor, Double side break	
4.	Standard		IEC 62271-102	
5.	Rated voltage		245 kV	
6.	Rated short-duration power frequency withstand voltage (1 min.) To earth Across isolating distance		460 kV rms 530 kV rms	
7.	Rated switching impulse withstand voltage To earth Across isolating distance			
8.	Rated lightning impulse withstand voltage		1050 kV peak	

SE-17

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			245KV	
	- To earth Across isolating distance		1200 kV peak	
9.	Corona extinction voltage			
10.	Rated short circuit current (I _{th}), 1s		50 kA rms	
11.	Rated short circuit current (I _{dyn})		125 kA peak	
12.	Operating mechanism of isolator / earthing switch		AC motor operated	
13.	Number of auxiliary contacts for main switch - Making - Breaking Middle position		Min. 12 Min. 12 Min. 1	
14.	Number of auxiliary contacts for earthing switch - Making - Breaking Middle position		Min. 10 Min. 10 Min. 1	
15.	Radio interference level for 0.5 MHz to 2 MHz		500 micro V (at 92 kV rms)	
16.	Type Number			
17.	Operating type			
18.	(a) horizontal/vertical break			
19.	(b) Pantograph			
20.	(c) Number of support insulation for pole			
21.	(d) Number of breaks per pole			
22.	(e) Material of contact surfaces			
23.	(f) Type of Contacts			
24.	Rated normal current	A		
25.	Rated short time withstand current	kA, rms		
26.	Rated duration of short time current	s		
27.	Rated peak withstand current	kA pk		
28.	Rated insulation levels:			
29.	Lightning impulse withstand to earth (waveshape: 1.2/50μs)	kV pk		
30.				

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			245KV	
	Lightning impulse withstand across open contacts (waveshape: 1.2/50 μ s)	kV pk		
31.	Power frequency voltage withstand to earth	kV rms		
32.	Power frequency voltage withstand across open contacts	kV rms		
33.	Contact Resistance			
34.	Method of operation			
35.	Type of operating mechanism manual/power			
36.	Operating power			
37.	Voltage/pressure rated max min	V/MPa(g) V/MPa(g) V/MPa(g)		
38.	Auxiliary Consumption	A		
39.	Operating time: open max min	ms ms		
40.	Operating time: close max min	ms ms		
41.	Manual operating torque	kNm		
42.	Load switching capability Inductive Capacitive	A		
43.	Mechanical Terminal Load	N		
44.	Insulator Creepage (25mm/kV)	mm		
45.	Radio interference voltage	mV		
46.	Number of auxiliary switches - normally open - normally closed - adjustable			
47.	Other auxiliary loads - voltage - current			
48.				

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			245KV	
	Mechanical endurance:			
49.	Number of operations carried out for mechanical operation test			
50.	Degree of protection for 1) auxiliary circuits 2) moving parts			
51.	Total weight of three pole disconnector complete	kg		
52.	Type test certificate date/reference			
53.	Period of time equipment has been in commercial operation			
54.	Number of the same type of disconnectors supplied to date			

1.2.3 145KV DISCONNECTORS AND EARTHING SWITCHES

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			145kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Type		Outdoor, Double side break	
4.	Standard		IEC 62271-102	
5.	Rated voltage		145 kV	
6.	Rated short-duration power frequency withstand voltage (1 min.) To earth Across isolating distance		275 kV rms 315 kV rms	
7.	Rated switching impulse withstand voltage To earth Across isolating distance			
8.	Rated lightning impulse withstand voltage - To earth Across isolating distance		650 kV peak 750 kV peak	
9.	Corona extinction voltage			
10.	Rated short circuit current (I _{th}), 1s		40 kA rms	
11.	Rated short circuit current (I _{dyn})		100 kA peak	

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			145kV	
12.	Operating mechanism of isolator / earthing switch		AC motor operated	
13.	Number of auxiliary contacts for main switch - Making - Breaking Middle position		Min. 12 Min. 12 Min. 1	
14.	Number of auxiliary contacts for earthing switch - Making - Breaking Middle position		Min. 10 Min. 10 Min. 1	
15.	Radio interference level for 0.5 MHz to 2 MHz		500 micro V (at 92 kV rms)	
16.	Type Number			
17.	Operating type			
18.	(a) horizontal/vertical break			
19.	(b) Pantograph			
20.	(c) Number of support insulation for pole			
21.	(d) Number of breaks per pole			
22.	(e) Material of contact surfaces			
23.	(f) Type of Contacts			
24.	Rated normal current	A		
25.	Rated short time withstand current	kA, rms		
26.	Rated duration of short time current	s		
27.	Rated peak withstand current	kA pk		
28.	Rated insulation levels:			
29.	Lightning impulse withstand to earth (waveshape: 1.2/50 μ s)	kV pk		
30.	Lightning impulse withstand across open contacts (waveshape: 1.2/50 μ s)	kV pk		
31.	Power frequency voltage withstand to earth	kV rms		

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			145kV	
32.	Power frequency voltage withstand across open contacts	kV rms		
33.	Contact Resistance			
34.	Method of operation			
35.	Type of operating mechanism manual/power			
36.	Operating power			
37.	Voltage/pressure rated max min	V/MPa(g) V/MPa(g) V/MPa(g)		
38.	Auxiliary Consumption	A		
39.	Operating time: open max min	ms ms		
40.	Operating time: close max min	ms ms		
41.	Manual operating torque	kNm		
42.	Load switching capability Inductive Capacitive	A		
43.	Mechanical Terminal Load	N		
44.	Insulator Creepage (25mm/kV)	mm		
45.	Radio interference voltage	mV		
46.	Number of auxiliary switches - normally open - normally closed - adjustable			
47.	Other auxiliary loads - voltage - current			
48.	Mechanical endurance:			
49.	Number of operations carried out for mechanical operation test			
50.				

Sl. No.	Description	Unit	Miniumim Requirements	Guranteed Technical Particulars
			145kV	
	Degree of protection for 1) auxiliary circuits 2) moving parts			
51.	Total weight of three pole disconnector complete	kg		
52.	Type test certificate date/reference			
53.	Period of time equipment has been in commercial operation			
54.	Number of the same type of disconnectors supplied to date			

1.2.4 33KV DISCONNECTORS

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	

1.	Disconnecter- General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 62271-102 IEC 60273 IEC 60694 IEC 60815	
1.6	Quality control		ISO 9001 ISO 14001 ISO 18001	
1.7	Type of disconnector		Outdoor	
1.8	Design		Vertical break, horizontal or wall mounting	
1.9	Number of poles	pcs.	3	
1.10	Type of operating mechanism		Motor operated	
1.11	Number of operating mechanisms	pcs.	1	
2.	Disconnecter - 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 withstand current I_k	kA _{rms}	≥ 31.5	
2.9	Rated duration of short-circuit	s	≥ 1	
2.10	Rated maximum withstand current I_p	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 F_a	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.	Disconnecter - Design and Construction			
3.1	Disconnecter			
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	
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)				

1.3 CURRENT TRANSFORMERS

1.3.1 420KV CURRENT TRANSFORMER (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			420kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Rated lightning impulse withstand voltage		1425 kVp	
4.	Rated switching impulse withstand voltage		1050 kVp	
5.	Power frequency withstand voltage (1 min.)		630 kVrms	
6.	Corona extinction voltage		320 kVrms	
7.	Radio interference level for 0.5 MHz to 2 MHz		1000 micro V (at 266 kVrms)	
8.	Partial discharge level		10 pC	
9.	Type of insulation		Class A	
10.	Rated primary current	A rms		
11.	Rated secondary current	A rms		
12.	Rated frequency	Hz		
13.	Highest voltage for equipment	kV		
14.	Rated insulation level - primary winding	kV		
15.	Lightning impulse withstand	kV pk		
16.	(a) Power frequency withstand (dry) (b) Power frequency withstand (wet)	kV rms kV rms		
17.	Insulator creepage (phase to earth)	mm		
18.	Electrical dissipation factor at power frequency test voltage			
19.	Radio influence voltage measured at U/ $\sqrt{3}$ 1 MHz	μ V		
20.	Rated short term thermal current for 1s Rated short term thermal current for 3s	A rms A rms		
21.	Rated dynamic current	kA pk		
22.	Insulation class			
23.	Number of secondary windings			
24.	Location of core			
25.	Core 1 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			

26.	Core 2 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
27.	Core 3 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
28.	Core 4 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
29.	Class X winding: - Rated knee point emf - Exciting current - Resistance ^a *including instrument security factor where applicable	V A		
30.	Is earth screen fitted between primary and secondary windings			
31.	Maximum cantilever strength	Nm		
32.	Type test certificate ref/date			

- a. Preliminary value. Actual shall be as per Detail Engineering during execution

1.3.2 245KV CURRENT TRANSFORMER (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			245KV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Rated lightning impulse withstand voltage		1050kVp	
4.	Rated switching impulse withstand voltage		-	
5.	Power frequency withstand voltage (1 min.)		460kVrms	
6.	Corona extinction voltage		156KV	
7.	Radio interference level for 0.5 MHz to 2 MHz		1000 micro V (at 156 kVrms)	
8.	Partial discharge level		10 pC	
9.	Type of insulation		Class A	
10.	Rated primary current	A rms		
11.	Rated secondary current	A rms		
12.	Rated frequency	Hz		
13.	Highest voltage for equipment	kV		
14.	Rated insulation level - primary winding	kV		
15.	Lightning impulse withstand	kV pk		
16.	(a) Power frequency withstand (dry) (b) Power frequency withstand (wet)	kV rms kV rms		
17.	Insulator creepage (phase to earth)	mm		
18.	Electrical dissipation factor at power frequency test voltage			
19.	Radio influence voltage measured at $U/\sqrt{3}$ 1 MHz	μV		
20.	Rated short term thermal current for 1s Rated short term thermal current for 3s	A rms A rms		
21.	Rated dynamic current	kA pk		
22.	Insulation class			
23.	Number of secondary windings			
24.	Location of core			
25.	Core 1 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			

26.	Core 2 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
27.	Core 3 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
28.	Core 4 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
29.	Class X winding: - Rated knee point emf - Exciting current - Resistance ^a *including instrument security factor where applicable	V A		
30.	Is earth screen fitted between primary and secondary windings			
31.	Maximum cantilever strength	Nm		
32.	Type test certificate ref/date			

1.3.3 145KV CURRENT TRANSFORMER

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			145kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Rated lightning impulse withstand voltage		650kVp	
4.	Rated switching impulse withstand voltage		-	
5.	Power frequency withstand voltage (1 min.)		275kVrms	
6.	Corona extinction voltage		-	
7.	Radio interference level for 0.5 MHz to 2 MHz		500 micro V (at 92 kVrms)	
8.	Partial discharge level		10 pC	
9.	Type of insulation		Class A	
10.	Rated primary current	A rms		
11.	Rated secondary current	A rms		
12.	Rated frequency	Hz		
13.	Highest voltage for equipment	kV		
14.	Rated insulation level - primary winding	kV		
15.	Lightning impulse withstand	kV pk		
16.	(a) Power frequency withstand (dry) (b) Power frequency withstand (wet)	kV rms kV rms		
17.	Insulator creepage (phase to earth)	mm		
18.	Electrical dissipation factor at power frequency test voltage			
19.	Radio influence voltage measured at $U/\sqrt{3}$ 1 MHz	μV		
20.	Rated short term thermal current for 1s Rated short term thermal current for 3s	A rms A rms		
21.	Rated dynamic current	kA pk		
22.	Insulation class			
23.	Number of secondary windings			
24.	Location of core			

25.	Core 1 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
26.	Core 2 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
27.	Core 3 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
28.	Core 4 Rated output Accuracy class * Accuracy limit factor burden Resistance ^a			
29.	Class X winding: - Rated knee point emf - Exciting current - Resistance ^a *including instrument security factor where applicable	V A		
30.	Is earth screen fitted between primary and secondary windings			
31.	Maximum cantilever strength	Nm		
32.	Type test certificate ref/date			

1.3.4 36KV CURRENT TRANSFORMER (For Power Transformer bay)

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

1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		<i>insert</i>	
1.5	Country of Origin		EU/UK/USA/ Japan/Turkey or equivalent	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor	
1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earthing		Effectively earthed	
1.12	Service Condition: Seismic Condition	g	0.1	
2.	Current Transformer-Characteristics			
2.1	Nominal System Voltage	kV _{-rms}	33	

2.2	Highest voltage for equipment, U_m	kV _{-rms}	36	
2.3	Rated lightning impulse withstand voltage	kV _{-peak}	170	
2.4	Rated Short duration power frequency voltage	kV _{-rms}	70	
2.5	Rated frequency	Hz	50	
2.6	Rated short-time thermal current, I_{th} , 1s	kA	31.5	
2.7	Rated dynamic current, I_{dyn}	kA	80	
2.8.1	Rated primary current	A	2400	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Electrical dissipation factor at power frequency test voltage		<i>insert</i>	
2.10	Capacitance	pF		
2.11	Maximum Allowable winding temperature	°C	<i>insert</i>	
2.12	Normal current density of primary winding		<i>insert</i>	

2.13	Rated continuous thermal current (40°C): - Core-I - Core-II - Core-III - Core-IV	% In % In % In % In	150 150 120 120	
2.14	Rated Transformer ratio: - Core-I - Core-II - Core-III - Core-IV	A/A A/A A/A A/A	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, $V_k(\text{Min})$ at highest ratio - Core-I - Core-II - Core-III - Core-IV	V	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.18	Max. magnetizing current guaranteed at knee point voltage, I_{Exc} at V_k at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.19	Max. magnetizing current guaranteed at half of knee point voltage, I_{Exc} at $V_k/2$ at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	

2.20	Max. magnetizing current guaranteed at quarter of knee point voltage, I_{Exc} at $V_k/4$ at highest ratio - Core-I - Core-II - Core-III - Core-IV	mA	<i>insert</i> <i>insert</i> <i>insert</i> <i>insert</i>	
2.21	Rated Accuracy limit Factor, ISF/ALF: - Core-I - Core-II - Core-III - Core-IV		≤ 5 ≤ 5 20 20	
2.22	Max. resistance of primary winding at 75 °C, R_{CT} for each rating:	Ohms	<i>insert</i>	
2.23	Max. resistance of secondary winding at 75 °C, R_{CT} for each rating: - Core-I - Core-II - Core-III - Core-IV	Ohms	<i>insert</i>	
3.	Current Transformers-Design & Constructions			
3.1	External Insulator material		Porcelain/Cast resin	

3.2	Internal Insulating medium		Oil paper/Cast resin	
3.3	Type of cast resin (if applicable)		<i>Insert</i>	
3.4	Type including Brand		<i>Insert</i>	
3.5	Quantity of insulating oil		<i>Insert</i>	
3.6	Porcelain Breaking Strength	kN	<i>Insert</i>	
3.7	Minimum creepage distance	mm/kV	≥31	
3.8	In case of resin type, production process type		vacuum	
3.9	Partial discharge level; test voltage U_m test voltage $1.2 U_m/\sqrt{3}$	pC pC	≤10 (non-solid)/50 (solid) ≤5(non-solid)/20 (solid)	
3.10	Min. LV enclosure protection		IP55	
3.11	Insulation Class		Class A/Class E	
3.12	Insulation test tapping data		Yes/No.	
3.13.1	MV terminals : Shape		Flat	
3.13.2	MV terminals: Position		Horizontal	
3.13.3	MV terminals: Material Suitable for		Al terminal	
3.13.4	MV terminals: Adjustable holes		Yes	

3.13.5	MV terminals: Admissible Static Load	KN	<i>insert</i>	
3.13.6	MV terminals: Admissible Dynamic Load	KN	<i>insert</i>	
3.13.7	MV terminals: Cantilever test Load	KN	<i>insert</i>	
3.14	Total weight	kg	<i>insert</i>	
3.15	Total Height	mm	<i>insert</i>	
3.16	Ten delta test terminal provided		Yes	
3.17	Pressure relieving device		Yes	
3.18	Oil level gauge		Yes	
4.	Reliability Data			
4.1	Mean Time to Failure in yrs		<i>insert</i>	
4.2	Expected Operating Life in Yrs		<i>insert</i>	
4.3	Mean time to repair in Hrs		<i>insert</i>	
4.4	Mean time between preventive maintenance in Yrs		<i>insert</i>	
4.5	Mean Time to (perform) preventive maintenance in Hrs		<i>insert</i>	
4.0	Overall compliance with the requirements (yes/no)		Yes/No.	

Note:

1) The oil immersed Type CT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture from the environment. Following accessories / fittings shall, but not restricted to, be supplied along with the Current Transformers.

Ø Pressure release device

Ø Oil level indicator

Ø Lifting lugs

Ø 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.

1.3.5 36kV Current Transformer (For Earthing Transformer)

Sl no.	Particulars	Unit	PGCB's Requirement	Bidder's Guaranteed
1.	Current Transformer-General			
1.1	Manufacturer		<i>insert</i>	
1.2	Country of Manufacturing		Insert	
1.3	Type		Post type vertical mounting, Single Phase, Free Standing, Oil immersed / Resin encapsulated	
1.4	Model designation		<i>insert</i>	
1.5	Country of Origin		EU/UK/USA/ Japan/Turkey or equivalent	
1.6	Standards		IEC 61869-1 IEC 61869-2	
1.7	Quality Control		ISO 9001	
1.8	Installation type		Outdoor	

1.9	Service Condition: Ambient air temperature	°C	-5 to +45	
1.10	Service Condition: Altitude	m	≤1000	
1.11	Service Condition: System Earthing		Effectively earthed	
1.12	Service Condition: Seismic Condition	g	0.1	
2.	Current Transformer-Characteristics			
2.1	Nominal System Voltage	kV _{-rms}	33	
2.2	Highest voltage for equipment, U _m	kV _{-rms}	36	
2.3	Rated lightning impulse withstand voltage	kV _{-peak}	170	
2.4	Rated Short duration power frequency voltage	kV _{-rms}	70	
2.5	Rated frequency	Hz	50	
2.6	Rated short-time thermal current, I _{th} , 1s	kA	31.5	
2.7	Rated dynamic current, I _{dyn}	kA	80	
2.8.1	Rated primary current	A	800	
2.8.2	Rated secondary current	A	1	
2.8.3	Primary reconnection		No	
2.9	Electrical dissipation factor at power frequency test voltage		<i>insert</i>	

2.10	Capacitance	pF	<i>insert</i>	
2.11	Maximum Allowable winding temperature	°C	<i>insert</i>	
2.12	Normal current density of primary winding		<i>insert</i>	
2.13	Rated continuous thermal current (40°C): · Core-I · Core-II · Core-III	% In % In % In	150 120 120	
2.14	Rated Transformer ratio: · Core-I · Core-II · Core-III	A/A A/A A/A	100/1 800/1 800/1 800/1	
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	<i>insert</i> <i>insert</i> <i>insert</i>	
2.18	Max. magnetizing current guaranteed at knee point voltage, I_{Exc} at V_k at highest ratio - Core-I - Core-II - Core-III	mA	<i>insert</i> <i>insert</i> <i>insert</i>	
2.19	Max. magnetizing current guaranteed at half of knee point voltage, I_{Exc} at $V_k/2$ at highest ratio - Core-I - Core-II - Core-III	mA	<i>insert</i> <i>insert</i> <i>insert</i>	
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	<i>insert</i> <i>insert</i> <i>insert</i>	

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 °C, R _{CT} for each rating:	Ohms	<i>insert</i>	
2.23	Max. resistance of secondary winding at 75 °C, R _{CT} for each rating: · Core-I · Core-II · Core-III	Ohms	<i>insert</i>	
3.	Current Transformers-Design & Constructions			
3.1	External Insulator material		Porcelain/Cast resin	
3.2	Internal Insulating medium		Oil paper/Cast resin	
3.3	Type of cast resin (if applicable)		<i>Insert</i>	
3.4	Type including Brand		<i>Insert</i>	
3.5	Quantity of insulating oil		<i>Insert</i>	
3.6	Porcelain Breaking Strength	kN	<i>Insert</i>	
3.7	Minimum creepage distance	mm/kV	≥31	
3.8	In case of resin type, production process type		vacuum	

3.9	Partial discharge level; test voltage U_m test voltage $1.2 U_m/\sqrt{3}$	pC pC	≤ 10 (non-solid)/50 (solid) ≤ 5 (non-solid)/20 (solid)	
3.10	Min. LV enclosure protection		IP55	
3.11	Insulation Class		Class A/Class E	
3.12	Insulation test tapping data		Yes/No.	
3.13.1	MV terminals : Shape		Flat	
3.13.2	MV terminals: Position		Horizontal	
3.13.3	MV terminals: Material Suitable for		Al terminal	
3.13.4	MV terminals: Adjustable holes		Yes	
3.13.5	MV terminals: Admissible Static Load	KN	<i>insert</i>	
3.13.6	MV terminals: Admissible Dynamic Load	KN	<i>insert</i>	
3.13.7	MV terminals: Cantilever test Load	KN	<i>insert</i>	
3.14	Total weight	kg	<i>insert</i>	
3.15	Total Height	mm	<i>insert</i>	
3.16	Ten delta test terminal provided		Yes	
3.17	Pressure relieving device		Yes	
3.18	Oil level gauge		Yes	

4.	Reliability Data			
4.1	Mean Time to Failure in yrs		<i>insert</i>	
4.2	Expected Operating Life in Yrs		<i>insert</i>	
4.3	Mean time to repair in Hrs		<i>insert</i>	
4.4	Mean time between preventive maintenance in Yrs		<i>insert</i>	
4.5	Mean Time to (perform) preventive maintenance in Hrs		<i>insert</i>	
4.0	Overall compliance with the requirements (yes/no)		Yes/No.	

Note:

1)The oil immersed Type CT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture from the environment. Following accessories / fittings shall, but not restricted to, be supplied along with the Current Transformers.

Ø Pressure release device

Ø Oil level indicator

Ø Lifting lugs

Ø 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.

1.4 CAPACITIVE VOLTAGE TRANSFORMERS

1.4.1 420KV CAPACITIVE VOLTAGE TRANSFORMERS (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			420kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Type No.	-		

4.	Transformer type	-		
5.	Rated primary voltage	kV rms	420 kV	
6.	Rated Impedance			
7.	Rated secondary voltage for each secondary winding	kV rms		
8.	Accuracy class for each winding Rated output for each winding	VA		
9.	Rated voltage factor		1.2 continuous; 1.5 for 30 seconds	
10.	Type of Insulation			
11.	Maximum temperature rise	°C		
12.	Short-circuit withstand capability	kA rms		
13.	Primary insulation			
14.	Lightning impulse withstand dry	kV pk		
15.	(a) Power frequency withstand wet (b) Power frequency withstand dry	kV rms kV rms		
16.	Partial discharge magnitude	pC		
17.	Total external creepage distance	mm		
18.	Radio influence voltage measured at $1.1 U_m/\sqrt{3}$ at 1 MHz	μV		
19.	Total installed weight	kg		
20.	Capacitance			
21.	High voltage capacitance (C1)	pF		
22.	Intermediate - voltage capacitance (C2)	pF		
23.	Total Capacitance (C_T)	pF	5000, +10% and -5%	
24.	Open circuit intermediate voltage	kV		
25.	Rated open-circuit intermediate voltage	kV		
26.	Acceptable limit of variation of total capacitance over the entire carrier frequency range		+ 50% and -20% of the rated capacitance	
27.	Stray capacitance and stray conductance of low voltage terminal over the entire capacitance.		As per IEC-358	
28.	Standard reference range of frequencies for which the accuracies are valid		97% to 103% for protection 99% to 101% for metering	
29.	High frequency capacitance for entire carrier frequency range		Within 80% to 150% of rated capacitance	

30.	Equivalent series resistance over the entire carrier frequency range or temperature range (ohms)		Less than 40	
31.	Reference range of temperature	°C		
32.	No. of Protective devices to limit overvoltage & location			

1.4.2 245KV CAPACITIVE VOLTAGE TRANSFORMERS (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			245KV	
33.	Manufacturer & country of origin			
34.	Model Reference (Manufacturer's designation)			
35.	Type No.	-		
36.	Transformer type	-		
37.	Rated primary voltage	kV rms	245 kV	
38.	Rated Impedance			
39.	Rated secondary voltage for each secondary winding	kV rms		
40.	Accuracy class for each winding Rated output for each winding	VA		
41.	Rated voltage factor		1.2 continuous; 1.5 for 30 seconds	
42.	Type of Insulation			
43.	Maximum temperature rise	°C		
44.	Short-circuit withstand capability	kA rms		
45.	Primary insulation			
46.	Lightning impulse withstand dry	kV pk		
47.	(a) Power frequency withstand wet	kV rms		
	(b) Power frequency withstand dry	kV rms		
48.	Partial discharge magnitude	pC		
49.	Total external creepage distance	mm		
50.	Radio influence voltage measured at 1.1 Um/√3 at 1 MHz	μV		
51.	Total installed weight	kg		
52.	Capacitance			
53.	High voltage capacitance (C1)	pF		
54.	Intermediate - voltage capacitance (C2)	pF		

55.	Total Capacitance (C _T)	pF	4400, +10% and -5%	
56.	Open circuit intermediate voltage	kV		
57.	Rated open-circuit intermediate voltage	kV		
58.	Acceptable limit of variation of total capacitance over the entire carrier frequency range		+ 50% and -20% of the rated capacitance	
59.	Stray capacitance and stray conductance of low voltage terminal over the entire capacitance.		As per IEC-358	
60.	Standard reference range of frequencies for which the accuracies are valid		97% to 103% for protection 99% to 101% for metering	
61.	High frequency capacitance for entire carrier frequency range		Within 80% to 150% of rated capacitance	
62.	Equivalent series resistance over the entire carrier frequency range or temperature range (ohms)		Less than 40	
63.	Reference range of temperature	°C		
64.	No. of Protective devices to limit overvoltage & location			

1.4.3 145KV VOLTAGE TRANSFORMERS

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			145KV	
1.	Manufacturer & country of origin	-		
2.	Model Reference (Manufacturer's designation)			
3.	Transformer type	-	Outdoor Inductive oil type	
4.	Rated primary voltage	kV rms	145kV	
5.	Rated Impedance			
6.	Rated secondary voltage for each secondary winding	kV rms		
7.	Accuracy class for each winding Rated output for each winding	VA		
8.	Rated voltage factor			
9.	Type of Insulation			
10.	Maximum temperature rise	°C		
11.	Short-circuit withstand capability	kA rms		
12.	Primary insulation		Class A	
13.	Lightning impulse withstand dry	kV pk	650 kVp	
14.	(a) Power frequency withstand wet (b) Power frequency withstand dry	kV rms kV rms	275 kVrms	

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			145KV	
15.	Partial discharge magnitude	pC	10 pC	
16.	Total external creepage distance	mm		
17.	Radio influence voltage measured at $1.1 U_m/\sqrt{3}$ at 1 MHz	μV	1000 micro V (at 92 kVrms)	
18.	Total installed weight	kg		
19.	No. of Protective devices to limit overvoltage & location			

1.4.4 36KV VOLTAGE TRANSFORMERS

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			36KV	
20.	Manufacturer & country of origin	-		
21.	Model Reference (Manufacturer's designation)			
22.	Transformer type	-	Outdoor Inductive oil type	
23.	Rated primary voltage	kV rms	36kV	
24.	Rated Impedance			
25.	Rated secondary voltage for each secondary winding	kV rms		
26.	Accuracy class for each winding Rated output for each winding	VA		
27.	Rated voltage factor			
28.	Type of Insulation			
29.	Maximum temperature rise	°C		
30.	Short-circuit withstand capability	kA rms		
31.	Primary insulation		Class A	
32.	Lightning impulse withstand dry	kV pk	170 kVp	
33.	(a) Power frequency withstand wet (b) Power frequency withstand dry	kV rms kV rms	70 kVrms	
34.	Partial discharge magnitude	pC	10 pC	
35.	Total external creepage distance	mm		
36.	Radio influence voltage measured at $1.1 U_m/\sqrt{3}$ at 1 MHz	μV	1000 micro V (at 92 kVrms)	
37.	Total installed weight	kg		
38.	No. of Protective devices to limit overvoltage & location			

1.5 SURGE ARRESTERS
1.5.1 420KV Surge Arrester (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			420kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Max. highest system voltage		420kV	
4.	Type		Outdoor type, ZnO, Gapless	
5.	Standard		IEC 60099-4	
6.	Rated voltage		390kV	
7.	Max. continuous operating voltage		303kVrms	
8.	Nominal discharge current		10kA	
9.	Discharge class		Heavy duty 3	
10.	Surge counter		Yes	
11.	Leakage current detector		Yes	
12.	Applicable Standard			
13.	System Earthing			
14.	Rated Frequency			
15.	Rated system voltage			
16.	Highest system voltage			
17.	Continuous operating voltage	kV rms		
18.	Rated voltage	kV rms		
19.	Standard nominal discharge current	kA		
20.	Reference current at ambient temperature	mA		
21.	Reference voltage for above item no. 7	kV rms		
22.	Currents at MCOV			
23.	Residual Voltage			
24.	Steep current impulse residual voltage	kV pk		
25.	Protective Ratio			

26.	Lightning impulse residual voltage at 5kA 10kA 20kA	kV pk kV pk kV pk		
27.	Duty Class			
28.	Discharge class			
29.	Pressure relief class			
30.	Minimum Energy Discharge Capability			
31.	Temporary Over Voltage Capability at 0.1s 1s 10s 100s			
32.	Nominal diameter of resistor blocks	mm		
33.	Number of resistor blocks connected electrically in parallel			
34.	Number of separately housed units per phase			
35.	Overall height of arrester (without supporting structure)	m		
36.	Overall height of arrester including grading ring if applicable	mm		
37.	Clearances: phase to earth (from centre line) phase to phase (centre line to centre line)	mm mm		
38.	Overall Weight of arrester (without supporting structure)	kg		
39.	Maximum cantilever strength	Nm		
40.	Maximum force due to wind (at maximum specified gust speed)	Nm		
41.	Minimum creepage distance over insulator housing	mm		
42.	Insulator shed profile - Reference Document			
43.	Terminal palm details - Drawing No.			

44.	Earthing terminal - Drawing No.			
45.	Type & Description of surge monitoring device			
46.	Type test certificate ref/date			
47.	Number of the same type of surge arresters supplied to date			

1.5.2 245KV Surge Arrester (NOT APPLICABLE)

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			245KV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Max. highest system voltage		245KV	
4.	Type		Outdoor type, ZnO, Gapless	
5.	Standard		IEC 60099-4	
6.	Rated voltage		196kV	
7.	Max. continuous operating voltage		160kVrms	
8.	Nominal discharge current		10kA	
9.	Discharge class		Heavy duty 3	
10.	Surge counter		Yes	
11.	Leakage current detector		Yes	
12.	Applicable Standard			
13.	System Earthing			
14.	Rated Frequency			
15.	Rated system voltage			
16.	Highest system voltage			
17.	Continuous operating voltage	kV rms		
18.	Rated voltage	kV rms		
19.	Standard nominal discharge current	kA		
20.	Reference current at ambient temperature	mA		
21.	Reference voltage for above item no. 7			

		kV rms		
22.	Currents at MCOV			
23.	Residual Voltage			
24.	Steep current impulse residual voltage	kV pk		
25.	Protective Ratio			
26.	Lightning impulse residual voltage at 5kA 10kA 20kA	kV pk kV pk kV pk		
27.	Duty Class			
28.	Discharge class			
29.	Pressure relief class			
30.	Minimum Energy Discharge Capability			
31.	Temporary Over Voltage Capability at 0.1s 1s 10s 100s			
32.	Nominal diameter of resistor blocks	mm		
33.	Number of resistor blocks connected electrically in parallel			
34.	Number of separately housed units per phase			
35.	Overall height of arrester (without supporting structure)	m		
36.	Overall height of arrester including grading ring if applicable	mm		
37.	Clearances: phase to earth (from centre line) phase to phase (centre line to centre line)	mm mm		
38.	Overall Weight of arrester (without supporting structure)	kg		
39.	Maximum cantilever strength	Nm		
40.	Maximum force due to wind (at maximum specified gust speed)	Nm		
41.		mm		

	Minimum creepage distance over insulator housing			
42.	Insulator shed profile - Reference Document			
43.	Terminal palm details - Drawing No.			
44.	Earthing terminal - Drawing No.			
45.	Type & Description of surge monitoring device			
46.	Type test certificate ref/date			
47.	Number of the same type of surge arresters supplied to date			

1.5.3 145KV Surge Arrester

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			145kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Max. highest system voltage		145kV	
4.	Type		Outdoor type, ZnO, Gapless	
5.	Standard		IEC 60099-4	
6.	Rated voltage		120kV	
7.	Max. continuous operating voltage		102kVrms	
8.	Nominal discharge current		10kA	
9.	Discharge class		Heavy duty 3	
10.	Surge counter		Yes	
11.	Leakage current detector		Yes	
12.	Applicable Standard			
13.	System Earthing			
14.	Rated Frequency			
15.	Rated system voltage			
16.	Highest system voltage			
17.	Continuous operating voltage	kV rms		
18.	Rated voltage	kV rms		

19.	Standard nominal discharge current	kA		
20.	Reference current at ambient temperature	mA		
21.	Reference voltage for above item no. 7	kV rms		
22.	Currents at MCOV			
23.	Residual Voltage			
24.	Steep current impulse residual voltage	kV pk		
25.	Protective Ratio			
26.	Lightning impulse residual voltage at 5kA 10kA 20kA	kV pk kV pk kV pk		
27.	Duty Class			
28.	Discharge class			
29.	Pressure relief class			
30.	Minimum Energy Discharge Capability			
31.	Temporary Over Voltage Capability at 0.1s 1s 10s 100s			
32.	Nominal diameter of resistor blocks	mm		
33.	Number of resistor blocks connected electrically in parallel			
34.	Number of separately housed units per phase			
35.	Overall height of arrester (without supporting structure)	m		
36.	Overall height of arrester including grading ring if applicable	mm		
37.	Clearances: phase to earth (from centre line) phase to phase (centre line to centre line)	mm mm		
38.	Overall Weight of arrester (without supporting structure)	kg		
39.	Maximum cantilever strength	Nm		

40.	Maximum force due to wind (at maximum specified gust speed)	Nm		
41.	Minimum creepage distance over insulator housing	mm		
42.	Insulator shed profile - Reference Document			
43.	Terminal palm details - Drawing No.			
44.	Earthing terminal - Drawing No.			
45.	Type & Description of surge monitoring device			
46.	Type test certificate ref/date			
47.	Number of the same type of surge arresters supplied to date			

1.5.4 36KV Surge Arrester

Sl. No.	Description	Unit	Minimum Requirements	Guaranteed Technical Particulars
			36kV	
1.	Manufacturer & country of origin			
2.	Model Reference (Manufacturer's designation)			
3.	Max. highest system voltage		36kV	
4.	Type		Outdoor type, ZnO, Gapless	
5.	Standard		IEC 60099-4	
6.	Rated voltage		30kV	
7.	Max. continuous operating voltage		25kV	
8.	Nominal discharge current		10kA	
9.	Discharge class		Heavy duty 3	
10.	Surge counter		Yes	
11.	Leakage current detector		Yes	
12.	Applicable Standard			
13.	System Earthing			
14.	Rated Frequency			
15.	Rated system voltage			
16.	Highest system voltage			
17.	Continuous operating voltage	kV rms		

18.	Rated voltage	kV rms		
19.	Standard nominal discharge current	kA		
20.	Reference current at ambient temperature	mA		
21.	Reference voltage for above item no. 7	kV rms		
22.	Currents at MCOV			
23.	Residual Voltage			
24.	Steep current impulse residual voltage	kV pk		
25.	Protective Ratio			
26.	Lightning impulse residual voltage at 5kA 10kA 20kA	kV pk kV pk kV pk		
27.	Duty Class			
28.	Discharge class			
29.	Pressure relief class			
30.	Minimum Energy Discharge Capability			
31.	Temporary Over Voltage Capability at 0.1s 1s 10s 100s			
32.	Nominal diameter of resistor blocks	mm		
33.	Number of resistor blocks connected electrically in parallel			
34.	Number of separately housed units per phase			
35.	Overall height of arrester (without supporting structure)	m		
36.	Overall height of arrester including grading ring if applicable	mm		
37.	Clearances: phase to earth (from centre line) phase to phase (centre line to centre line)	mm mm		

38.	Overall Weight of arrester (without supporting structure)	kg		
39.	Maximum cantilever strength	Nm		
40.	Maximum force due to wind (at maximum specified gust speed)	Nm		
41.	Minimum creepage distance over insulator housing	mm		
42.	Insulator shed profile - Reference Document			
43.	Terminal palm details - Drawing No.			
44.	Earthing terminal - Drawing No.			
45.	Type & Description of surge monitoring device			
46.	Type test certificate ref/date			
47.	Number of the same type of surge arresters supplied to date			

1.6 STEEL STRUCTURES, CONDUCTOR ,INSULATOR SETS & FITTINGS

No	Description	Unit	Minimum Requirements	Guaranteed
1	Structural Steel			
1.1	Type and standard specification		Insert	
1.2	Manufacturer and country		Insert	
1.3	Minimum yield strength	kg/mm ²	Insert	
1.4	Ultimate tensile strength	kg/mm ²	Insert	
2.	Copper Conductors for Earthing system			
2.1	Type and standard specification		Insert	
2.2	Manufacturer and country		Insert	
2.3	Conductor material		Insert	
2.4	Size of conductors (Solid copper rods)	mm ²	Insert	
2.5	Size of conductors (Flat copper bars) (Width×Thickness×Bundles)	mm	Insert	
2.6	Rated current	A	Insert	
2.7	Short time withstand current	kA rms	Insert	

2.8	Peak withstand current	kA pk	Insert	
3	High Voltage Bus Work			
3.1	Switchyard Conductor			
3.1.1	Copper Tubular Conductors for Busbar			
3.1.1.1	Type and standard specification		Insert	
3.1.1.2	Manufacturer and country		Insert	
3.1.1.3	Inner diameter	mm	Insert	
3.1.1.4	Outer diameter	mm	Insert	
3.1.1.5	Rated continuous current (site rating)	A rms	Insert	
3.1.1.6	Temperature rise at rated current	°C	Insert	
3.1.1.7	Rated short time current	kA rms	Insert	
3.1.1.8	Peak withstand current	kA pk	Insert	
3.1.1.9	Weight	kg/m	Insert	
3.1.2	Aluminium Tubular Conductors for Busbar			
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	°C	Insert	
3.1.2.7	Rated short time current	kA rms	Insert	
3.1.2.8	Peak withstand current	kA pk	Insert	
3.1.2.9	Weight	kg/m	Insert	
3.1.2.10	Moment of inertia	kg-m ²	Insert	
3.1.2.11	Temperature rise at rated current	°C	Insert	
3.1.2.12	Rated short time current	kA rms	Insert	
3.1.2.13	Peak withstand current	kA pk	Insert	
3.1.2.14	Rated ultimate tensile strength	kN	Insert	
3.1.2.15	Mass, nominal	kg/m	Insert	
3.1.2.16	No. of conductors per bundle		Insert	
3.1.2.17	Bundle configuration		Insert	
3.1.2.18	Bundle spacing			
3.1.3	Flexible Bus Conductor			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Conductor type		Insert	
	Conductor size		Insert	
	Standing - No. of Al wires Dia. Of each wire	mm	Insert	

	Overall conductor dia.	mm	Insert	
	Cross-sectional area	mm ²	Insert	
	Rated continuous current (site rating)	A rms	Insert	
	Temperature rise at rated current	°C	Insert	
	Rated short time current	kA rms	Insert	
	Peak withstand current	kA pk	Insert	
	Rated ultimate tensile strength	kN	Insert	
	Mass, nominal	kg/m	Insert	
	No. of conductors per bundle		Insert	
	Bundle configuration		Insert	
	Bundle spacing		Insert	
3.1.4	Shield Wire			
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Dia. of galvanized steel wire	mm	Insert	
	Stranding -No. of Al wires Dia. Of each wire	mm	Insert	
	Grade of wire		Insert	
	Weight of wire	kg/km	Insert	
	Minimum breaking strength of wire	kN	Insert	
No	Description	Unit	Minimum Requirements	Guaranteed
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	

No	Description	Unit	Minimum Requirements	Guaranteed
	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 - Combined electrical and mechanical strength Impact strength	N N N-m N N N-m	Insert	
3.2.2	String Type		Insert	
	Type and standard specification		Insert	
	Manufacturer and country		Insert	
	Insulator unit, length	mm	Insert	
	No. of units in each insulator		Insert	
	No. of insulator strings per conductor (at each end)		Insert	
	Dia. of disc	mm	Insert	
	Disc spacing	mm	Insert	
	Power frequency flashover voltage - Dry Wet	kV kV	Insert	
	Impulse flashover voltage - Positive	kV	Insert	

No	Description	Unit	Minimum Requirements	Guaranteed
	Negative	kV		
	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	
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	

1.7 Post Insulator (400kV) **(NOT APPLICABLE)**

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	Post Insulators - General			
1.1	Manufacturer		Insert	
1.2	Type		Insert	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60168 IEC 60273 IEC 60672 IEC 60694	
1.6	Quality control		ISO 9001	
1.7	Design		Solid core, porcelain, outdoor	
2	Post Insulators - Characteristics			
2.1	Nominal system voltage	kV _{rms}	400	
2.2	Highest voltage for equipment U ⁿ	kV _{rms}	420	
2.3	Rated lightning impulse withstand voltage (Wet and Dry)	kV _{peak}	1425	
2.4	Rated switching impulse withstand voltage	kV _{peak}	1050	
2.5	One min. power freq. withstand voltage (Wet and Dry)	kVrms	630	
2.6	Rated frequency f ^r	Hz	50	
2.7	Minimum creepage distance	mm/kV	Min. ≥ 25 mm/kV	
2.8	Total creepage distance, pedestal	mm	Min. ≥ 10500 mm	
2.9	Failing load bending (p0) (C10)	N	≥ 12500 Calculation is required during design	
2.10	Failing load torsion	Nm	≥ 4000 Calculation is required during design	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Total min. cantilever strength	kg	≥ 1000	
2.12	Corona extinction voltage	(kVrms)	320	
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	Insulator height	mm	Insert	
3.5.1	Total min. height of insulator	(mm)	≥ 3500	
3.6	Max. diameter of insulating part	mm	Insert	
3.7	Diameter of upper base	mm	Insert	
3.8	Number of holes on upper base		Insert	
3.9	Diameter distance between holes on upper base	mm	Insert	
3.10	Hole type on upper base		Insert	
3.11	Diameter on lower base	mm	Insert	
3.12	Number of holes on lower base		Insert	
3.13	Diameter distance between holes on lower base	mm	Insert	
3.14	Hole type on lower base		Insert	
3.15	Insulator weight	kg	Insert	
Overall compliance with the requirements & detail specification described in Vol-2		Yes		

1.8 Post Insulator (245kV) (NOT APPLICABLE)

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}	230	
2.2	Highest voltage for equipment U ⁿ	kV _{rms}	245	
2.3	Rated lightning impulse withstand voltage (Wet and Dry)	kV _{peak}	1050	
2.4	Rated switching impulse withstand voltage	kV _{peak}	850	
2.5	One min. power freq. withstand voltage (Wet and Dry)	kVrms	460	
2.6	Rated frequency f ^r	Hz	50	
2.7	Minimum creepage distance	mm/kV	Min. ≥ 25 mm/kV	
2.8	Total creepage distance, pedestal	mm	Min. ≥ 6125 mm	
2.9	Failing load bending (p0) (C10)	N	≥ 10000 Calculation is required during design	
2.10	Failing load torsion	Nm	≥ 4000 Calculation is required during design	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Total min. cantilever strength	kg	≥ 800	
2.12	Corona extinction voltage	kVrms	156	
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	Insulator height	mm	Insert	
3.5.1	Total min. height of insulator	(mm)	≥ 2500	
3.6	Max. diameter of insulating part	mm	Insert	
3.7	Diameter of upper base	mm	Insert	
3.8	Number of holes on upper base		Insert	
3.9	Diameter distance between holes on upper base	mm	Insert	
3.10	Hole type on upper base		Insert	
3.11	Diameter on lower base	mm	Insert	
3.12	Number of holes on lower base		Insert	
3.13	Diameter distance between holes on lower base	mm	Insert	
3.14	Hole type on lower base		Insert	
3.15	Insulator weight	kg	Insert	
Overall compliance with the requirements & detail specification described in Vol-2		Yes		

1.9 Post Insulator (145kV)

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}	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 switching impulse withstand voltage (Wet and Dry)	kV _{peak}	-	
2.5	One min. power freq. withstand voltage (Wet and Dry)	kVrms	275	
2.6	Rated frequency f ^r	Hz	50	
2.7	Minimum creepage distance	mm/kV	Min. ≥ 25 mm/kV	
2.8	Total creepage distance, pedestal	mm	Min. ≥ 3625 mm	
2.9	Failing load bending (p0) (C10)	N	≥ 10000 Calculation is required during design	
2.10	Failing load torsion	Nm	≥ 4000 Calculation is required during design	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Total min. cantilever strength	kg	≥ 800	
2.12	Corona extinction voltage	kVrms	Insert	
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^g	MPa	≥ 140	
3.5	Insulator height	mm	Insert	
3.5.1	Total min. height of insulator	mm	≥2500	
3.6	Max. diameter of insulating part	mm	Insert	
3.7	Diameter of upper base	mm	Insert	
3.8	Number of holes on upper base		Insert	
3.9	Diameter distance between holes on upper base	mm	Insert	
3.10	Hole type on upper base		Insert	
3.11	Diameter on lower base	mm	Insert	
3.12	Number of holes on lower base		Insert	
3.13	Diameter distance between holes on lower base	mm	Insert	
3.14	Hole type on lower base		Insert	
3.15	Insulator weight	kg	Insert	
Overall compliance with the requirements & detail specification described in Vol-2		Yes		

PART 2 – TRANSFORMERS

2.1 400/230/33 kV, 400/520MVA, 3-PHASE POWER TRANSFORMER: (NOT APPLICABLE)

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 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	Tertiary winding function		Stabilizing winding & auxiliary power supply	
1.8	Thermal insulation class		A	
2	Ratings and properties			
2.1	Rated power: • Primary / secondary winding • Tertiary - minimum	MVA MVA	520 / 520 ≥ 104	
2.2	Rated power by cooling ONAN / ONAF • Primary / secondary winding • Tertiary – minimum	MVA MVA	400 / 520 ≥ 80 / ≥ 104	
2.3	Rated voltage of windings: • HV winding • MV winding • LV - stabilizing winding	kV kV kV	400 230 33	
2.4	Tap changer:			
	• Manufacturer		Insert	
	• Country of origin		Insert	
	• Model designation		insert	
	• Type of tap changing		On-load	
	• Tap changer location		At High voltage side	
	• Type of voltage regulation	%	C.F.V.V.	
	• Tapping range	%	±10	
	•			
	• Tapping step		1.25	
	• Rating		Rated power 520 MVA, all taps	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.5	Frequency	Hz	50	
2.6	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	
2.7	Neutral point insulation		Li95	
2.8	Low voltage winding connection (LV)		closed delta, with three terminals brought out outside of the tank	
2.9	Type of oil preservation system		Air Cell	
2.10	Maximum acceptable noise level		78dB	
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 - MV, on the basis of rated power with on-load tap changer in middle position	%	13 ±10 %	
3.1.2	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.1.3	MV - LV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	Insert	
3.2	Zero-sequence impedance, with tap changer in middle position: • HV/MV • HV/LV • MV/LV	% % %	Insert Insert Insert	
3.3	Autotransformer capacity to withstand external short circuits			
3.3.1	Short-circuit duration	s	2	
3.3.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period: • HV winding • MV winding • LV winding • Pre-fault voltage	kA kA kA p.u.	63 50 31.5 1.05	
3.4	Guaranteed losses			
3.4.1	a. No-load losses with tap changer in nominal tap position: at rated voltage and rated frequency	kW	Insert	
	b. No-load losses with tap changer in nominal tap position at 110% rated voltage and rated frequency	kW	Insert	
	c. No-load losses with tap changer in nominal tap position at 90% rated voltage, at rated frequency	kW	Insert	
	d. average no load loss (this value will be evaluated)	kW	(a+b+c)/3	
3.4.2	No-load losses capitalized value	BDT/kW	As per vol 1 of tender doc	
3.4.3	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.4	a. On-load losses at 75°C, with tap changer in nominal position and at rated current of that tap position	kW	Insert	
	b. On-load losses at 75°C, with tap position in plus (+) extreme tap position and at rated current of that position	kW	Insert	
	c. On-load losses at 75°C, with tap position in minus (-) extreme tap position and at rated current of that position	kW	Insert	
	d. average on load losses (this value will be evaluated)	kW	(a+b+c)/3	
3.4.5	On-load losses capitalized value	BDT/kW	As per vol 1 of tender doc	
3.4.6	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.5	Ancillary equipment (fans, pumps, heaters, etc.)			
3.5.1	Load of ancillary equipment (<u>this value will be evaluated</u>)	kW	Insert	
3.5.2	Capitalized valued of ancillary equipment load	BDT/kW	As per vol 1 of tender doc	
3.5.3	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
3.6	Insulation level			
3.6.1	High voltage (HV)		LI 1425 SI1050	
3.6.2	Medium voltage (MV)		LI 1050 AC 460	
3.6.3	Neutral		LI 170 AC 70	
3.6.4	Low voltage (LV)		LI 170 AC 70	
3.7	The highest voltage for equipment (effective value)			
3.7.1	High voltage (HV)	kV	420	
3.7.2	Medium voltage (MV)	kV	245	
3.7.3	Neutral	kV	36	
3.7.4	Low voltage (LV)	kV	36	
3.8	Rated insulation level			
3.8.1	Induced voltage (ACSD, ACLD)	kV	In acc. to IEC 60076-3	
3.9	Efficiencies			
3.9.1	If $\cos\phi = 1.0$ and: 25 % load of the rated value 50 % load of the rated value 75 % load of the rated value 100 % load of the rated value		Insert Insert Insert Insert	
3.9.2	If $\cos\phi = 0.8$ (inductive) and: 25 % load of the rated value 50 % load of the rated value 75 % load of the rated value 100 % load of the rated value		Insert Insert Insert Insert	
3.10	Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position			
3.10.1	• $\cos\phi = 1.00$		Insert	
3.10.2	• $\cos\phi = 0.95$ (inductive)		Insert	
3.10.3	• $\cos\phi = 0.90$ (inductive)		Insert	
3.10.4	• $\cos\phi = 0.80$ (inductive)		Insert	

3.11	No-load current at rated frequency			
3.11.1	At 0.90 Un		Insert	
3.11.2	At 1.00 Un		Insert	
3.11.3	At 1.05 Un		Insert	
3.12	Temperature rise limits, at rated power, with complete cooling system in service and at lowest volt- age tap			
3.12.1	Top oil	K	≤ 50	
3.12.2	Winding	K	≤ 55	
3.12.3	Hottest spot	K	≤ 65	
3.13	At the emergency cases it is allowed: - Continuous overload at the highestwinding 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)	MVA %	Compliant to IEC 60076-7	
3.14	Guaranteed value of overloads in % of the rated power			
3.14.1	Normal overloads prediction which can occur once a day (in % of the rated power) within the winding temperature rise limit of 75°C			
3.14.1.1	After operation under 15 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	
3.14.1.2	After operation under 20 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	
3.14.1.3	After operation under 120 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	
3.14.2	Sudden transient overloads (in % of the rated power) with the winding temperature rise limit of 85°C			
3.14.2.1	After operation under 15 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	
3.14.2.2	After operation under 15 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	
3.14.2.3	After operation under 15 min - full rated power ¾ rated power ½ rated power		Insert Insert Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.15	Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits: - with all cooling groups in operation (excluding stand-by cooling group) - with one cooling group out of operation - with two cooling groups out of operation		Insert Insert Insert	
4	Oil			
4.1	New		Insert	
4.2	Manufacturer		Insert	
4.3	Type		Insert	
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	Insert	
4.6	Viscosity at 20°C	mm ² /s	Insert	
4.7	Maximum dielectric strength	kV/cm	Insert	
4.8	Data sheet attached		Insert	
4.9	Corrosive Sulphur		Non-Corrosive	
4.10	PCB content		Without PCB	
5	Bushing			
5.1	HV bushing			
5.1.1	Quantity		3	
5.1.2	Class	kV	420	
5.1.3	Manufacturer		Insert	
5.1.4	Type		Insert	
5.1.5	Rated current	A	≥ 1000	
5.1.6	Rated short circuit current (2 s)	kA rms	63	
5.1.7	Rated lightning impulse withstand voltage	kV peak	1425	
5.1.8	Rated switching impulse withstand voltage	kV peak	1050	
5.1.9	Rated power frequency withstand voltage	kV rms	650	
5.1.10	Connectors			
5.1.10.1	Shape	mm	Ø 50	
5.1.10.2	Length	mm	125	
5.1.10.3	Suitable for		Al wire	
5.1.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.1.12	Full vacuum withstand of complete bushing		YES	
5.2	Neutral bushing (identical as LV bushing)			
5.2.1	Quantity		1	
5.2.2	Class	kV	52	
5.2.3	Manufacturer		Insert	
5.2.4	Type		Insert	
5.2.5	Rated current	A	≥ 2000	
5.2.6	Rated short-circuit current (2 s)	kA rms	50	
5.2.7	Rated lightning impulse withstand voltage	kV peak	250	
5.2.8	Rated switching impulse withstand voltage	kV peak	-	
5.2.9	Rated power frequency withstand voltage	kV rms	95	
5.2.10	Connectors			
5.2.10.1	Shape	mm	Flat	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2.10.2	Length	mm	-	
5.2.10.3	Suitable for		Cu wire	
5.2.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.2.12	Full vacuum withstand of complete bushing		YES	
5.3	MV bushings			
5.3.1	Quantity		3	
5.3.2	Class	kV	245	
5.3.3	Manufacturer		Insert	
5.3.4	Type		Insert	
5.3.5	Rated current	A	≥ 1600	
5.3.6	Rated short-circuit current (2 s)	kA rms	50	
5.3.7	Rated lightning impulse withstand voltage	kV peak	1050	
5.3.8	Rated switching impulse withstand voltage	kV peak	-	
5.3.9	Rated power frequency withstand voltage	kV rms	460	
5.3.10	Connectors			
5.3.10.1	Shape	mm	$\varnothing 50$	
5.3.10.2	Length	mm	125	
5.3.10.3	Suitable for		Al wire	
5.3.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.3.12	Full vacuum withstand of complete bushing		YES	
5.4	LV bushings			
5.4.1	Quantity		3	
5.4.2	Class	kV	52	
5.4.3	Manufacturer		Insert	
5.4.4	Type		Insert	
5.4.5	Rated current	A	≥ 2000	
5.4.6	Rated short-circuit current (2 s)	kA rms	31.5	
5.4.7	Rated lightning impulse withstand voltage	kV peak	250	
5.4.8	Rated switching impulse withstand voltage	kV peak	-	
5.4.9	Rated power frequency withstand voltage	kV rms	95	
5.4.10	Connectors			
5.4.10.1	Shape	mm	Flat	
5.4.10.2	Length	mm	-	
5.4.10.3	Adjusted for Cu wire		Cu wire	
5.4.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.4.12	Full vacuum withstand of complete bushing		YES	
6	Design Data			
6.1	Maximum flux density in the legs • At rated voltage • At 105 % of the rated voltage	T T	Insert Insert	
6.2	Maximum flux density in the yokes: • At rated voltage • At 105 % of the rated voltage	T T	Insert Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.3	Maximum current density in windings at rated power and normal tap changer position: • HV winding • MV winding • LV - stabilizing winding	A/mm ² A/mm ² A/mm ²	Insert Insert Insert	
6.4	Winding resistance at 75°C and middle tap changer position: • HV winding • MV winding • LV - stabilizing winding	Ω Ω Ω	Insert Insert Insert	
6.5	Core construction			
6.5.1	Method of joining of legs		Insert	
6.5.2	Method of joining of yokes		Insert	
6.5.3	Joining material		Insert	
6.5.4	Number of legs		Insert	
6.5.5	Type of core steel		Insert	
6.5.6	Specific loss of core steel at 1.7 T inductance	W/kg	< 1.11	
6.6	Winding conductor			
6.6.1	HV winding		Cu - Interleaved & Continuous	
6.6.2	MV winding		Cu - Continuous	
6.6.3	LV - stabilizing winding		Cu - Helical	
6.7	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete cooling system in service	dB	Insert	
6.8	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	μV	2500 max	
7	Weights and dimensions			
7.1	Total weight of autotransformer, equipped for service	kg	less or equals to attached GA value*	
7.2	Core and oil assembly	kg	insert*	
7.3	Total mass excluding oil	kg	insert*	
7.4	Tank and accessories	kg	insert*	
7.5	Oil mass in tank	kg	insert*	
7.6	Oil mass in coolers	kg	insert*	
7.7	Oil mass total	kg	insert*	
7.8	Total mass	kg	insert*	
7.9	Maximum shipping weight (the heaviest item)	kg	insert*	
7.10	Height from foundation to: • Highest point of HV bushing • Highest point of tank • Highest point of conservator • Highest point of lifting hook for removal of core and oil assembly	mm mm mm mm	As per GA* As per GA* As per GA* As per GA*	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
7.11	Outer dimensions: • Length • Width	mm mm	As per GA* As per GA*	
7.12	Informative dimensional sketch		To be enclosed with bid	
7.13	Maximum shipping dimensions of tank: • Outside height • Outside width • Outside length	mm mm mm	insert	
7.14	Transportation drawing		To be enclosed with bid	
8	Tap changer			
8.1	Manufacturer		Insert	
8.2	Type		Insert	
8.3	Insulation level	kV	Li 1050	
8.4	Rated current	A	≥ 1000	
8.5	Number of steps		17	
8.6	Regulating coil		At auto point	
8.7	Short-circuit withstand	kA rms	Insert	
8.8	BIL to ground through the regulating coil	kV peak	Insert	
8.9	Power frequency withstand voltage for 1 minute through the regulating coil	kV rms	Insert	
8.10	Tap position indicator		Digital code matrix (BCD)	
8.11	Auxiliary supply		3x400 V / 230 V, 50 Hz	
8.12	Type of control		On load local, remote and supervisory electrical and hand operation	
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		3x400 V / 50 Hz	
10	Current transformer incorporated into the power autotransformer			
10.1	CT in HV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
10.2	CT in MV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
10.3	CT in neutral bushing , for protection		In all phases, 3cores characteristics shall be defined in design stage	
10.4	CT in LV bushings, for protection		In all phases, 3 cores characteristics shall be defined in design stage	
11	Layout			
11.1	Primary winding bushings		Longitudinal axis	
11.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
11.3	Conservator tank		To be defined in design stage	
11.4	Tap changer		To be defined in design stage	
11.5	Control cabinet		To be defined in design stage	
11.6	Coolers		To be defined in design stage	
11.7	Connection drawing, block diagram		To be enclosed with bid	
12	Cooling groups			
12.1	Number of cooling groups (total)	Qty.	4	
12.2	Number of cooling groups (for rated power)	Qty.	3	
12.3	Number of stand-by cooling groups	Qty.	One fan in each group with failing of one fan shall not reduce the MCR	
12.4	Number of coolers in a cooling group	Qty.	Insert	
12.5	Number of spare fans	Qty.	Insert	
12.6	Rating of each cooler	kW	Insert	
12.7	Power factor of the fan motor of each fan			
12.8	Full vacuum withstand of complete cooler	mbar	Yes	
13	Dehydrating breather			
13.1	Type of dehydrating breather		Insert	
13.2	Dehumidifying agent	kg	Insert	
14	Autotransformer tank			
14.1	Type of design			
14.2	Thickness of transformer tank: • Sides • Bottom • Top	mm mm mm	Insert Insert Insert	
14.3	Material of the autotransformer tank		Insert	
14.4	Wheels			
14.4.1	Wheel number for each rail of two pair rails		Two pairs	
14.4.2	Axial inter space in transversal direction between two pairs of rails	mm	insert	
14.4.3	Transversal distance between wheels in pair	mm	insert	
14.4.4	Distance between wheels in longitudinal direction	mm	insert	
14.5	Corrosion protection of the tank		YES	
14.6	Vacuum withstand of the complete tank with cooler	mbar	insert	
14.7	Over-pressure withstand of the complete autotransformer	bar	insert	
15	Conservator			
15.1	Type		With diaphragm	
15.2	Number of compartments	pcs.	2	
15.3	Total volume of conservator	m ³	Insert	
15.4	Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 0°C of the volume of autotransformer	%	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
15.5	Pressure rise inside the tank due to oil expansion		Insert	
15.6	Diagraph design parameters: - Maximum diagraph stress at highest working pressure - Diagraph construction details - Type of diagraph material		Insert Insert Insert	
15.7	Corrosion protection of conservator		Insert	
15.8	Oil level indicators with alarm for minimum oil level	pcs.	2	
16	Operating conditions			
16.1	At the altitude (above sea level)	m	≤ 1000	
16.2	Maximum ambient temperature	°C	+ 45	
16.3	Average daily temperature	°C	+ 35	
16.4	Average annual temperature	°C	+ 30	
16.5	Minimum ambient temperature	°C	– 5	
16.6	Tertiary winding		Will be used	
16.7	Parallel operation		Yes	
	Overall compliance with the requirements (yes/no)			

* Guaranteed values subject to deduction from Contract Price

**These values are required for Foundation design & shipping purpose only. During detail design, these values may vary from Bid value due to attaining desired electrical output.

2.2 230/132/33 kV, 225/300MVA, 3-PHASE POWER TRANSFORMER: (NOT APPLICABLE)

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 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	Tertiary winding function		Stabilizing winding & auxiliary power supply	
1.8	Thermal insulation class		A	
2	Ratings and properties			
2.1	Rated power: • Primary / secondary winding • Tertiary - minimum	MVA MVA	300 / 300 ≥ 100	
2.2	Rated power by cooling ONAN / ONAF • Primary / secondary winding • Tertiary – minimum	MVA MVA	225 / 300 ≥ 75 / ≥ 100	
2.3	Rated voltage of windings: • HV winding • MV winding • LV - stabilizing winding	kV kV kV	230 132 33	
2.4	Tap changer:			
	• Manufacturer		Insert	
	• Country of origin		Insert	
	• Model designation		insert	
	• Type of tap changing		On-load	
	• Tap changer location		At High voltage side	
	• Type of voltage regulation	%	C.F.V.V.	
	• Tapping range	%	±10	
	Tapping step		1.25	
	Rating		Rated power 300 MVA, all taps	
2.5	Frequency	Hz	50	
2.6	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.7	Neutral point insulation		Li95	
2.8	Low voltage winding connection (LV)		closed delta, with three terminals brought out outside of the tank	
2.9	Type of oil preservation system		Air Cell	
2.10	Maximum acceptable noise level		78dB	
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 - MV, on the basis of rated power with on-load tap changer in middle position	%	13 ±10 %	
3.1.2	HV - LV, on the basis of rated power with on-load tap changer in middle position	%	Insert	
3.1.3	MV - LV, on the basis of rated power 'x' MVA with on-load tap changer in middle position	%	Insert	
3.2	Zero-sequence impedance, with tap changer in middle position: • HV/MV • HV/LV • MV/LV	% % %	Insert Insert Insert	
3.3	Autotransformer capacity to withstand external short circuits			
3.3.1	Short-circuit duration	s	2	
3.3.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period: • HV winding • MV winding • LV winding • Pre-fault voltage	kA kA kA p.u.	50 40 31.5 1.05	
3.4	Guaranteed losses			
3.4.1	a. No-load losses with tap changer in nominal tap position: at rated voltage and rated frequency	kW	Insert	
	b. No-load losses with tap changer in nominal tap position at 110% rated voltage and rated frequency	kW	Insert	
	c. No-load losses with tap changer in nominal tap position at 90% rated voltage, at rated frequency	kW	Insert	
	d. average no load loss (this value will be evaluated)	kW	(a+b+c)/3	
3.4.2	No-load losses capitalized value	BDT/kW	As per vol 1 of tender doc	
3.4.3	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.4.4	a. On-load losses at 75°C, with tap changer in nominal position and at rated current of that tap position	kW	Insert	
	b. On-load losses at 75°C, with tap position in plus (+) extreme tap position and at rated current of that position	kW	Insert	
	c. On-load losses at 75°C, with tap position in minus (-) extreme tap position and at rated current of that position	kW	Insert	
	d. average on load losses (this value will be evaluated)	kW	(a+b+c)/3	
3.4.5	On-load losses capitalized value	BDT/kW	As per vol 1 of tender doc	
3.4.6	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.5	Ancillary equipment (fans, pumps, heaters, etc.)			
3.5.1	Load of ancillary equipment (<u>this value will be evaluated</u>)	kW	Insert	
3.5.2	Capitalized valued of ancillary equipment load	BDT/kW	As per vol 1 of tender doc	
3.5.3	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
3.6	Insulation level			
3.6.1	High voltage (HV)		LI 1050 AC460	
3.6.2	Medium voltage (MV)		LI 650 AC 275	
3.6.3	Neutral		LI 95 AC 38	
3.6.4	Low voltage (LV)		LI 170 AC 70	
3.7	The highest voltage for equipment (effective value)			
3.7.1	High voltage (HV)	kV	245	
3.7.2	Medium voltage (MV)	kV	145	
3.7.3	Neutral	kV	36	
3.7.4	Low voltage (LV)	kV	36	
3.8	Rated insulation level			
3.8.1	Induced voltage (ACSD, ACLD)	kV	In acc. to IEC 60076-3	
3.9	Efficiencies			
3.9.1	If $\cos\phi = 1.0$ and: • 25 % load of the rated value • 50 % load of the rated value • 75 % load of the rated value • 100 % load of the rated value		Insert Insert Insert Insert	
3.9.2	If $\cos\phi = 0.8$ (inductive) and: • 25 % load of the rated value • 50 % load of the rated value • 75 % load of the rated value • 100 % load of the rated value		Insert Insert Insert Insert	
3.10	Voltage drop at the terminals of secondary winding at rated temperature and at the middle tap changer position			
3.10.1	• $\cos\phi = 1.00$		Insert	
3.10.2	• $\cos\phi = 0.95$ (inductive)		Insert	
3.10.3	• $\cos\phi = 0.90$ (inductive)		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.10.4	$\cos\phi = 0.80$ (inductive)		Insert	
3.11	No-load current at rated frequency			
3.11.1	At 0.90 Un		Insert	
3.11.2	At 1.00 Un		Insert	
3.11.3	At 1.05 Un		Insert	
3.12	Temperature rise limits, at rated power, with complete cooling system in service and at lowest volt- age tap			
3.12.1	Top oil	K	≤ 50	
3.12.2	Winding	K	≤ 55	
3.12.3	Hottest spot	K	≤ 65	
3.13	At the emergency cases it is allowed: - Continuous overload at the highestwinding 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)	MVA %	Compliant to IEC 60076-7	
3.14	Guaranteed value of overloads in % of the rated power			
3.14.1	Normal overloads prediction which can occur once a day (in % of the rated power) within the winding temperature rise limit of 75°C			
3.14.1.1	After operation under 15 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	
3.14.1.2	After operation under 20 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	
3.14.1.3	After operation under 120 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	
3.14.2	Sudden transient overloads (in % of the rated power) with the winding temperature rise limit of 85°C			
3.14.2.1	After operation under 15 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	
3.14.2.2	After operation under 15 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	
3.14.2.3	After operation under 15 min - full rated power $\frac{3}{4}$ rated power $\frac{1}{2}$ rated power		Insert Insert Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.15	Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits: - with all cooling groups in operation (excluding stand-by cooling group) - with one cooling group out of operation - with two cooling groups out of operation		Insert Insert Insert	
4	Oil			
4.1	New		Insert	
4.2	Manufacturer		Insert	
4.3	Type		Insert	
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	Insert	
4.6	Viscosity at 20°C	mm ² /s	Insert	
4.7	Maximum dielectric strength	kV/cm	Insert	
4.8	Data sheet attached		Insert	
4.9	Corrosive Sulphur		Non-Corrosive	
4.10	PCB content		Without PCB	
5	Bushing			
5.1	HV bushing			
5.1.1	Quantity		3	
5.1.2	Class	kV	420	
5.1.3	Manufacturer		Insert	
5.1.4	Type		Insert	
5.1.5	Rated current	A	≥ 1000	
5.1.6	Rated short circuit current (2 s)	kA rms	50	
5.1.7	Rated lightning impulse withstand voltage	kV peak	1050	
5.1.8	Rated switching impulse withstand voltage	kV peak		
5.1.9	Rated power frequency withstand voltage	kV rms	460	
5.1.10	Connectors			
5.1.10.1	Shape	mm	Ø 50	
5.1.10.2	Length	mm	125	
5.1.10.3	Suitable for		Al wire	
5.1.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.1.12	Full vacuum withstand of complete bushing		YES	
5.2	Neutral bushing (identical as LV bushing)			
5.2.1	Quantity		1	
5.2.2	Class	kV	36	
5.2.3	Manufacturer		Insert	
5.2.4	Type		Insert	
5.2.5	Rated current	A	≥ 2000	
5.2.6	Rated short-circuit current (2 s)	kA rms	50	
5.2.7	Rated lightning impulse withstand voltage	kV peak	170	
5.2.8	Rated switching impulse withstand voltage	kV peak	-	
5.2.9	Rated power frequency withstand voltage	kV rms	70	
5.2.10	Connectors			
5.2.10.1	Shape	mm	Flat	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
5.2.10.2	Length	mm	-	
5.2.10.3	Suitable for		Cu wire	
5.2.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.2.12	Full vacuum withstand of complete bushing		YES	
5.3	MV bushings			
5.3.1	Quantity		3	
5.3.2	Class	kV	145	
5.3.3	Manufacturer		Insert	
5.3.4	Type		Insert	
5.3.5	Rated current	A	≥ 1600	
5.3.6	Rated short-circuit current (2 s)	kA rms	40	
5.3.7	Rated lightning impulse withstand voltage	kV peak	650	
5.3.8	Rated switching impulse withstand voltage	kV peak	-	
5.3.9	Rated power frequency withstand voltage	kV rms	275	
5.3.10	Connectors			
5.3.10.1	Shape	mm	$\varnothing 50$	
5.3.10.2	Length	mm	125	
5.3.10.3	Suitable for		Al wire	
5.3.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.3.12	Full vacuum withstand of complete bushing		YES	
5.4	LV bushings			
5.4.1	Quantity		4	
5.4.2	Class	kV	36	
5.4.3	Manufacturer		Insert	
5.4.4	Type		Insert	
5.4.5	Rated current	A	≥ 2000	
5.4.6	Rated short-circuit current (2 s)	kA rms	31.5	
5.4.7	Rated lightning impulse withstand voltage	kV peak	170	
5.4.8	Rated switching impulse withstand voltage	kV peak	-	
5.4.9	Rated power frequency withstand voltage	kV rms	70	
5.4.10	Connectors			
5.4.10.1	Shape	mm	Flat	
5.4.10.2	Length	mm	-	
5.4.10.3	Adjusted for Cu wire		Cu wire	
5.4.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
5.4.12	Full vacuum withstand of complete bushing		YES	
6	Design Data			
6.1	Maximum flux density in the legs • At rated voltage • At 105 % of the rated voltage	T T	Insert Insert	
6.2	Maximum flux density in the yokes: • At rated voltage • At 105 % of the rated voltage	T T	Insert Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.3	Maximum current density in windings at rated power and normal tap changer position: • HV winding • MV winding • LV - stabilizing winding	A/mm ² A/mm ² A/mm ²	Insert Insert Insert	
6.4	Winding resistance at 75°C and middle tap changer position: • HV winding • MV winding • LV - stabilizing winding	Ω Ω Ω	Insert Insert Insert	
6.5	Core construction			
6.5.1	Method of joining of legs		Insert	
6.5.2	Method of joining of yokes		Insert	
6.5.3	Joining material		Insert	
6.5.4	Number of legs		Insert	
6.5.5	Type of core steel		Insert	
6.5.6	Specific loss of core steel at 1.7 T inductance	W/kg	< 1.11	
6.6	Winding conductor			
6.6.1	HV winding		Cu - Interleaved & Continuous	
6.6.2	MV winding		Cu - Continuous	
6.6.3	LV - stabilizing winding		Cu - Helical	
6.7	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete cooling system in service	dB	Insert	
6.8	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	μV	2500 max	
7	Weights and dimensions			
7.1	Total weight of autotransformer, equipped for service	kg	less or equals to attached GA value*	
7.2	Core and oil assembly	kg	insert*	
7.3	Total mass excluding oil	kg	insert*	
7.4	Tank and accessories	kg	insert*	
7.5	Oil mass in tank	kg	insert*	
7.6	Oil mass in coolers	kg	insert*	
7.7	Oil mass total	kg	insert*	
7.8	Total mass	kg	insert*	
7.9	Maximum shipping weight (the heaviest item)	kg	insert*	
7.10	Height from foundation to: • Highest point of HV bushing • Highest point of tank • Highest point of conservator • Highest point of lifting hook for removal of core and oil assembly	mm mm mm mm	As per GA* As per GA* As per GA* As per GA*	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
7.11	Outer dimensions: • Length • Width	mm mm	As per GA* As per GA*	
7.12	Informative dimensional sketch		To be enclosed with bid	
7.13	Maximum shipping dimensions of tank: • Outside height • Outside width • Outside length	mm mm mm	insert	
7.14	Transportation drawing		To be enclosed with bid	
8	Tap changer			
8.1	Manufacturer		Insert	
8.2	Type		Insert	
8.3	Insulation level	kV	Li 1050	
8.4	Rated current	A	≥ 1000	
8.5	Number of steps		17	
8.6	Regulating coil		At auto point	
8.7	Short-circuit withstand	kA rms	Insert	
8.8	BIL to ground through the regulating coil	kV peak	Insert	
8.9	Power frequency withstand voltage for 1 minute through the regulating coil	kV rms	Insert	
8.10	Tap position indicator		Digital code matrix (BCD)	
8.11	Auxiliary supply		3x400 V / 230 V, 50 Hz	
8.12	Type of control		On load local, remote and supervisory electrical and hand operation	
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		3x400 V / 50 Hz	
10	Current transformer incorporated into the power autotransformer			
10.1	CT in HV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
10.2	CT in MV bushings, for protection, WTI and/or Tap Changer		In all phases, 3 cores characteristics shall be defined in design stage	
10.3	CT in neutral bushing , for protection		In all phases, 3cores characteristics shall be defined in design stage	
10.4	CT in LV bushings, for protection		In all phases, 3 cores characteristics shall be defined in design stage	
11	Layout			
11.1	Primary winding bushings		Longitudinal axis	
11.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
11.3	Conservator tank		To be defined in design stage	
11.4	Tap changer		To be defined in design stage	
11.5	Control cabinet		To be defined in design stage	
11.6	Coolers		To be defined in design stage	
11.7	Connection drawing, block diagram		To be enclosed with bid	
12	Cooling groups			
12.1	Number of cooling groups (total)	Qty.	4	
12.2	Number of cooling groups (for rated power)	Qty.	3	
12.3	Number of stand-by cooling groups	Qty.	1	
12.4	Number of coolers in a cooling group	Qty.	Insert	
12.5	Number of spare fans	Qty.	Insert (One fan in each group with failing of one fan shall not reduce the MCR)	
12.6	Rating of each cooler	kW	Insert	
12.7	Power factor of the fan motor of each fan			
12.8	Full vacuum with stand of complete cooler	mbar	Yes	
13	Dehydrating breather			
13.1	Type of dehydrating breather		Insert	
13.2	Dehumidifying agent	kg	Insert	
14	Autotransformer tank			
14.1	Type of design			
14.2	Thickness of transformer tank: • Sides • Bottom • Top	mm mm mm	Insert Insert Insert	
14.3	Material of the autotransformer tank		Insert	
14.4	Wheels			
14.4.1	Wheel number for each rail of two pair rails		Two pairs	
14.4.2	Axial inter space in transversal direction between two pairs of rails	mm	insert	
14.4.3	Transversal distance between wheels in pair	mm	insert	
14.4.4	Distance between wheels in longitudinal direction	mm	insert	
14.5	Corrosion protection of the tank		YES	
14.6	Vacuum withstand of the complete tank with cooler	mbar	insert	
14.7	Over-pressure withstand of the complete autotransformer	bar	insert	
15	Conservator			
15.1	Type		With diaphragm	
15.2	Number of compartments	pcs.	2	
15.3	Total volume of conservator	m ³	Insert	
15.4	Minimum volume of conservator between highest and lowest levels as percentage of total cold oil at 0°C of the volume of autotransformer	%	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
15.5	Pressure rise inside the tank due to oil expansion		Insert	
15.6	Diagraph design parameters: - Maximum diagraph stress at highest working pressure - Diagraph construction details - Type of diagraph material		Insert Insert Insert	
15.7	Corrosion protection of conservator		Insert	
15.8	Oil level indicators with alarm for minimum oil level	pcs.	2	
16	Operating conditions			
16.1	At the altitude (above sea level)	m	≤ 1000	
16.2	Maximum ambient temperature	°C	+ 45	
16.3	Average daily temperature	°C	+ 35	
16.4	Average annual temperature	°C	+ 30	
16.5	Minimum ambient temperature	°C	– 5	
16.6	Tertiary winding		Will be used	
16.7	Parallel operation		Yes	
	Overall compliance with the requirements (yes/no)			

* Guaranteed values subject to deduction from Contract Price

**These values are required for Foundation design & shipping purpose only. During detail design, these values may vary from Bid value due to attaining desired electrical output.

* Estimated values. Actual values shall be measured during execution of the contract and shall be included on the name plate.

2.3 132/33 kV 50/75 MVA ONAN/ONAF Power transformer

SN	Description		Unit	Minimum Requirement	Manufacturer's Data
1.1	Name of the Manufacturer			Insert	
1.2	Type/Model			Insert	
2.1	Continuous Rating-	ONAN	MVA	50	
		ONAF	MVA	75	
2.2	Voltage ratio at no-load HV/LV		kV	132/33	
3	Tap Changer				
3.1	HV Tap Changer (On load type)			On load vacuum type	

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
	Tapping Range		+10% to -10%	
	Size of tapping step		1.25%	
	No. of steps		17	
4	Vector Group		Dyn1	
5	On-load voltage control equipment:			
	(A) Type.		Insert	
	(B) Manufacturer		MR, Germany/ABB SWEDEN/Equivalent	
	(C) Range	%	+10 to -10	
	(D) Size of steps	%	1.25	
	(E) Power frequency withstand test voltage (BS.4571) between :			
	first and last contacts of the selector switch		275	
	between any two adjacent contacts of the selector		275	
	between open diverter switch contacts		275	
	(F) Type test certificate, reference:		refer to test report submitted with tender	
6	Type of cooling		ONAN/ONAF	
7	Winding temperature rise at CMR under service conditions stated in schedule of technical requirement	°C	55	
8	Top oil temperature under service conditions stated in Schedule of Technical Requirement			
	(A) CMR	°C	50	
	(B) ONAN rating	°C	50	
	Maximum hot spot temperature rise in core at rated power	°C	73	
10	Maximum hot spot temperature rise in copper at rated power	°C	73	
11	Temperature gradient at rating specified	°C	25	
12	Flux density in iron at normal voltage and frequency and at normal ratio -(no load)			
	(A) Cores	Tesla	1.733	

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
	(B) Yokes	Tesla	1.733	
	(C) Volts/turn	V	143	
13	Magnetizing current (approx) at nominal ratio and			
	at 0.9 x nominal voltage	%	0.1	
	at 1.0 x nominal voltage	%	0.2	
	at 1.1 x nominal voltage	%	0.6	
	at 1.2 x nominal voltage	%	1.74	
14	Harmonic component of magnetizing current at rated voltage as percentage of fundamental			
	(A) Fifth harmonic	%	<15%	
	(B) Seventh harmonic	%	<3%	
15*	No-load loss (excluding cooling plant losses) at rated voltage, ratio and frequency	kW	Insert	
16*	Copper loss (excluding cooling plant losses) at 75 °C and rated voltage, ratio (nominal tap), frequency & 75 MVA	kW	Insert	
17*	Auxiliary loss at 75MVA (Total power input to fans for operation of total insulated cooling capacity	kW	Insert	
18	Total loss at 75 °C and normal ratio and 75MVA (SI.No.15+16+17)	kW	Insert	
19	Regulation at 75 °C and normal ratio-			
	(A) At unity power factor %	%	0.3	
	(B) At 0.8 lagging power factor	%	8.12	
20	(i) Impedance voltage at 75 °C and CMR between HV & LV windings			
	(A) at extreme minus tap (17)	%	12.2	
	normal tap (9a,9b,9c)	%	12.5	
	extreme plus tap (1)	%	13.07	

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
	(B) Maximum Impedance over tapping range	%	13.07	
	Corresponding tap			
	(C) Minimum Impedance over tapping range.	%	12.2	
	Corresponding tap		Insert	
	Impedance voltage 75 °C and CMR between HV & LV at normal tap.	%	12.5	
21	Equivalent circuit zero sequence impedance :			
	HV-LV	%	10.5	
22	Maximum current density in windings at C.M.R.			
	(A) HV winding	A/mm ²	3.0	
	(B) LV winding	A/mm ²	3.1	
	(C) SV winding	A/mm ²	N.A.	
23	Noise level	dB	<78	
24	Types of transformers (shell or core)		core type	
25	Core steel			
	(a) Type		Insert	
	(b) Grade		Grade A	
26	Types of winding-			
	(A) HV		Inner shield continuous type	
	(B) LV		Continuous type	
27	Insulation of			
	(a) HV windings		Insulation paper (thermally upgraded)	
	(b) LV windings		Insulation paper (thermally upgraded)	
28	Insulation of			
	(A) Yoke bolts		Insulation paper (thermally upgraded)	
	(B) Side plates		Insulation paper (thermally upgraded)	
29	Safe working temperature of core plate insulation	°C	105	
30	winding connections brazed or crimped		crimped	
31	For fault with zero impedance external to the transformer and infinite system			

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
	(a) Maximum axial force	kN	225	
	(b) Maximum tensile stress in winding	kN/m ²	HV: 65.6 LV: 44.3	
32	Is facility provided for adjustment of axial pressure on windings	Yes/No	Yes	
33	Thickness of transformer tank			
	(A) Sides	mm	8	
	(B) Bottom	mm	12	
34	Material used for gaskets for oil-tight joints		Rubber	
	Radiators, Valves, Fans			
35	Thickness of radiator plates	mm	1.2	
36	Valve type/material :			
	(A) 100mm and below		Φ80, Φ50, Φ25, copper	
	(B) Above 100mm		N.A.	
37	Equipment for ONAF + cooling state-		Radiators on the main tank	
38	Number of coolers/radiators or cooler banks per transformer			
39	Number of air blowers per transformer			
40	Speed of air blowers	rpm		
41	Rating of each air blower motor	kW	0.5	
42	Starting current of each air blower motor	A	1.35	
	Oil Volumes and Weights			
43	Total oil required including cooler system	litres	Insert	
44	Volume of oil to fill transformer to above the top yoke	litres	Insert	
45	Total volume of conservator	litres	Insert	
46	Weight of active copper	tonnes	Insert	
47	Weight of active iron in core	tonnes	Insert	
48	Weight of core and winding assembly	tonnes	Insert	
49	Weight of each cooler bank complete with oil if mounted separately from transformer	tonnes	Insert	
50	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tonnes	Insert	
51	Weight of transformer arranged for transport	tonnes	(with oil filled)	
52	Manufacture, type and class of oil to IEC 296		Keramay 25#, A class	

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
53	Transformer Parts Subject To Short-Circuit Test			
	Breif description of transformer or parts thereof subjected to short-circuit test		refer to test report submitted with tender	
	Transformer Bushing Insulators			
54	Maker		132KV: Insert 33KV: Insert	
55	Insulator material		132KV: RIP 33KV: solid	
56	Maker's type reference and rated voltage		132KV: Insert 33KV: Insert	
57	Rated current	Amp	132KV: 1250A 33KV: 2000A	
58	BCT particulars			
	i) HV Side: 132KV			
	Core 1,2:		Core 1,2 : 400/1A, 5P20, 30VA	
	Core 3:		Core 3: 400/5A, 0.5, 15VA (matched with WTI meter at phase B)	
	ii) LV Side: 33KV			
	Core 1,2:		Core 1: 1600/1A, 5P20, 30VA	
			Core 2: 1600/1A, 5P20, 30VA	
	Core 3:		Core 3: 1600/5A, 0.5, 15VA (matched with WTI) at phase b Core 3:1600/5A 0.5, 15VA for AVR (at phase c)	
	iii) Neutral:			
	Core 1:		1600/1A, 5P20, 30VA	
	Core 2:		1600/1A, 5P20, 30VA	
59	N/A	N/A	N/A	N/A

SN	Description	Unit	Minimum Requirement	Manufacturer's Data
60	Length of insulator (overall)	mm	132KV: Insert 33KV: Insert	
61	Weight of insulator	Kg	132KV: Insert 33KV: Insert	
62	Electrostatic capacity of complete bushings	pF	132KV: 250—350pF 33KV: N.A.	
63	Dry lightning impulse voltage withstand (1.2/50wave)	KV	132KV: 750kV 33KV: 200kV	
64	50Hz wet withstand voltage without arcing horns	KV	132KV: 355kV 33KV: 95kV	
65	Total creepage distance of outdoor shedding	mm	132KV: 5075 33KV: 200kV 5075mm	
66	Protected creepage distance of shedding	mm	132KV: 1450mm 33KV: 485mm	

2.4 132/33 kV 80/120 MVA ONAN/ONAF Power transformer

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	General			
1.1	Manufacturer		Insert	
1.2	Type		Power transformer three phase, oil immersed, with on-load tap changer, outdoor	
1.3	Model designation		Insert	
1.4	Country of origin		Insert	
1.5	Standards		IEC 60044	
			IEC 60076	
			IEC 60137	
			IEC 60214	
			IEC 60354	
			IEC 60529	
			IEC 60815	
			IEC 60947	
			NEMA TR-1	

			CENELEC EN 50216	
1.6	Quality control		ISO 9001	
1.7	No. of Windings		Two	
1.8	Tertiary winding function		NA	
1.9	Thermal insulation class		A	
2	Ratings and properties			
2.1	Rating			
2.1.1	Voltage ratio (No Load)	kV/kV	132/33	
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($\pm 10\%$)	
	At 70MVA base, HV-TV	%	NA	
	At 70MVA base, LV-TV	%	NA	
2.1.6	Percent Zero-Sequence Impedance			
	At 120MVA base, HV-LV	%	[not less than 90% of Z+]	
	At 70MVA base, HV-TV	%	NA	
	At 70MVA base, LV-TV	%	NA	
2.1.7	X/R ratio		[Insert]	
2.1.8	Rated Frequency	Hz	50	
2.1.9	Corresponding minimum Designed Frequency	Hz	48	
2.1.10	Induced Voltage			

	HV	kVrms	[Insert]	
	RV	kVrms	[Insert]	
	LV	kVrms	[Insert]	
	TV	kVrms	[Insert]	
2.1.11	Insulation level			
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	No Load Loss			
2.2.1.1	No-load losses with tap changer in nominal (principal) tap position at rated voltage and at rated frequency	kW	[Insert]	
2.2.1.2	No-load losses with tap changer in nominal (principal) tap position at 110 % rated voltage and at rated frequency	kW	[Insert]	
2.2.1.3	No-load losses with tap changer in nominal (principal) tap position at 90 % rated voltage and at rated frequency	kW	[Insert]	
2.2.1.4	Average of the above & No-Load Loss for Loss capitalization (N) [This value will be evaluated]	kW	[Insert]	
2.2.1.5	Loss Capitalization Unit	Tk/kW	600000	
2.2.1.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
2.2.2	On-load losses at 75°C			
2.2.2.1	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]	

2.2.2.2	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]	
2.2.2.3	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]	
2.2.2.4	Average of the above & On-load Loss for Loss capitalization (L) [This value will be evaluated]	kW	[Insert]	
2.2.2.5	Loss Capitalization Unit	Tk/kW	300000	
2.2.2.6	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
2.2.3	Load Loss due to Ancillary Equipment [fans, pumps, heaters, etc.]	kW		
2.2.3.1	Capitalized valued of ancillary equipment load	Tk/kW	300000	
2.2.3.2	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	20	
2.2.4	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. 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]	
	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	0C	60	
3.2.2	Top Oil			
	At ONAN	0C		
	At ONAF/OFAF/ODAF (as per schedule of requirement)	0C		
3.2.3	Average Winding Temperature rise	0C	65	
3.2.3.1	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	0C	[Insert]	
3.2.4	Maximum hot spot temperature rises in core at rated power	0C	[Insert]	
3.2.4.1	Internal Hot-spot Temperature (Amb. Temp. + Top oil rise + Core hot spot)	0C	130	
3.2.4.2	Surface Temperature (Amb. Temp. + Top oil rise + Core surface temp.)	0C	[Insert]	
3.2.5	Temperature gradient at specified rating			
3.2.6	Temperature rise of metallic parts			
	Tank walls	0C	[Insert]	
	Tie plate	0C	[Insert]	
	Top clamp	0C	[Insert]	
	Bottom clamp	0C	[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	0C	[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			
b	at 125% of rated Voltage	T, Min or s		
c	at 140% of rated Voltage	T, Min or s		
d	at 150% of rated Voltage	T, Min or s		
3.3.11	Magnetizing current (approx) at nominal ratio and			
a	at 0.90 x nominal voltage	% of FLA		

b	at 0.95 x nominal voltage	% of FLA		
c	at 1.0 x nominal voltage	% of FLA		
d	at 1.05 x nominal voltage	% of FLA		
e	at 1.1 x nominal voltage	% of FLA		
3.3.12	Power factor of magnetizing current at normal voltage ratio and frequency			
3.3.13	Oil Ducts among cores		Yes	
3.4	Winding Construction			
3.4.1	Materials of winding		Copper	
3.4.2	Make, country			
3.4.3	Conductor Used		CTC/others	
	HV		[Insert]	
	RV/ tap Winding			
	LV		[Insert]	
	TV		[Insert]	
3.4.4	Type of Conductor Used			
	HV		Disc	
	RV/ tap Winding		Insert	
	LV		Disc	
	TV		Helical/Disk	
3.4.5	Current density, Thermal			
	HV	A/mm ²	[Insert]	
	RV/ tap Winding	A/mm ²	[Insert]	
	LV	A/mm ²	[Insert]	
	TV	A/mm ²	[Insert]	
3.4.6	Current Density, Short circuit			
	HV	A/mm ²	[Insert]	
	RV/ tap Winding	A/mm ²	[Insert]	
	LV	A/mm ²	[Insert]	
	TV	A/mm ²	[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			
	Between Winding Layers/Disk			
	Between Main Winding & Tap Winding			
	Between Windings & Leads			
3.4.13	Clamping of Winding			
	The individual winding sets clamped separately from each other and separately from the core.		Yes	
	Core		Insert	
3.4.14	Guaranteed Tangent delta of winding		Insert	

3.4.15	Guaranteed PD level		pC	
3.4.16	Curing of Active Part			
	Highest temperature	°C	Insert	
	Duration	Hrs	Insert	
	Average temperature	°C	Insert	
	Duration	Hrs	Insert	
	Total duration	Hrs	Insert	
3.4.17	Active Part Compression during Pressure, (approx)	mm		
3.5	Sound / Noise			
	At No load , rated frequency , 100% rated voltage	dB	[Insert]	
	At No load , rated frequency , 105% rated voltage	dB	[Insert]	
	At load , rated frequency , 100% rated voltage	dB	[Insert]	
	At load , rated frequency , 105% rated voltage	dB	[Insert]	
	Guaranteed during Testing	dB	[Insert]	
	Audible noise level (acc. to NEMA TR1), at 105 % of rated voltage, at maximum power and with complete cooling system in service	dB	[Insert]	
	Radio Interference Voltage at 0.5 MHz as specified in IEC 60694	µV	2500 max	
3.6	Short Circuit			
3.6.1	Current through windings for Terminal Fault			
	HV	kArms		
	LV	kArms		
	TV	kArms		
3.6.2	Pre-fault voltage	p.u.	1.05	
3.6.3	Withstand Duration	s	2	
3.6.4	Similar Design Transformer (as per IEC 60076-5, Annex A) type test reference			
	Testing Authority		STL Lab, insert Name	

	certificate reference			
	Contact address of test Lab			
	Validity of test certificate			
3.6.5	Force			
	Axial Force	kN	[Insert]	
	Free Buckling Force	kN	[Insert]	
	Compression Force	kN	[Insert]	
	Designed Safety Margin		[Insert]	
3.6.7	Offered & Reference Similar Design transformer Short Circuit Force relationship		Within 110%	
3.6.8	Temperature during SC			
	HV Winding [Actual]	0C	[Insert]	
	LV Winding [Actual]	0C	[Insert]	
	RV Winding [Actual]	0C	[Insert]	
	TV Winding [Actual]		[Insert]	
3.6.9	Maximum Circulating Current in Delta tertiary for L-G fault at TV terminal	kA	[Insert]	
3.6.9.1	Winding withstand capacity of this current	Min or s		
3.7	Dielectric Design			
3.7.1	Impulse Voltage at HV (LI)			
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	
	ZnO Block to limit distributed impulse [tap Winding/other]		No	
3.7.2	Impulse Voltage at HV (SI)		NA	
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	

	ZnO Block to limit distributed impulse [tap Winding/other]		No	
3.7.3	Impulse Voltage at LV (LI)			
	Maximum applied voltage at critical points	kV	[Insert]	
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at HV	kV	[Insert]	
	Transferred surge at TV	kV	[Insert]	
	ZnO Block to limit distributed impulse		No.	
3.7.4	Impulse Voltage at LV (LI)		NA	
	Maximum applied voltage at critical points	kV		
	Permissible Voltage	kV	[Insert]	
	Safety Factor	kV	[Insert]	
	Transferred surge at HV	kV	[Insert]	
	Transferred surge at LV	kV	[Insert]	
	ZnO Block to limit distributed impulse		No.	
3.8	Tap changer			
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	
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	
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			
3.11.1	Primary winding bushings		Longitudinal axis	
3.11.2	Secondary winding bushings		Longitudinal axis (opposite to HV)	
3.11.3	Tertiary winding bushings		As per Specification	
3.11.4	Conservator tank		As per Specification	

3.11.5	Tap changer		To be defined in design stage	
3.11.6	Control cabinet		To be defined in design stage	
3.11.7	Coolers		To be defined in design stage	
3.12	Dehydrating breather			
3.12.1	Type of dehydrating breather		Insert	
3.12.2	Dehumidifying agent	kg	Insert	
3.13	Transformer Tank			
3.13.1	Type of design		Welded/Bolted	
3.13.2	Thickness of transformer tank:			
	• Sides	mm	Insert	
	• Bottom	mm	Insert	
	• Top	mm	Insert	
3.13.3	Material of the autotransformer tank		Insert	
3.13.4	Corrosion protection of the tank		YES	
3.13.5	Vacuum withstand of the complete tank with cooler	mbar	1	
3.13.6	Over-pressure withstand of the complete autotransformer	bar	0.3	
3.13.7	Painting Color		Insert	
3.14	Conservator			
3.14.1	Type		With diaphragm	
3.14.2	Number of compartments	pcs.	Insert	
3.14.3	Oil level indicators with alarm for minimum oil level	pcs.	Insert	
3.14.4	Membrane provided inside the conservator for "breathing" of the transformer		Yes	
3.15	Winding Temperature			
4	Oil for Transformer & Tap-Changer			
4.1	Manufacturer, Country		Insert	

4.2	Type		Mineral	
4.3	Type Designation			
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	Insert	
4.6	Viscosity at 20°C	mm ² /s	Insert	
4.7	Minimum dielectric strength	kV/cm	Insert	
5	Bushing			
	Standard		IEC 60137	
5.1	HV bushing (145 kV)			
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	
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	
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		
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	
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	
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)			

2.5 33/0.415 kV EARTHING/AUXILIARY TRANSFORMERS

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	General			
1.1	Manufacturer		Insert	
1.2	Type		Power transformer three-phase, oil immersed, two windings, without tertiary winding, 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	300 (As per BoQ)	
2.2	Type of cooling ONAN / ONAF	-	ONAN	
2.3	Rated voltage of windings: - HV winding - LV winding	kV V	33 415	
2.4	Tap changer: - Type of tap changing - Tapping range - Tapping step - Rating	% %	Off-load ±5 2.5 Rated power 300 kVA, all taps (As per BoQ) (Calculation is required)	
2.5	Frequency	Hz	50	
2.6	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			
3.1.1	Short-circuit duration	s	3	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3.1.2	Symmetrical short-circuit with-stand capacity and asymmetrical short-circuit withstand capacity during indicated period: - HV winding - LV winding	kA kA	31.5 15	
3.2	Guaranteed losses			
3.2.1	No-load losses with tap changer in normal 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	On-load losses at 75°C, at rated voltage and rated frequency, with tap changer in normal 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 - AC 3	
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	≤ 65	
4	Oil			
4.1	New		Insert	
4.2	Manufacturer		Insert	
4.3	Type		Insert	
4.4	Standard		IEC 60296	
4.5	Minimum flash point	°C	Insert	
4.6	Viscosity at 20°C	mm ² /s	Insert	
4.7	Maximum dielectric strength	kV/cm	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
4.8	Data sheet attached		Insert	
4.9	Corrosive Sulphur		NO	
4.10	PCB content		Without PCB	
5	Bushing			
5.1	MV bushing (36 kV)			
5.1.1	Quantity		3 + 1	
5.1.2	Class	kV	36	
5.1.3	Manufacturer		Insert	
5.1.4	Type		Insert	
5.1.5	Model		Insert	
5.1.6	Rated current	A	≥ 100	
5.1.7	Rated short circuit current (3 s)	kA rms	31.5	
5.1.8	Rated lightning impulse withstand voltage	kV peak	170	
5.1.9	Rated switching impulse withstand voltage	kV peak	N.A.	
5.1.10	Rated power frequency withstand voltage	kV rms	70	
5.1.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 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		Insert	
5.2.5	Model		Insert	
5.2.6	Rated current	A	≥ 1000A	
5.2.7	Rated short-circuit current (3 s)	kA rms	15	
5.2.8	Rated lightning impulse withstand voltage	kV peak	N.A.	
5.2.9	Rated switching impulse withstand voltage	kV peak	-	
5.2.10	Rated power frequency withstand voltage	kV rms	3	
5.2.11	Minimum creepage distance (25 mm/kV)	mm/kV	≥ 25 mm/kV	
6	Design data			
6.1	Maximum flux density, at rated voltage	TT	Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
6.2	Maximum current density in windings at rated power and normal tap changer position: - HV winding - LV winding	A/mm ² A/mm ²	Insert Insert	
6.4	Winding resistance at 75°C and middle tap changer position: - HV winding - LV winding	Ω Ω	Insert Insert	
7	Weights and dimensions			
7.1	Total weight of transformer, equipped for service	kg	*Insert	
7.10	Height from foundation to highest point of HV bushing	mm	*Insert	
7.11	Outer dimensions: - Length - Width	mm	*Insert *Insert	
7.12	Informative dimensional sketch		To be enclosed with bid	
7.13	Maximum shipping dimensions of tank: - Outside height - Outside width - Outside length	mm mm mm	*Insert *Insert *Insert	
7.14	Transportation drawing		To be enclosed with bid	
8	Dehydrating breather			
8.1	Type of dehydrating breather		Insert	
8.2	Dehumidifying agent	kg	Insert	
9	Conservator			
9.1	Type		With dehydrating breather	
9.2	Number of compartments	pcs.	1	
9.3	Total volume of conservator	m ³	Insert	
9.8	Oil level indicators with alarm for minimum oil level	pcs.	1	
10	Current transformer incorporated into the auxiliary power transformer			
10.1	CT in all HV bushings, for protection		In all bushings, 3 cores characteristics shall be defined in design stage	
10.2	CT in all LV bushings, for protection		In all bushings, 3 cores characteristics shall be defined in design stage	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
10	Operating conditions			
10.1	At the altitude (above sea level)	m	≤ 1000	
10.2	Maximum ambient temperature	°C	+ 40	
10.3	Average daily temperature	°C	+ 35	
10.4	Average annual temperature	°C	+ 30	
10.5	Minimum ambient temperature	°C	– 5	
	Overall compliance with the requirements (yes/no)			

PART-3 Cable

3.1 33 KV XLPE POWER CABLES

Sl No.	Description	Unit	Requirement	Bidder's Data
	General			
	Manufacturer		Insert	
	Type		Insert	
	Model Designation		Insert	
	Country of Origin		Insert	
	Standards		EC 60502:2	
	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	
	Voltage			
	Rated Voltage	kV	33kV	
	Maximum System Voltage	kV	36kV	
	Impulse withstand voltage	kV	170	
	Power frequency withstand voltage	kV	70	
	Cores			
	Number of cores		1 (one)	
	Conductor			
	Standard		IEC 60228	
	Nominal Current	A	Insert	
	Cross sectional area	mm ²	Insert	
	Nominal Diameter	mm	Insert	
	Material		Annealed Copper	

Sl No.	Description	Unit	Requirement	Bidder's Data
	Design (standard of segmental)		Milliken (4/5 segment)	
	Conductor Screen			
	Material		Semi conducting tape & Extruded semiconducting compound, cross linked	
	Thickness (approx.)	mm	Insert	
	Nominal Diameter over semi-conducting layer	mm	Insert	
	Insulation			
	Material		XLPE	
	Process		Triple simultaneous extrusion	
	Type of curing (dry)		CCV / VCV	
	Average Thickness		IEC standard	
	Minimum Thickness		Insert	
	Nominal Diameter over insulation		Insert	
	Insulation screen			
	Material		Extruded semi conducting compound, cross linked	
	Thickness approx.		Insert	
	Nominal Diameter over semi conducting layer		Insert	
	Metallic Screen/Sheath			
	Type		Corrugated Seamless Aluminium Sheath	
	Thickness (nominal)			
	Nominal Diameter over semi Metallic sheath	mm	Insert	
	Longitudinal water tightness			
	Material		Semi-conducting swellable tape	
	Nominal thickness and width approx.		Insert	
	Radial moisture barrier			
	Material		Laminated plastic coated aluminium tape / lead/copper	
	Nominal thickness and width approx.		Insert	
	Outer Covering			
	Material		MDPE	
	Colour		Black	
	Minimum average thickness		Insert	
	Type of termite repellent		Insert	
	Completed Cable		Insert	
	Overall diameter (approx.)	mm	Insert	
	Weight per meter (approx.)	kg	Insert	

Sl No.	Description	Unit	Requirement	Bidder's Data
	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	
	Continuous Current carrying capacity based on the conditions special laid in the cable trench		FLAT	
	One circuit		Insert	
	Continuous Current carrying capacity based on the conditions special laid in the cable trench		buried	
	One circuit		Insert	
	Max Conductor temperature			
	Laid direct ground	°C	Insert	
	Draw into ducts	°C	Insert	
	Elected in air	°C	Insert	
	Permissible overload in service condition		2 hrs in a day 100 hrs in a month 500 hrs in total life	
	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		
	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°	
	Max. Dielectric stress	kV/meter	Insert	
	on the conductor screen (assumed smooth)	kV/meter	Insert	
	on the insulation	kV/meter	Insert	

Sl No.	Description	Unit	Requirement	Bidder's Data
	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	
	Nominal Internal diameter of pipes on ducts through which cable may be pulled (One cable in duct)		Insert	
	Maximum DC resistance per km of cable at 20°C	ohm/km		
	Of conductor	ohm/km	Insert	
	Of metallic layer	ohm/km	Insert	
	Maximum ac resistance per km of cable at maximum conductor temperature	ohm/km	Insert	
	Insulation Resistance per km of cable per core			
	At 20°C	mega ohm-km	Insert	
	At maximum rated temperature	mega ohm-km	Insert	
	Equivalent star Reactance per meter of 1 - phase circuit at nominal frequency	ohm/km	Insert	
	Maximum electrostatic capacitance per meter of cable approx.	μF/km	Insert	
	Maximum charging current per core per meter pf cable at nominal voltage, U ₀	A/km	Insert	
	Maximum dielectric loss cable per uncl of 3 phase circuit when laid direct in the ground ay nominal	W/m/phase	Insert	
	Maximum induced voltage on metal sheath under fault condition (single core only)		Insert	
	Maximum dielectric Dissipation factor of charging of cable when laid direct in the ground at nominal voltage U ₀ , normal frequency at			
	Conductor temperature of 20°C		Insert	
	Maximum conductor temperature of 90°C		Insert	
	Sheath loss of cable per meter of phase circuit at nominal voltage U ₀ , normal frequency.	W/m/phase	Insert	
	Cree page	Mm	Insert	

Sl No.	Description	Unit	Requirement	Bidder's Data
	Total creepage distance of outdoor sealing approx. mm and porcelain.			
	Earth continuity copper Conductor (IF REQD)	mm ²	Insert	
	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	

3.2 AUXILIARY POWER AND MULTICORE CONTROL CABLES

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

PART 4 - DC EQUIPMENT

4.1 110 V BATTERIES

PART-A: (Employer Requirement:)

No.	Description (Employer Requirement)	Minimum Requirements		Guaranteed
		Unit	Data	
	110V Battery units (01 Set)			
1.	Standards		IEC 60623 IEC 60993	
2.	Quality control		ISO 9001 ISO 14001 ISO 18001	
3.	Type of cell (M Class)		Nickel Cadmium (Ni-Cd)	
4.	Rated voltage	V	110 V	
5.	Number of cells per battery unit	pcs	Not less than 92 nos.	
6.	Operating voltage per cell	V	1.2	
7.	Floating voltage per cell	V	1.40-1.42	
8.	Equalizing/Boost Charging Voltage	V	1.5-1.75	
9.	Rated capacity at 20°C			
a.	• For 3h discharge time (C5)	Ah	insert	
b.	• For 5h discharge time (C5)	Ah	As per schedule A	
c.	• For 10h discharge time (C5)	Ah	insert	
10.	ECV	V/Cell	1.10	
11.	Spec. gravity of electrolyte	1	insert	
12.	Sp. gravity of electrolyte (Charged)	1	insert	
13.	Vent plug		Anti-corrosive & fire proof	
14.	Positive plate	-	Tubular/pocket plate type/ other	
15.	Negative plate	-	Pasted/ pocket plate type/ other	
16.	Type of container	-	Translucent Polypropylene	
17.	Cell condition	-	Pre-charged	
18.	The battery stands steel frame step type		Yes	
19.	The battery stands earth-quake endurance type		Yes	
20.	Design Life	years	>20	
21.	Vent plug		Anti-corrosive & fire proof	
22.	Overall compliance with above requirements & detail specification described in other PARTS	Yes/No	Yes	

PART-B: (Manufacturer Information)

No.	Description (To be inserted)	Manufacturer Information	
		Unit	Data
	110V Battery units (01 Set)		
1.	Manufacturer		Insert
2.	Country of origin		Insert
3.	Type Designation		Insert
4.	Floating voltage per cell	V(1.40-1.42)	Insert
5.	Equalizing/ Boost voltage per cell	V	Insert
6.	Normal charging rate	A	Insert

No.	Description (To be inserted)	Manufacturer Information	
		Unit	Data
7.	Maximum charging rate	A	Insert
8.	Capacity at 5 hour rate	Ah	Insert
9.	Ampere-hour efficiency at ten hour rate	%	Insert
10.	Ampere-hour efficiency at one hour rate	%	Insert
11.	Continuous Discharge Current	A	Insert
12.	Electrolyte		Insert
13.	Overall dimensions of one cell	mm	Insert
14.	Dimensions of battery complete	mm	Insert
15.	Quantity of electrolyte per one cell	litre	Insert
16.	Length/width/height of assembled battery	mm	Insert
17.	Weight of battery and stands in service	kg	Insert (only battery)
18.	Weight of cell complete with electrolyte	kg	Insert
19.	Internal resistance per cell when fully charged	ohms	Insert
20.	Material of battery case		Insert
	Overall compliance with above requirements & detail specification described in other PARTS	Yes/No	Yes

PART-C: (Manufacturer Confirmation)

No.	Description (Guidelines to be followed)	Unit	PGCB's Requirement	Manufacturer Confirmation
	110V Battery units (01 Set)			
1.	Dispatch condition of battery		Pre-charged	
2.	Protection			
a.	Safety pressure vent		Yes	
b.	Thermally welded cases for leak proof joints		Yes	
3.	Battery Marking			
a.	Battery cells shall be clearly identified by permanent numbering		Yes	
b.	Permanent identification with each Battery cell (i) Manufacturer's name, reference No. & cell type (ii) Year and month of manufacture (iii) Voltage and nominal capacity at 5 hr. discharge rate (iv) positive terminal: either a red washer or an indented or raised symbol (v) maximum and minimum electrolyte levels		Yes	
4.	Accessories included			
a.	Nickle plated copper terminal post		Yes	
b.	Nickle plated copper inter cell connectors, insulated copper cable connectors, connector cover, and end lug caps for each cell		Yes	
c.	Electrolyte for each cell		Yes	

No.	Description (Guidelines to be followed)	Unit	PGCB's Requirement	Manufacturer Confirmation
d.	A complete set of test and maintenance accessories including following items with each set of battery- i) Two Syringe hydrometer ii) Two cell-bridging connectors iii) Two electrolyte-pouring funnels iv) Two electrolyte thermometers v) Battery instruction card for wall mounting vi) Electrolyte airtight container		Yes	

4.2 48 V BATTERIES

PART-A: (Employer Requirement:)

No.	Description (Employer Requirement)	Unit	Minimum Requirements Data	Guaranteed
	48V Battery units (01 Set)			
23.	Standards		IEC 60623 IEC 60993	
24.	Quality control		ISO 9001 ISO 14001 ISO 18001	
25.	Type of cell (L Class)		Nickel Cadmium (Ni-Cd)	
26.	Rated voltage	V	48 V	
27.	Number of cells per battery unit	pcs	Not less than 42 nos.	
28.	Operating voltage per cell	V	1.2	
29.	Floating voltage per cell	V	1.40-1.42	
30.	Equilizing/Boost Charging Voltage	V	1.5-1.75	
31.	Rated capacity at 20°C			
d.	• For 3h discharge time (C5)	Ah	insert	
e.	• For 5h discharge time (C5)	Ah	As per schedule A	
f.	• For 10h discharge time (C5)	Ah	insert	
32.	ECV	V/Cell	1.10	
33.	Spec. gravity of electrolyte	1	1.19±0.01	
34.	Sp. gravity of electrolyte (Charged)	1	1.19 ± 1%	
35.	Vent plug		Anti-corrosive & fire proof	
36.	Positive plate	-	Tubular/pocket plate type/ other	
37.	Negative plate	-	Pasted/ pocket plate type/ other	
38.	Type of container	-	Translucent Polypropylene	
39.	Cell condition	-	Pre-charged	
40.	The battery stands steel frame step type		Yes	
41.	The battery stands earth-quake endurance type		Yes	
42.	Design Life	years	>20	
43.	Vent plug		Anti-corrosive & fire proof	
44.	Overall compliance with above requirements & detail specification described in other PARTS	Yes/No	Yes	

PART-B: (Manufacturer Information)

No.	Description (To be inserted)	Manufacturer Information	
		Unit	Data
	48V Battery units (01 Set)		
21.	Manufacturer		Insert
22.	Country of origin		Insert
23.	Type Designation		Insert
24.	Floating voltage per cell	V(1.40-1.42)	Insert
25.	Equalizing/ Boost voltage per cell	V	Insert
26.	Normal charging rate	A	Insert
27.	Maximum charging rate	A	Insert
28.	Capacity at 5 hour rate	Ah	Insert
29.	Ampere-hour efficiency at ten hour rate	%	Insert
30.	Ampere-hour efficiency at one hour rate	%	Insert
31.	Continuous Discharge Current	A	Insert
32.	Electrolyte		Insert
33.	Overall dimensions of one cell	mm	Insert
34.	Dimensions of battery complete	mm	Insert
35.	Quantity of electrolyte per one cell	litre	Insert
36.	Length/width/height of assembled battery	mm	Insert
37.	Weight of battery and stands in service	kg	Insert (only battery)
38.	Weight of cell complete with electrolyte	kg	Insert
39.	Internal resistance per cell when fully charged	ohms	Insert
40.	Material of battery case		Insert
	Overall compliance with detail specification described in other PARTS & existing Charger Module specification	Yes/No	Yes

PART-C: (Manufacturer Confirmation)

No.	Description (Guidelines to be followed)	Unit	PGCB's Requirement	Manufacturer Confirmation
	48V Battery units (01 Set)			
5.	Dispatch condition of battery		Pre-charged	
6.	Protection			
c.	Safety pressure vent		Yes	
d.	Thermally welded cases for leak proof joints		Yes	
7.	Battery Marking			
c.	Battery cells shall be clearly identified by permanent numbering		Yes	
d.	Permanent identification with each Battery cell (i) Manufacturer's name, reference No. & cell type (ii) Year and month of manufacture (iii) Voltage and nominal capacity at 5hr. discharge rate (iv) positive terminal: either a red washer or an indented or raised symbol (v) maximum and minimum electrolyte levels		Yes	
8.	Accessories included			
e.	Nickle plated copper/other terminal post		Yes	

No.	Description (Guidelines to be followed)	Unit	PGCB's Requirement	Manufacturer Confirmation
f.	Nickle plated copper inter cell connectors, insulated copper cable connectors, connector cover, and end lug caps for each cell		Yes	
g.	Electrolyte for each cell		Yes	
h.	A complete set of test and maintenance accessories including following items with each set of battery- i) Two Syringe hydrometer ii) Two cell-bridging connectors iii) Two electrolyte-pouring funnels iv) Two electrolyte thermometers v) Battery instruction card for wall mounting vi) Electrolyte airtight container		Yes	

4.3 110 V BATTERY CHARGER

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 $\pm 5\%$	
1.9	Rated output current	A	(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	M Ω	10 M Ω 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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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)	%	insert	
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)	%	±2%	
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		As required	
5	Output current sharing facility (for parallel operation of chargers)		Yes	
	Overall compliance with the requirements (yes/no)			

4.4 48 V BATTERY CHARGER

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	48V ±5%	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.9	Rated output current	A	(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)	%	insert	
2.7	Charge Characteristics		Constant current /Constant voltage (During float charge)	
2.8	Current limitation	%	110%	
3	D.C. OUTPUT			
3.1	Voltage	V	48±5%	
3.2	Ripple Voltage (Full load)	%	±2%	
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		As required	
5	Output current sharing facility (for parallel operation of chargers)		Yes	
	Overall compliance with the requirements (yes/no)			

4.5 LV DC EQUIPMENT

	DC Switchboard		
30	Manufacturer		
31	Type		
32	Busbars:		
	- maximum current rating	A	
	- dimensions	mm	
33	Boost charge contactors:		
	- manufacturer		
	- maximum current rating		
	- coil rating		
	- method of interlocking		
34	Alarm relays:		
	- manufacturer		
	- type and reference		
	- power consumption:		
	a) quiescent	A	
	b) operated	mA	
35	Number and rating of distribution circuits		
36	Overall dimensions	mm	
37	Total weight	kg	

PART 5 - LV AC EQUIPMENT

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1	AC Distribution Panel			
1.1	Manufacturer		Insert	
1.2	Manufacturer's type designation		Insert	
	Country of origin			
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	
2.5	Overall compliance with the requirements & detail specification described in Vol-2	Yes	Yes	

PART 6

Digital Fault and Disturbance Recorder [DFDR]

SL	ITEM	UNITS	PGCB'S REQUIREMENT	Guaranteed
(A)	GENERAL			
1.	Manufacture's name and address		To be mentioned	
2.	Type		To be mentioned	
3.	Power supply	VDC	110	
4.	-Power supply for printer	VAC	240	
(B)	ANALOGUE INPUTS			
1.	Number of channel		As per required number of signals for particular feeders	
	Expandability		As required for future feeders	
2.	Nominal current	Amp	1A/5A	
3.	Nominal voltage	Vac/Vdc		
	-Current	mA/Amp		
4.	Frequency response			
5.	Cut –off frequency			
	Bandwidth	dB	Insert	
	Attenuation at	dB	Insert	
	(C) Auto adjusted anti-aliasing filters for chosen sampling rate	Yes/No	Yes	
	(d) Simultaneously programmable sampling rate for all feeders/inputs		3 distinct programmable Sampling rates and generate 3 simultaneously distinct records	
	-Locally Changeable	Yes/No	Yes	
	-Remotely Changeable	Yes/No	Yes	
	(e) Possible sampling rates	Samples /sec Samples /sec Samples /sec	3 different sampling rates: Slow. 1Hz-500Hz Fast: 0.5kHz-6kHz Continuous (variable rate)	
6.	DC coupled inputs	Yes/No	Yes, all Analog inputs should be capable of connecting AC or DC	

SL	ITEM	UNITS	PGCB'S REQUIREMENT	Guaranteed
			inputs as per site requirement without changing any hardware .	
7.	Resolution	bits	16 bits	
8.	Accuracy	%	Min 0.5	
9.	Burden			
	1.Current Circuit at IN	VA	Insert	
	2.Voltage Circuit	VA	Insert	
10.	Over load			
	1.Current	% In	100% In continuously, Min 600% in for 1sec	
	2.Voltage Circuit	% Vn	2Vn and max. 350Vn	
(C)	DIGITAL INPUTS			
1.	Number of channel		As per required number of signals for particular feeders	
	-Expandability(without and time skew)		As required for future feeders	
2.	Selectable input level	Vdc	N/O or N/C. 24,48,110 and 220 VDC	
3.	Type		Potential or potential free contract	
4.	Resolution	ms		
(D)	MEMORY			
1.	Size	MB	64 MB or Higher	
2.	Type		Solid State	
3.	Pre-fault time (fast scanning rate)	sec	0.1-2 user programmable	
4.	Post-fault (fast scanning rate)	sec	0.1-2 user programmable	
5.	Pre and Post fault time (slow scanning rate)	sec	min. 180 user programmable	
6.	In-Build Flash disk (auto-maintained)	GB	min. 4 GB	
(E)	SENSORS/ TRIGGERING CRITERIA			
	All sensors/triggers are preferable Programmable and Virtually recordable	Yes/No	Yes	
1.	Logical combination sensor	Yes/No	Yes	
2.	Three phase over or under Voltage/ Current	Yes/No	Yes	
3.	Mono phase over or under Voltage/ Current	Yes/No	Yes	
4.	*du/dt, dp/dt, dq/dt, [Single/3 Phases], df/dt, etc.	Yes/No	Yes	
5.	RMS [Voltage/Current]	Yes/No	Yes	
6.	Zero Sequence	Yes/No	Yes	
7.	Negative, Positive Sequence	Yes/No	Yes	
8.	Frequency	Yes/No	Yes	
9.	DC Step	Yes/No	Yes	
10.	Pending/Swing	Yes/No	Yes	

SL	ITEM	UNITS	PGCB'S REQUIREMENT	Guaranteed
11.	Digital level and edge	Yes/No	Yes	
12.	Sensor Trigger	Yes/No	Yes	
13.	Event Trigger	Yes/No	Yes	
14.	Manual Trigger	Yes/No	Yes	
15.	Remote Trigger	Yes/No	Yes	
(F)	CLOCK SYSTEM			
1.	Internal Clock	Yes/No	Yes	
2.	Accuracy			
3.	External Synchronization	Yes/No	Yes	
4.	Time resolution between 2 synchronized pulse			
(G)	OUTPUT ALARM RELAY CONTACT			
1.	Max. operation Voltage DC/AC	Vac/Vdc	250 Vac or above, 60 Vdc or above	
2.	Make and carry for 0.5 sec	A	Min. 8A	
3.	Carry continuously	A	Min. 5A	
4.	Break (DC)-resistive	W		
(H)	INTERFACE FOR DATA COMMUNICATION			
1.	Full definition compression	Yes/No	Yes	
2.	Maximum transmission rat	Bits/Sec		
3.	Standard serial port (EIA-232-D)	Yes/No	Yes	
4.	Printer Port	Yes/No	Yes	
5.	Dedicated serial port for modem	Yes/No	Yes	
(I)	PRINTER DATA			
1.	Printer amplitude (scaling peak to peak)			
2.	Time Scale (mm/s)			
3.	Printer resolution	mm		
4.	Auto printing	Yes/No	Yes	
(J)	Fault Priority transmission	Yes/No	Yes	
(K)	Fault location (distance calculation)	Yes/No	Yes	
(L)	Test certificate from internationally recognized Laboratories	Yes/No	Yes	
(M)	COMMUNICATION AND REMOTE ANALYZING UNIT			
1.	Processor Pentium	(MHz), Yes/No	Yes, at least 450MHz Pentium	
2.	Co-Processor Pentium	Yes/No	Yes	
3.	Main memory capacity	(Mb), Yes/No	Yes, at least 64Mb	
4.	Color graphics board S-VGA	Yes/No	Yes	
5.	Screen S-VGA	Yes/No	Yes	
6.	Hard disk unit	Yes/No	Yes, at least 40GB	
7.	Printer	Yes/No	Yes	
8.	Modem	Yes/No	Yes	

PART 7 – Control, Protection, Substation Automation & Metering

7.1 Line Distance Protection

No.	Description	Unit	Minimum Requirements	Guaranteed
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/USA/ France or from other eligible countries with equivalent quality).	
2	Country of Origin (Place of Manufacturing)			
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, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	8 (4 for Double bus arrangement)	
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			

No.	Description	Unit	Minimum Requirements	Guaranteed
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 ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos. high speed trip output and 2 Nos. watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	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		Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license	
14	GPS Time synchronization	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	

No.	Description	Unit	Minimum Requirements	Guaranteed
17.6	Reverse looking element		Settable in all 5 zones	
17.7	Can resistance and reactance reaches be set independent of each other	Yes/No	Yes	
17.8	Arc forward and reverse reach setting independent of each other?	Yes/No	Yes	
17.9	Switch on to fault	Yes/No	Yes	
17.10	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	Ohm	0.1 to 1000 or higher with the step size of 0.001/ln	
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 (1 set for Double busbar arrangement)	
20	Monitoring functions			
20.1	Fuse failure supervision, current circuit supervision	Yes/No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.3	Fault locator	Yes/No	Yes	
20.4	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue	

No.	Description	Unit	Minimum Requirements	Guaranteed
			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	

7.2 Line Differential Protection

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/USA/ France or from other eligible countries with equivalent quality).	
2	Country of Origin (Place of Manufacturing)			
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, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	8 (4 for Double Busbar arrangement)	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
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 ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	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		2nd and 5th 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 (1 set for Double busbar arrangement)	
20	Monitoring functions			
20.1	Fuse failure supervision, current circuit supervision	Yes/No	Yes	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.3	Event records and oculographic		Event recorder should keep at least 20Nos previous records and disturbance recorder	

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

	disturbance records		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	

7.3 Transformer Differential Protection (3 Winding):

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/USA/ France or from other eligible countries with equivalent quality).	
2	Country of Origin (Place of Manufacturing)			
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, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	12 (8 Nos for 2 winding Transformer)	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3 *Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs		6 (For Line VT & Bus VT)	

9.2	Nominal voltage	V AC	110	
9.3	Minimum continuous withstand voltage	V AC	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	20 (programmable) (Should be increased as per the scheme design)	
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	20 (minimum 8 Nos high speed trip output and 2 Nos watchdog outputs) (Should be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	
11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos.	15 (programmable) (Should be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any 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 (For 2 winding transformer as per requirement)	
17.2	Number of parameter setting groups	Nos.	Minimum 4 (Independently settable)	
17.3	Pre-configuration		For all basic functions	
17.4	Differential characteristics		Restrained biased characteristics with stabilization during magnetizing inrush and CT saturation	
17.5	Harmonics blocking		2nd and 5th 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 (1 set for Double Busbar arrangement)	
20	Monitoring functions			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels 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	

7.4 Over current and Earth fault protection:

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/US A/ France or from other eligible countries with equivalent quality).	
2	Country of Origin (Place of Manufacturing)			
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos.	4	
8.2	Nominal current	A	Operable in 1A and 5A (User settable)	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs	Nos	4	
9.2	Nominal voltage	V	110	
9.3	Minimum continuous withstand voltage	V	220	
10	Binary input module			
10.1	Minimum number of inputs	Nos.	10 (programmable)	Should be increased as per the scheme design
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos.	10 (minimum 6 Nos high speed trip output and 2 Nos watchdog outputs)	Should be increased as per the scheme design
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	

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

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
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	Control functions		2 Sets of Synchrocheck for single and multi CB arrangements if required by PSLD	1 set for Double Busbar arrangement
20	Monitoring functions			
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	Yes	
20.2	Event records and oscillographic disturbance records		Event recorder should keep at least 20Nos previous records and disturbance recorder should handle at least 8Nos analogue channels 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	

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

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germ any/UK/USA/ France or from	

			other eligible countries with equivalent quality).	
2	Country of Origin (Place of Manufacturing)			
3	Relay Identification			
3.1	Relay Type & model		Should be filled up by bidder	
3.2	Relay Software version		Should be filled up by bidder	
3.3	Relay Hardware version		Should be filled up by bidder	
4	Language		English	
5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
6	Relay auxiliary voltage	V	Minimum range of 88V to 250V DC and minimum range of 115V to 230V AC	
7	Operating frequency	Hz	50/60Hz, $\pm 5\%$	
8	Current transformer requirement			
8.1	No of Inputs	Nos	4	
8.2	Nominal current	A	Operable in 1A and 5A	
8.3	Minimum continuous current capacity	A	3*Nominal current	
8.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
9	Voltage transformer requirement			
9.1	No of Inputs	Nos	5 (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	24 (programmable) (Can be increased as per the scheme design)	
10.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11	Binary output module			
11.1	Minimum number of outputs	Nos	10 (minimum 5 Nos fast operating trip output and 1 Nos watchdog outputs) (Can be increased as per the scheme design)	
11.2	Minimum operating range	V	110V and 220V DC ($\pm 20\%$ tolerance)	
11.3	Minimum continuous current capacity	A	5	

11.4	Short time withstand capacity	A	10A for at least 1s	
11.5	Maximum operating time	ms	10	
12	Number of LEDs	Nos	08 (programmable) (Can be increased as per the scheme design)	
13	HMI		Front mounted, should be suitable to issue close & open commands to switching devices through visual animation, access all functions, settings and stored records without external computer	
14	Software requirement		1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
15	GPS Time synchronization		Should be available	
16	Communication interface			
16.1	Standard protocol		IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
16.2	Ethernet speed and connector		100Mbps, RJ45 plug connector/RS232 serial connector as front port	
17	Main protection function		Instantaneous/delayed, directional/non-directional, over current and earth fault protection with IEC and ANSI/IEEE characteristics curves	
17.1	Number of parameter setting groups	Nos	Minimum 4 (Independently settable)	
17.2	Minimum stages in each setting groups for Over-current	Nos	3	
17.3	Minimum stages in each setting groups for Earth fault	Nos	3	
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	

7.6 Frequency Protection

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

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

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

7.7 Busbar and Breaker Failure Protection

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/USA/ France or from other eligible countries with equivalent quality).	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
2	Country of Origin (Place of Manufacturing)			
3	Relay Installation			
3.1	Operating architecture		Distributed	
3.2	Number of Central Unit	Nos	1	
3.3	Number of Bay Units	Nos	As mentioned in Substation Single Line Diagram; For Breaker Failure Protection of Tie CB in 1 and Half CB bus arrangement, stand-alone relays will also be accepted.	
3.4	Minimum number of Bay Units supported by single Central Unit	Nos	30	
4	Central Unit Requirements			
4.1	Relay Type & model		Should be filled up by bidder	
4.2	Relay Software version		Should be filled up by bidder	
4.3	Relay Hardware version		Should be filled up by bidder	
4.4	Language		English	
4.5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
4.6	Relay auxiliary voltage	V DC	Minimum range of 48V to 250V; with protective fuse	
4.7	Maximum ripple		≤15%	
4.8	Operating frequency	Hz	50Hz, ±5%	
4.9	Binary Inputs of Central Unit			
	4.8.1	Minimum number of binary inputs	Nos.	12 (programmable)
	4.8.2	Minimum operating range	V DC	Substation nominal DC voltage ±15%
	4.8.3	Operating time	ms	<1
4.10	Binary Outputs of Central Unit			
	4.9.1	Minimum number of outputs	Nos.	9
	4.9.2	Operating time	ms	3
	4.9.3	Operating voltage	V	Upto 250 V AC/DC
	4.9.4	Continuous current capacity	A	8
	4.9.5	Short time current capacity	A	30A for at least 0.5s
	4.9.6	Binary output reset response		Programmable for latched and self reset

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
4.11	Number of LEDs	Nos.	20 (programmable)	
4.12	HMI		Front mounted, should be suitable to access all relevant measurements, alarms, tripping information and switching device information without external computer	
5	Bay Unit Requirements			
5.1	Relay Type & model		Should be filled up by bidder	
5.2	Relay Software version		Should be filled up by bidder	
5.3	Relay Hardware version		Should be filled up by bidder	
5.4	Language		English	
5.5	Housing & mounting		Flush mounting housing and capable of sustaining in harsh environmental condition	
5.6	Relay auxiliary voltage	V DC	Minimum range of 48V to 250V	
5.7	Maximum ripple		≤15%	
5.8	Operating frequency	Hz	50Hz, ±5%	
5.9	Binary Inputs of Bay Unit			
	5.8.1	Minimum number of binary inputs	Nos.	12 (programmable)
	5.8.2	Minimum operating range	V DC	Substation nominal DC voltage ±15%
	5.8.3	Operating time	ms	<1
5.10	Binary Outputs of Bay Unit			
	5.9.1	Minimum number of outputs	Nos.	16
	5.9.2	Operating time	ms	3
	5.9.3	Operating voltage	V	Upto 250 V AC/DC
	5.9.4	Continuous current capacity	A	8
	5.9.5	Short time current capacity	A	30A for at least 0.5s
	5.9.6	Binary output reset response		Programmable for latched and self reset
5.11	CT requirements of Bay Unit			
	5.1.0.1	No of CT Inputs	Nos.	4
	5.1.0.2	Nominal current	A	Operable in 1A and 5A (User settable)
	5.1.0.3	Minimum continuous current capacity	A	4*Nominal current

SL. No.	Description		Unit	PGCB's requirements	Bidder's Data
	5.1 0.4	Thermal withstand capacity	A	100*Nominal current for at least 1s	
	5.1 0.5	Burden per phase	VA	≤0.2	
5.12	Number of LEDs		Nos.	8 (programmable)	
5.13	HMI			Front mounted, should be suitable to access all relevant measurements, alarms, tripping information and switching device information without external computer	
5.14	Test socket			Should be installed in the front side of the panel with each Bay Unit	
5.15	Supply of applicable test plug		Nos	2 Nos for each substation	
6	Communication interface & Software				
6.1	Software requirement			1. Should be able to configure, operate and monitor with user friendly engineering and disturbance handling tool. 2. Necessary software for configuration, disturbance handling and parameterization has to be supplied free of cost and without any time-bounded license.	
6.2	GPS Time synchronization			Should be available	
6.3	Standard protocol			IEC 61850 (have to be able to communicate to IEC 61850 base Substation Automation System)	
6.4	Ethernet speed and connector			100Mbps, RJ45 plug connector/RS232 serial connector as front port	
6.5	Protection communication interface				
	6.5 .1	Type of communication		Optical fibre	
	6.5 .2	Number of cores per Bay Unit	Nos	2	
	6.5 .3	Core/sheath diameter		62.5/125μm (multi-mode)	
	6.5 .4	Maximum permissible attenuation	dB	5	
	6.5 .5	Minimum supported transmission length	m	1200	
7	Protection Functions				
7.1	Main protection function				
	7.1 .1	Required function		Highly reliable low-impedance based busbar differential protection	
	7.1 .2	Evaluation criteria		Differential current with restrain feature Directional current comparison method	
	7.1 .3	Evaluation method		Phase segregated	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
	7.1.4	Through-fault stability during CT saturation		Must be complied
	7.1.5	CT switching/Busbar selection		Must be done internally
	7.1.6	Minimum fault current pick-up setting	A	0.2 to 4 x IN in step size of 0.01
	7.1.7	Differential restraining characteristics slope setting		0.5 to 0.8; in step size of 0.05
	7.1.8	Differential current alarms Current setting Time delay setting		5 to 50% of minimum pick-up in steps of 5% 2 to 10s in steps of 1s
	7.1.9	Isolator alarm time delay		0.5 to 90s
	7.1.10	Typical tripping time		20 to 30ms at IDiff/IRest ≥ 5
	7.1.11	Settable CT ratio per feeder		50 to 10,000/1A
7.2		Check zone criterion		Should be available
	7.2.1	Minimum fault current pick-up setting	A	0.2 to 4 x IN in step size of 0.01
	7.2.2	Differential restraining characteristics slope setting		0 to 0.8; in step size of 0.05
	7.2.3	Settable CT ratio per feeder		50 to 10,000/1A
7.3	Additional protection function 1			
	7.3.1	Required function		TEE-point differential protection (for 1 and half CB bus arrangement only) Not applicable for Double busbar arrangement
	7.3.2	Evaluation criteria		Differential current with restrain feature Directional current comparison method
	7.3.3	Evaluation method		Phase segregated
	7.3.4	Through-fault stability during CT saturation		Must be complied
	7.3.5	CT switching/selection		Must be done internally
	7.3.6	Minimum fault current pick-up setting	A	0.2 to 4 x IN in step size of 0.01
	7.3.7	Differential restraining characteristics slope setting		0.5 to 0.8; in step size of 0.05
	7.3.8	Differential current alarms Current setting Time delay setting		5 to 50% of minimum pick-up in steps of 5% 2 to 10s in steps of 1s

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
	7.3.9 Isolator alarm time delay		0.5 to 90s	
	7.3.10 Typical tripping time		20 to 30ms at IDiff/IRest ≥ 5	
	7.3.11 Settable CT ratio per feeder		50 to 10,000/1A	
7.4	Additional protection function 2			
	7.4.1 Required function		Breaker failure protection	
	7.4.2 Current setting range		0.1 to 2 x IN in step size of 0.1 x IN	
	7.4.3 Measurement accuracy		$\pm 5\%$	
	7.4.4 Tripping logic		Should be available for minimum 2 (two) stages: re-trip and remote trip	
	7.4.5 Setting range of re-trip timer (t1)	ms	10 to 5,000ms in steps of 10ms	
	7.4.6 Setting range of remote trip timer (t2)	ms	10 to 5,000ms in steps of 10ms	
	7.4.7 Remote trip pulse duration	ms	100 to 2,000ms in steps on 10ms	
7.5	Additional protection function 3			
	7.5.1 Required function		End-fault protection	
	7.5.2 Current setting range		0.1 to 2 x IN in step size of 0.1 x IN	
	7.5.3 Timer setting range	ms	100 to 10,000ms in steps of 100ms	
7.6	Selective Tripping & Blocking options			
	7.6.1 Selective tripping		Should be provided based of statuses of switching devices	
	7.6.2 Selective blocking		Should be available for differential current alarm, switching object alarm, measurement abnormality, communication failure between Central Unit and Bay Unit	
	7.6.3 Forced blocking		Should be provided with selector switches installed in the panel for following options: BBP block, BFP block, EFP block, Output contacts block, All functions block	
7.7	Pre-configuration		For all basic functions with respect to the complete Single Line Diagram of the substation	
8	Monitoring & Supervision functions			
8.1	Current measurement		For all feeders and all phases, Differential Current, Restraining current	

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

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

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		ABB/SIEMENS/GE/SEL or equivalent.	

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

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

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/ USA/ France or from other eligible countries with equivalent quality).	
2	Country of Origin			
3	Type, model		Should be filled up by bidder	
4	Reset mechanism		Self reset	
5	Maximum operating time	ms	10	
6	Maximum reset time	ms	20	
7	Rated voltage	V DC	100-125 or higher range	
8	Minimum threshold voltage	V DC	35% lower than the nominal voltage	
9	Minimum Rated capacity of relay contacts		AC 1250VA with maxima of 5A and 300V	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
			DC 1250W with maxima of 5A and 300V	
10	Minimum thermal capacity of relay contacts		AC 7500VA with maxima of 30A and 300V DC 7500W with maxima of 30A and 300V	
11	Number of Normally Open contacts	Nos	As required for standard scheme	
12	Number of Normally Close contacts	Nos	As required for standard scheme	
13	Standards		Should conform IEC-60255 in all aspects	

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

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
1	Manufacturer's name		ABB/SIEMENS/GE/SEL or equivalent. (Switzerland/Sweden/Germany/UK/USA/ France or from other eligible countries with equivalent quality).	
2	Country of Origin			
3	Type, model		Should be filled up by bidder	
4	Reset mechanism		Hand reset	
5	Maximum operating time	ms	10	
6	Rated voltage	V DC	100-125 or higher range	
7	Minimum threshold voltage	V DC	35% lower than the nominal voltage	
8	Minimum Rated capacity of relay contacts		AC 1250VA with maxima of 5A and 300V DC 1250W with maxima of 5A and 300V	
9	Minimum thermal capacity of relay contacts		AC 7500VA with maxima of 30A and 300V DC 7500W with maxima of 30A and 300V	

SL. No.	Description	Unit	PGCB's requirements	Bidder's Data
10	Number of Normally Open contacts	Nos	As required for standard scheme	
11	Number of Normally Close contacts	Nos	As required for standard scheme	
12	Standards		Should conform IEC-60255 in all aspects	

7.11 Test Socket

No.	Description	Unit	Minimum Requirements	Bidder's Data
			Data	
1.1	Manufacturer			
1.2	Country of origin			
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	

7.12 **Energy Meter (3-phase, 4-wire, 3-element, Numerical Indoor Type with Power Quality Monitoring):**

SL. No.	Description	Unit	PGCB's requirements	Bidder's data
1	Manufacturer's name		CEWE/Elster/Landis+Gyr/EDMI/SEL	
2	Country of Origin		France/UK/USA/Switzerland/Sweden/Germany/EU	
3	Model		Should be filled up by bidder	
4	Meter type		Numerical, programmable, multi-function	
5	Display language		English	
6	Connection type		CT/VT operated, 3-phase, 4 wires, solidly grounded neutral	
7	Installation		Indoor installation	
8	Type of socket		To be mentioned	
9	Number of element	Nos	3 (three)	
10	Number of terminals	Nos	At least 10 (ten)	
11	Current range	A	1 to 10, user programmable	
12	Starting Current	A	0.1% of nominal	
13	Continuous Thermal current rating	A	1.5*In or higher	
14	Short time thermal rating	A	10*In or higher for 1sec	
15	Voltage range	V AC	50 to 82.5 (P-N) or higher range, Burden-10MΩ	
16	Overload voltage	V AC	1.3*Vn, continuous	
17	Burden			
	17.1 Current Circuit	VA/phase	< 0.1 @ 1A, < 0.5 @ 5A	
	17.2 Voltage Circuit (with auxiliary power)	VA/phase	< 0.1	
	17.3 Voltage Circuit (with self power)	VA/phase	< 6VA	
18	Auxiliary supply range		Dual Power Supply: 80V to 240V AC/DC or higher range Self Power with VT voltage (80V to 130V AC)	
19	Operating frequency		50Hz (±5%)	
20	Measuring mode		True 4 quadrant	
21	Accuracy class		0.2S for kWh, 0.5 for kVARh	
22	Losses at nominal load		To be mentioned	
23	Local communication		DLMS, RS232/RS485/Ethernet	
24	Remote communication		Standard metering protocol, MODBUS; Communication facility to Network Control Center should be available	

SL. No.	Description	Unit	PGCB's requirements	Bidder's data
25	Software interfacing facility with PC		Should be available	
26	Software requirement		Should be able to configure and monitor with user friendly PC-based tool. 2. Necessary software for configuration and parameterization has to be supplied free of cost and without any time-bound license	
27	Password protection		Should be available for programming, configuration and read out meter data	
28	Meter sealing condition		Hermatically or Ultrasonic welded	
29	Display options		Built-in HMI LCD display, configurable display, including meter ID, power quadrant display	
30	Integration period		30 (thirty) minutes	
	Resetting period		1 (one) month	
	Cumulative MD transfer		Built-in	
	Cycle Timing device		Built-in	
31	Normal display list		Complete LCD test, Present date, Present time Current billing total kWh-Del, Current billing total kWh-Rec Current billing total kVARh-(Q1+Q4), Current billing total kVARh-(Q2+Q3) Current billing maximum kW-Del, Current billing maximum kW- Del Date, Current billing maximum kW-Del Time, Current billing cumulative kW-Del Current billing maximum kW-Rec, Current billing maximum kW-Rec Date, Current billing maximum kW-Rec Time, Current billing cumulative kW-Rec Phase A voltage, Phase B voltage, Phase C voltage Phase A current, Phase B current, Phase C current Phase A voltage angle, Phase B voltage angle, Phase C voltage angle Phase A current angle, Phase B current angle, Phase C current angle System PF-arithmetic, Line frequency	
32	Alternate mode display list		Complete LCD test, Present date, Present time	

SL. No.	Description	Unit	PGCB's requirements	Bidder's data
			Current billing total kWh-Del, Current billing total kWh-Rec Current billing total kVARh-(Q1+Q4), Current billing total kVARh-(Q2+Q3) System PF-arithmetic, Line frequency	
33	Online testing facility		Should be available with online CT shorting facility with security sealing provision	
34	Data storage		At least 32MB of nonvolatile memory for data storage and capable of simultaneously record 4 load profile recorders x 8 channels for at least 90days at 30 minute intervals.	
35	Data logging and event recording		Should be available	
36	In built clock		Should be available	
37	Provision of GPS synchronization		Should be available	
38	Additional Features		Power Quality Measurement (At least 1 GB of memory, 192 channels of LDP, 24kHz waveform, 600 VSSI summary events, Wave View, Flicker, Power Harmonics and Interharmonics, Total Harmonic Distortion) Necessary software for accessing the mentioned features should be provided without any time-bound license.	
39	Environment requirement			
	39.1 Ingress protection		IP54 or better	
	39.2 Operating temperature		-10°C to +60°C	
	39.3 Storage temperature		-40°C to +80°C	
	39.4 Humidity range		0% to 95%, non-condensing	
40	Weight of the meter		To be mentioned	
41	Dimension of the meter		To be mentioned	
42	Outline, drawing and leaflets		To be provided	
43	Performance curves for balanced and unbalanced load		To be mentioned	
44	Year of manufacture		To be mentioned	
45	Minimum Battery Service life and shelf life	Years	10 (ten) & 15 (fifteen) respectively	
46	Meter service life	Years	15 (fifteen)	

SL. No.	Description	Unit	PGCB's requirements	Bidder's data
47	Reference standard		Relevant ANSI/IEC standard	
48	Warranty	Years	3 (three)	
49	Type test certificate		Should be provided	

7.13 Overall Fault Clearance Times

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
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	

7.14 Multi-Phase Auto reclose

No.	Description	Unit	Minimum Requirements	Guaranteed
			Data	
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	

7.15 Front Panel Annunciation for OHL & Power Transformers (Optional)

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.

7.16 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.

7.17 SCADA Server

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	
2.2	Processor type		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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)			

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

Substation Automation System

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
1.	General			
1.1	Standards			
	Test Cab: Damp heat, steady state Test Db: Damp heat, cycle (12h + 12h cycle) Digital I/O, Analogue I/O dielectric Tests Digital I/O, Surge withstand test Radio interference test Transient fast burst test Static Discharge Electromagnetic fields		IEC 60068-2-78 IEC 60068-2-30 IEC 60255-27 IEC 61000-4-5 IEC 60870-3/Class 2 IEC 61000-4-4 IEC 61000-4-2 IEC 61000-4-3	
1.2	Number of years of proven field experience of offered system. (Note: proof of experience should be furnished. The components used in the offered system and those with field experience should be the same)	Year	5	
1.3	Design life of substation Automation System	Year	15	
1.4	Manufacturers quality assurance system		ISO 9001/9002 or equivalent	
1.5	Dimensions of cubicle Width Depth Height Floor load	mm mm mm N/m2	Insert Insert Insert Max 600	
1.6	Temperature range (min/max)	oC	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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
3	Gateway to National Load dispatch Center			
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 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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
8.7	Synchro check function Maximum Voltage difference Maximum Frequency difference Maximum Phase difference	Specify Range	Insert	
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			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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)			

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	

7.19 Operator Workstation

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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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	
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)			

7.20 Printer

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)			

7.21 Monitoring Workstation

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Monitoring 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		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	
2.19.5	Supply voltage			

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

7.22 Time Synchronization Device

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

7.23 Weather Station (Optional)

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Weather Station			
1.1	Terminal Type		Insert	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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)			

7.24 Ethernet Switch Process LAN

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

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
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); eRSTPTM 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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.11	Type Test Reports		To be included with bid	
2.12	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

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

7.25 Ethernet Switch Control Room

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); eRSTPTM or RSTP (802.1D-2004) network fault recovery	
2.6	Switching latency		≤ 5μs	
2.7	Switching bandwidth		≤ 1.6 Gbps	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.8	Failsafe output relay		Potential-free	
2.9	Cyber security features			
2.9.1	Multi-level passwords		Yes	
2.9.2	SSH/SSL encryption		Yes	
2.9.3	Enable/disable ports, MAC based port security		Yes	
2.9.4	Port based network access control		Yes	
2.10	System features			
2.10.1	Automatic learning negotiation and crossover detection			
2.10.2	Port configuration, status, statistics, mirroring, security			
2.10.3	Network fault recovery		≤ 5 ms	
2.11	Type Test Reports		To be included with bid	
2.12	Installation		Indoor	
	Overall compliance with the requirements (yes/no)			

7.26 Protection Monitoring Software

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)			

7.27 SCADA Software

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

7.26 Fibre Optic Cables & Terminal Equipment

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

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.2	Optical distributor with connectors Overall quantity of Optical Distributor with Connectors should be closely related to number of relay houses. Optical Distributor with Connectors should be foreseen for both cable ends. At least 10% spare Optical Distributors with Connectors should be foreseen.		Yes	
2.2.1	Fibre optic cable gland		To accept metal-free optical cable	
2.2.3	Patch-cord connection		Yes	
2.2.4	Type of optical connectors		Insert	
2.2.5	Manufacturer		Insert	
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.

7.27 Special Control Equipment and Tools

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
	Special Control Equipment and Tools			
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)			

7.28 Automatic Voltage Regulation

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
14008	Automatic Voltage Regulation			
1.1	Manufacturer		MR Germany or ABB Sweden make or equivalent.	
1.2	Country of origin		Germany / Sweden or from other eligible countries with equivalent quality.	
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		3xI _r	
2.2.4	Permissive overload, 1 s		100xI _r	
2.2.5	Burden at I _r	VA	< 0.5	
2.3	a.c. voltage inputs			
2.3.1	Number of inputs		Min 4	
2.3.2	Rated voltage Ph-Ph U _r	V	100	
2.3.3	Permissive overload, continuous	% U _r	150	
2.3.4	Permissive overload, 1 s	% U _r	250	
2.3.5	Burden at U _r	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	

No.	Description	Minimum Requirements		Guaranteed
		Unit	Data	
2.4.6	Regulation for capacitive load	Yes/No	Insert	
2.4.7	Undervoltage blocking range	% Ur2	Insert	
2.4.8	Overcurrent blocking range	% Ir	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)			

7.29 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)			

PART 8– SHUNT REACTOR (NOT APPLICABLE)

SL	Description	Unit	Minimum Requirements	Guaranteed
1.	Name of manufacturer			
2.	Model			
3.	Country of origin			
4.	Service conditions: - External cooling medium - Altitude not exceeding - Air temperature not exceeding Average air temperature in any one year not exceeding: - In any one day - Average in one year	- m °C °C °C	As per volume 2 section 1	
5.	Rated voltage	kV	420	
6.	Rated lightning impulse withstand voltage - HV - Neutral	kV	1425 insert	
7.	Rated switching impulse withstand voltage - HV - Neutral	kV	1050 NA	
8.	Rated power Frequency withstand voltage - HV - Neutral	kV	650 insert	
9.	Rated Capacity		25 MVar	
10.	Vector Group		Grounded Wye	
11.	Method of Earthing		Solidly Earth	
12.	Maximum temperature Rise - windings - Top oil - Hot spot of Core	°C	Insert Insert insert	
13.	Total Losses at rated voltage & frequency - Core Loss - Copper Loss - Total	kW	Insert Insert insert	
14.	Cooling		ONAN	
15.	Rated Power at Rated voltage & frequency	MVar	25MVar	
16.	Rated Current	A	insert	
17.	Rated reactance/phase	Ω	insert	
18.	Zero sequence reactance	Ω	insert	
19.	Mutual Reactance	Ω	insert	
20.	Linearity Range of magnetic circuit percent to rated voltage	%	insert	
21.	Reactance during saturation percent to rated reactance	%	insert	
22.	Harmonics - Even - Total	%	insert	
23.	Core Design	Gapped/Air Core	insert	
24.	No. of Core	No's	insert	

SL	Description	Unit	Minimum Requirements	Guaranteed
25.	Material & type of Core		insert	
26.	Type of winding		insert	
27.	Winding Connection brazed or crimped		insert	
28.	Type of Insulation - HV side - Neutral side	Non/Uniform	insert	
29.	Flux Density at Rated voltage & frequency - Core - Yokes		insert	
30.	Volts per turn		insert	
31.	Efficiency	%	insert	
32.	Regulation - At unity power factor - At 0.8 lagging power factor	%	insert	
33.	Bushing Current Transformer -Ratio -Class -Burden	-- -- VA	520 30(actual value shall be as per calculation at execution stage)	
34.	Maximum Sound Pressure level	dB	78	
35.	Oil Type		insert	
36.	Weight of Active part	kg	insert	
37.	Weight of Oil*	kg	insert	
38.	Total weight*	kg	insert	
39.	Heaviest part for shipment	kg	insert	

*These values are required for Foundation design & shipping purpose only. During detail design, these values may vary from Bid value due to attaining desired electrical output.

PART 9 - FIBRE OPTIC MULTIPLEXER EQUIPMENT

Bidder shall provide all necessary information which deem to be necessary to complete the project in all respects.

No.	Description	Minimum Requirements	Guaranteed
1.0	GENERAL:		
1.1	Type of multiplexer		SDH / MPLS-TP / Hybrid (SDH, MPLS-TP) & PDH
1.2	Complying to ITU-T rec.		Yes
1.3	Transmission Capacity	Mbit/s	STM-4 & STM-16, 1Gbps & 10Gbps
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:		

No.	Description	Minimum Requirements		Guaranteed
1.0	GENERAL:			
2.1	Optical aggregates (ITU-T G.957)		As per field requirement	
2.2	Ethernet (ITU-T G.8112/Y.1371)		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 G.8112/Y.1371	
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	Not Applicable	
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, 2wire with E&M: Input level Output level	dBr	+6.5 .. -12.5 -1.0 .. -20	
4.1.3	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	V _{peak}	250	
4.3.1.4	1 + 1 com path protection		Yes	
4.3.2	Interface(s) for Differential Protection:			
4.3.2.1	Electrical interface: G.703	kbit/s	64	
4.3.2.2	Optical Interface : IEEE C37.94	kbit/s	Minimum 64	
4.4	Data: channels per module			
4.4.1	1 + 1 com path protection, available for all		Yes	
4.4.2	V.24/V.28 (RS-232) data interface	Nos.	4	
4.4.3	V.11/X.24 (RS-422) data interface	Nos.	4	

No.	Description	Minimum Requirements		Guaranteed
1.0	GENERAL:			
4.4.4	V.35/V.36 (RS-485) data interface		4	
4.4.5	G.703: 64kbit/s	Nos.	8	
4.4.6	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 Ethernet / 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	

PART -10

10.0 POWER LINE CARRIER EQUIPMENT

(NOT APPLICABLE)

10.1	Line Trap	400kV	Guaranteed
9.	Manufacturer/model		
10.	Type		

11.	Rated continuous current		
12.	Type of Line Trap Installation	To be inserted into high voltage A.C transmission line phase in series	
13.	Type of mounting	Pedestal	
14.	Suitable for system Frequency	--50Hz--	
15.	Nominal System Voltage	400 KV	
16.	Highest System Voltage	420 KV	
17.	Rated Continuous Current	4000 A	
18.	Rated Short time current for 1 second	63kA	
19.	Asymmetrical peak value of the First half wave of the rates short Time current	158 KA	
20.	Rated inductance	1.0 mH	
21.	Type of Tuning	Band tuned line trap	
22.	Blocking Band frequency range	Band-I 56 to 124 KHZ Band- II 76 to 500 KHZ	
23.	Minimum Guaranteed resistive Component of impedance in Blocking Frequency Rang	500 Ohm	
24.	Protective device	a) Non-linear resistive type Gapped lightning arresters for A.C system. Polymer housed Metal oxide surge arrester without Gaps for A.C system.	
25.	Nominal discharge current of protective device	10 KA. However, Co-ordination shall be done by taking 20KA 8/20 micro-sec discharge in to consideration.	
26.	Rated voltage of protective device	>15.72 KV rms	
27.	Minimum value of power frequency spark over voltage (Dry & wet) of protective device	>23.58KV rms	
28.	Visual Corona Extinction Volt	320 KV rms	
29.	Radio influence Voltage (RIV)	<500 micro Volt@280 KV	
30.	Attention in tuned frequency band	<7.5 dB	
31.	Maximum tapping loss over blocking Band I & II stated above	2.6 dB	
32.	Insulation class	Class F Insulation	
33.	Maximum working stress	Twice the weight of wave trap+500Kgs.	
34.	Coil inductance		
35.	Air temperature operating range		
36.	Weight of trap		
37.	Type of protective device		
38.	Temperature rise at normal rating		
39.	Dynamic short circuit rating		
40.	Temperature rise at short circuit rating		
41.	Working tension of strain (mounted units)		

42.	Bandwidth blocked band		
43.	Minimum impedance in working bandwidth		
44.	Compatibility with IEC Recommendation 353		
45.	Mounting details		
46.	MTBF		
47.	Design Life		
48.	Equipment technical description		
12.2	HF Coupling Unit	400kV	
1.	Manufacturer/model		
2.	Type		
3.	Working temperature range		
4.	Available bandwidth		
5.	Tuning range		
6.	Composite loss over tuning range		
7.	Line side impedance range for phase/phase coupling		
8.	Equipment side impedance		
9.	Drain coil current carrying ● continuous ● for 1 second ● for 3 seconds		
10.	Isolation transformer voltage withstand for 1 minute		
11.	Main arrestor voltage		
12.	Earth switch interlock with door		
13.	Compatibility with IEC Recommendation 481		
12.3	High Frequency Cable	400 kV	

1.	Manufacturer		
2.	Type		
3.	Coaxial or quad		
4.	Surge impedance		
5.	Voltage withstand: • between conductors • between cores and armouring		
	Attenuation per km: • at 50 kHz • at 400 kHz		
12.4	Digital PLC Terminal		
1.	Manufacturer/model		
2.	Type		
3.	Compliance with relevant parts of IEC 495		
4.	DC voltage working range		
5.	Service conditions (temperature and RH)		
6.	Power consumption		
7.	Design life		
8.	Carrier frequency range		
9.	Gross bandwidth		
10.	Teleprotection equipment mounted within the PLC units		
11.	Technical description of the equipment		
12.	Type of coupling (phase/phase or inter circuit)		
13.	Return loss within the carrier frequency band		
14.	Transmission rate of the digital signal		
15.	Output impedance		

16.	Dynamic range of receiver for digital signal	
17.	Means of RF frequency selection	
18.	frequency spacing for parallel connections • between two digital PLCs • between a digital and an analogue PLC	
19.	Output power (before hybrid at coaxial cable)	
20.	Channel terminal power at output to coupling equipment	
21.	Type of digital modulation available/proposed	
22.	Calculations to justify operation of the PLC over the transmission lines	
23.	Any limitations in parallelling of terminals (to digital or analogue PLCs)	
24.	Required minimum SNR for minimum BER	
25.	Switching off of parallel PLCs, not to cause interference with working PLCs	
26.	Spurious emissions	
	Digital PLC Terminal (Terminal)	
27.	Maximum transmitting level for parasitic signals: • 0-4 kHz from the band limits • 4-8 kHz from the band limits • >8 kHz from the band limits	
28.	Voltage withstand	
29.	Capacity options available for various services equipped within the digital bit stream	
30.	Capacity allocation proposed for this project	
31.	Speech channel 2W/4W interface	
32.	Speech channel impedance/levels	
33.	"Long line" telephone facility	

34.	Speech channel interfaces available (E&M etc.)	
35.	Service telephone	
36.	Type of speech codec	
37.	Compatibility with analogue speech bands	
38.	Method of telephone signalling	
39.	Frequency response of speech channel (Ref 800 Hz)	
40.	Data channel interface	
41.	Synchronous/asynchronous data channel availability	
42.	Data signalling transmission rates which can be accommodated	
43.	FSK Interface	
44.	VFT signal levels (2W and 4W)	
45.	Frequency response of VFT channel (Ref 3 kHz)	
46.	Test facilities	
47.	Alarm facilities	
48.	Equipment technical description	
49.	Terminal MTBF	
50.	Single or duplicated PSU	
	Teleprotection Equipment	
1.	Manufacturer/model	
2.	Type	
3.	DC voltage working range	
4.	Service conditions (temperature and RH)	
5.	Power consumption	

6.	Configured for analogue or digital communications media	
7.	Design life	
8.	Suitable for direct, permissive, blocking signalling	
9.	Single/duplication of teleprotection signals	
10.	VFT channel allocation and bandwidth	
11.	Frequency or coded signalling	
12.	Use of guard channel	
13.	Signal transmission time	
14.	Modem programmability	
15.	Means of monitoring communications channel	
16.	Transmission of "trip/send" signal at increased level	
17.	No. of signals per terminal	
18.	Facility to hold on output signal	
19.	Trip extension facility/time	
20.	Minimum/maximum input pulse and corresponding output	
21.	No. of receive output contracts	
22.	Provision of counters	
23.	Voltage withstand	
24.	Transmitter level output range	
25.	Receiver sensitivity range	
26.	Receiver alarm level or BER referred to nominal	
27.	Minimum alarm contact closure time	

28.	No. of alarm contacts	
29.	19"/ETSI rack mounting practice	
	Teleprotection Equipment (Continued)	
30.	Information to be submitted with the Tender (a) Technical description (b) MTBF calculations (c) Performance graphs/details	
12.6	PAX Telephone Equipment and Subscriber Equipment	(NOT APPLICABLE)
(a)	Exchange equipment	
1.	Type reference	
2.	Manufacturer	
3.	Dimensions of cubicle	
4.	Rack width	
5.	Literature reference for typical layout of cubicle	
6.	Operating temperature range	
7.	Operating relative humidity	
8.	Power requirements	
9.	Mean time between failures	
10.	Maximum number of local extensions	
11.	Maximum number of remote extensions	
12.	Maximum number of trunk lines	
13.	Maximum number of connecting circuits	
14.	Method of signalling ● Local extensions 2W ● Remote extensions 4W ● Trunk lines 4W	
15.	Frequency of audible tones	

	• Dial tone Hz • Busy tone Hz • Ringing tone Hz • Ringing current Hz • Ringing current Hz	
16.	Ring voltage	
17.	Type of processor	
18.	Type of memory	
(b)	Subscriber telephone	
1.	Type reference	
2.	Manufacturer	
3.	Type of dial (rotary/pushbutton)	
4.	Operating voltage	
5.	Outdoor bell	
6.	Type reference	
7.	Manufacturer	
8.	Operating voltage	

Part 11. GTP of IP camera surveillance system

1. 4 MP OUTDOOR FIXED TYPE BULLET IP CAMERA HAVING ONVIF WITH SMART/AI:				
Sl. No.	Items	Unit	Data	Guaranteed by bidder
1	Item Name		Outdoor Fixed Type Bullet IP CAMERA having ONVIF with Smart/AI Features	

2	Brand Name		Insert	
3	Model No		Insert	
4	Country of origin		Insert	
5	Country of Manufacturing		Insert	
6	CAMERA			
6.1	Application/working Environment		Outdoor Type / Day-Night	
6.2	Image sensor		Insert	
6.3	Sensitivity / Illumination	lux	Insert	
6.4	IR Working Distance	m	Minimum 30	
6.5	Horizontal Viewing Angle	degrees	95° -135° or Higher range of View Angle	
6.6	Memory	MB	Insert	
7	VIDEO			
7.1	Video compression		Ultra 265 / H.265 / H.264 / MJPEG	
7.2	Resolutions	MP	Min. 4MP (2592×1520) / 4MP (2560×1440)	
7.3	Frame Rate	fps	4MP (2560×1440): Min. 25 fps / (2592×1520): Min. 20 fps or Better	
7.4	ICR function		Insert	
8	IMAGE SETTING			
8.1	Day Night		Auto (ICR) / Color / B/W	
8.2	White Balance		Auto / Sunny / Night /outdoor / Customized	
8.3	Gain Control		Auto / Manual	
9	Network			
9.1	Security		Password Protection ,IP address filtering	
9.2	Supported protocols		Insert	
10	GENERAL			
10.1	Power	W	PoE Supported, Max 10 W	
10.2	Local Storage	GB	Insert	
10.3	Connectors		1 RJ45 10M/100M Base-TX Ethernet	
10.4	Environmental Casing/housing		IP66 or higher	
10.5	Accessories		Mounting bracket, Drill template etc.	
11	FEATURES			
11.1	Object Detection		Yes	
11.2	Alarm		Yes (Through the NVR)	
11.2	ONVIF		Yes	
2. 4 MP DOME TYPE IP CAMERA WITH ONVIF:				
1	Item Name		Outdoor Fixed Type Bullet IP CAMERA having ONVIF with Smart/AI Features	
2	Brand Name		Insert	
3	Model No		Insert	

4	Country of origin		Insert	
5	Country of Manufacturing		Insert	
6	CAMERA			
6.1	Application/Working Environment		Indoor/Day-Night	
6.2	Image sensor		Insert	
6.3	Sensitivity / Illumination	lux	Insert	
6.4	IR Working Distance	m	Minimum 30 Meter	
6.5	Horizontal Viewing Angle	degrees	95° - 135° or Higher range of View Angle	
6.6	Memory	MB	Insert	
7	VIDEO			
7.1	Video compression		Ultra 265, H.264, MJPEG	
7.2	Minimum Resolutions		Min. 4MP (2592×1520) / 4MP (2560×1440)	
7.3	Frame Rate		4MP (2560×1440): Min. 25 fps & (2592×1520): Min. 20 fps or Better	
8	IMAGE SETTING			
8.1	Day Night		Auto / Color / B/W	
8.2	White Balance		Auto/ Sunny/Night / outdoor /Customize	
8.3	Gain Control		Auto/Manual	
9	NETWORK			
9.1	Security		Password Protection, IP address filtering.	
9.2	Supported protocols		Insert	
10	GENERAL			
10.1	Power	W	PoE Supported, Max 10 W	
10.2	Local Storage	GB	SDXC/SDHC/SD/ Micro SD card slots having min 256 GB Expandable option	
10.3	Connectors		1 RJ45 10M/100M Base-TX Ethernet	
10.4	Environmental Casing/housing		IP66 or higher	
11	FEATURES			
11.1	Object Detection		Yes	
11.2	Alarm		Yes (Through the NVR)	
11.3	ONVIF		Yes	
3. 32-Channel Network Video Recorder having ONVIF & Smart/AI Features Supporting FEATURED:				
1	Item Name		32 Channel Network Video Receiver having ONVIF with Smart/AI Features Supporting	
2	Brand Name		Insert	
3	Model No		Insert	

4	Country of origin		Insert	
5	Country of Manufacturing		Insert	
6	NVR			
6.1	Main Processor		Intel Quad/Dual-core/ His3536 embedded processor or equivalent	
6.2	Operating System		Embedded Linux or Microsoft windows professional.	
6.3	Licenses		Min. 32 station parmanent licenses included	
6.4	IP Camera Input		Minimum 32 channel	
6.5	Memory	GB	Min. 2 GB	
6.6	Storage/HDD Capability		4 SATA interfaces, up to 6TB for each HDD or Better	
6.7	External storage interface		eSATA/USB	
6.8	HDD capacity (Inserted)	TB	storage for 15 days continuous recorindg (4MP @ 30fps) on all channels or higher	
6.9	Compression		Ultra 265, H.265, H.264	
6.10	Live view/Playback		8MP/6MP/5MP/4MP/3MP/1080p/960p/720 p/D1/2CIF/CIF or Better	
6.11	Capability		8 x 4MP@30, 16 x 1080p@30, 32 x 960p@25 or Better	
6.12	Maximum Bandwidth (Incoming & Outgoing)		Total 320 Mbps or Better	
6.13	Alarm Actions		Insert	
6.14	Video Detection		Video Motion Detection, Video Loss & Camera Blank	
6.15	External Network/interface connector			
6.15.1	RJ-45		2 RJ45 10M/100M/1000M self-adaptive Ethernet Interfaces	
6.15.2	HDMI Port	Nos	Min. 2	
6.15.3	USB Port	Nos	Insert	
6.15.4	Alarm In	nos	Insert	
6.15.5	Alarm Out	nos	Insert	
6.15.6	VGA		Yes	
6.16	Network Function		HTTP, TCP/IP, IPv4/IPv6, UPnP, RTSP, UDP, SMTP, NTP, DHCP, DNS, IP Filter,	

			PPPoE, DDNS, FTP, Alarm Server, IP Search	
6.17	Max. User Access	Nos	Insert	
6.18	Remote Access		Web client, Smartphone (iPhone, iPad, Android app)	
6.19	Safety / EMS Standard		CE/IEC/EN standard	
6.20	Power consumption	W	Insert	
6.21	Cooling system		Insert	
6.22	Accessories		Installation guide, Keyboard, Computer mouse, power cable etc. and other necessary materials	
6.23	Software		Genuine permanent Camera station license from the manufacturer	
7	FEATURES			
7.1	Object Detection		Yes	
7.2	Alarm (Buzzer)		Yes	
7.3	ONVIF		Yes	
4. Core Switch :				
1	Brand Name		Insert	
2	Model No		Insert	
3	Country of origin		Insert	
4	Country of Manufacturing		Insert	
5	Device Type		Min. 12 ports Gigabit Fiber & 12 ports Gigabit Ethernet (Combo) + 4 Port PoE+ Layer 2+ Managed	
6	Enclosure Type		Insert	
7	Ports		12 x Gigabit SFP+ 12 x Gigabit Combo Ethernet or Higher	
8	Switching capacity	Gbps	Min 20 Gbps	
9	Forwarding performance (64-byte packet size)	Mpps	Min. 15.0 Mpps	
10	Routing Protocol		Static IPv4 routing	
11	Remote Management Protocol		SNMP 1, RMON 1, RMON 2, RMON 3, RMON 9, Telnet, SNMP 3, SNMP 2c, HTTP, HTTPS, SSH, CLI	
12	Authentication Method		Secure Shell (SSH), RADIUS, TACACS+	
13	Compliant Standards		IEEE 802.3	
14	RAM	MB	Min. 128	
15	Flash Memory	MB	Min. 16	

16	Status Indicators		Link activity, port transmission speed, system	
17	Interfaces	Nos	12 x 10/100/1000 RJ-45	
		Nos	1 x console - DB-9 - management	
		Nos	12 x Shared SFP Fiber 100/1000	
18	Power Device		External power adapter or 1 fixed PSU	
19	Voltage Input	V	AC 230 V (50 Hz)	
20	Miscellaneous			
21	Rack Mounting Kit		Included	
22	MTBF	hours	Min. 5,00,000 hours	
23	Compliant Standards		UL listed (UL 1950)/cUL IEC 950/EN 60950	
5. Access Switch:				
1	Brand Name		Insert	
2	Model No		Insert	
3	Country of origin		Insert	
4	Country of Manufacturing		Insert	
5	Device type		8 x 10/100/1000 (PoE) + 2 x Combo Gigabit SFP	
6	Enclosure Type		Insert	
7	Routing Protocol		Static Ipv4 routing	
8	Compliant Standards		IEEE 802.1D	
9	Remote Management Protocol		CLI, HTTP, SSH, Telnet, HTTPS, RMON 1, RMON 2, RMON 3, RMON 9, SNMP 1, SNMP 2c, SNMP 3	
6. SFP Modular:				
1	Brand Name		Insert	
2	Model No		Insert	
3	Country of origin		Insert	
4	Country of Manufacturing		Insert	
5	Device Type		LC(Local Connector) / SM(Single Mode)/SF(Single Fibre) 1.25Gbit/s, 20km	
7. Ethernet Lightning Arrester (Outdoor type):				
1	Brand Name		Insert	
2	Model No		Insert	
3	Country of origin		Insert	
4	Country of manufacturing		Insert	
5	Type		Outdoor RJ-45 Bulkhead Mount/Pole mount or wall mount	
6	Data Rate	Mbps	1000	
7	Nominal Operating Voltage	Vdc	48	

8	Maximum Continuous Operating Voltage	Vdc	90	
9	Surge Current		Min. 1.5 kA, 10/1000us	
10	Input/output Connector		Two x RJ-45	
11	Protection		Min. IP54	
8. 40" LED TV:				
1	Brand Name		Insert	
2	Model No		Insert	
3	Country of origin		Insert	
4	Country of MFR		Insert	
5	Resolution		Min. 1920x1080	
6	Screen Size (Diagonal)	inch	Min. 40	
7	Dynamic Contrast Enhancer		Yes	
8	Display Type		LCD with Direct LED Backlight	
9	Viewing Angle	degrees	Insert	
10	HDCP		Yes	
11	Dolby Sound System		Yes	
12	Video Signal Support		1080/24p (HDMI only), 1080/60i, 1080/60p (HDMI/ Component), 1080/50i, 1080/50p (HDMI/ Component), 480/60i, 480/60p, 576/50i, 576/50p, 720/60p, 576/50p, 1080/30p or better	
13	Operating Voltage		AC 150-250 V, 50 Hz	
14	VGA Port		Yes	
15	HDMI Port (1.3/1.4 or higher)		Min. 2	
16	USB 2.0	Nos	Insert	
17	Operating System		Insert	
18	Accessories		Insert	
9. Offline UPS:				
1	Brand Name		Insert	
2	Model		Insert	
3	Country of manufacturing		Insert	
4	Output Power	VA	Min. 2000	
5	Input range	V	220V AC (Cover range 170-270V AC)	
6	Output range	V	220V AC (Must be compatible with offered IP cameras)	
7	Other features		Built –in- AVR	
8	Back-up time		Minimum 30 minutes at full load.	

10. 22U FLOOR MOUNT RACK :				
1	Brand		Insert	
2	Model		Insert	
3	Country of Origin		Insert	
4	Country of Manufacturing		Insert	
5	Size		22U	
6	Dimension(Width*Depth)		600mm*600mm	
7	Maximum Static Load Capacity	kg	1000 KG or higher	
8	Ventilation Percentage		>70% High density ventilation door	
9	Material		RAL 7021 Black	
10	Max. Open Angel		180 degree	
11	Surface Treatment		Powder coated	
12	19" Profile		Galvanized coated (2.0mm)	
13	Side Panel		Powder coating (1.2mm), removable side panel 4 part with Steel locking system for each part.	
14	Rear Door		High-density ventilation door, SPCC 1.2mm with lock system	
15	Front Door		Tempered glass door, SPCC 1.2mm with lock system	
16	Raw Material		SPCC	
17	Power Distribution Unit		13 Amp 6 way PDU UK type with 3 meter power cable length.	
18	Heavy Duty Castor & Adjustable Feet		Four M12 adjustable feet & four heavy duty castor	
19	Top Beam with fans		(1.5mm) SPCC with 4 nos fan.	
20	Standards		ANSI/EIA RS-310-D, IEC60297-2	
11. Fiber Optic Cable-(6 core Single mode , Armored):				
1	Brand		Insert	
2	Model		Insert	
3	Country of Origin		Insert	
4	Country of Manufacturing		Insert	
5	Type		Armored Optical Fiber Cable, 6core, Single Mode	
6	Standards		ISO/IEC 11801:2008, ANSI/EIA-568-C.3, TIA-598-C, EN50173:2002, TIA/EIA-526-7	
7	Cable Diameter	mm	8.2(±0.2)	
8	Strength Member		Steel	
9	Aarmor Material		Steel strip	
10	Tube Filling		Gel	

11	Water Blocking Material		Waterproof tape	
12	Dynamic / Static Min. Bend Radius (D)		20 D	
13	Wavelength	nm	1310	
14	Attenuation (max.)	dB/km	≤0.38	
15	Cutoff Wavelength	nm	≤1260	
12. CAT6 Network Cable : STP Type				
1	Brand Name		Insert	
2	Part No.		Insert	
3	Country of origin		Insert	
4	Country of manufacturing		Insert	
5	ANSI/TIA Category		6	
6	Conductor		Stranding: Solid, Material: Bare Copper, 23 AWG, 4 pairs	
7	Insulation Material		Insert	
8	Outer Shield Material		Material: Aluminium/Poly, Coverage: 100%,	
9	Outer Jacket Material		Material: PVC - Polyvinyl Chloride, Low Smoke Zero Halogen (LSZH)	
10				
11	Max. Conductor DCR	Ohm/km	Insert	
12	Max. Capacitance Unbalance	pF/100m	Insert	
13	Nominal Mutual Capacitance	pF/ft	Insert	
14	Nominal Velocity of Propagation	c	Insert	
15	Others Compliance:		Flammability / Fire Resistance: NFPA 262, UL 910 (Plenum), FT6, FT6, IEC 60332-1-2. IEEE Compliance: IEEE 802.3bt Type 1, Type 2, Type 3, Type 4. TIA/EIA Compliance: ANSI/TIA-568.2-D Category 6.	
13. Surveillance Cabinet:				
1	Brand Name		Insert	
2	Model No.		Insert	
3	Country of manufacturer		Insert	
4	Casing Sheet (Material)		Weather proof stainless steel/ G.I Sheet 14 AWG or Equivalent, Color: Silver/Gray	
5	Environment		Outdoor	

6	Rack		Yes (Mounting for 19" PoE switch, Power supply, Optical fibre, LA, junction box, holes for different cables etc.)	
7	Dimension		24"x18"x16" (As per attached Drawing)	
8	Painting		Powder Coating	
9	Ventilation		2 Nos (As per attached Drawing)	
10	Cooling Fan		Yes (As per attached Drawing)	
11	Heat Insulation		Yes	
12	Cable Grand		Yes (as per attached Drawing)	
13	Door Lock		Yes	
14	Earthing Plate/Strip		Yes (Mesh connected or individual as required)	
15	Foundation		Yes (as per attached Drawing)	
16	Included accessories		Different dia Cable glands, High Quality Power socket, Internal standard wiring with Terminal (if needed), Earthing Terminal & all necessary accessories	
14. Power Cable-NYFGBY (4.0 RM):				
1	Brand Name		Insert	
2	Country of origin		Insert	
3	Country of manufacturing		Insert	
4	Specification		for 4 RM cable: 2* 4.0 RM for 2.5 RM cable: 2.5 RM 1000V, VDE 0271-3.69 & IEC: 60502-1, PVC Insulated, Steel Wire Armoured & PVC Sheathed Cable	
5	Material		Copper	
15. uPVC pipes & fittings with sizes: 37/25/19/12 mm dia				
1	Size		24"x18"x16" (As per attached Drawing)	
2	Specification		uPVC pipe having specific gravity 1.35 - 1.45, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI, ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, with all accessories such as round grating/domed roof grating, bends, sockets etc.	
3	Size		for dia 37mm, wall thickness 3.7mm-4.3mm for 25 mm dia, wall thickness 3.4 mm-4.0 mm for 19mm dia, wall thickness 2.9mm-3.4mm for 12mm dia, wall thickness 2.8mm-3.3mm	
16. Poles				

1	Material of pole		Stainless Steel	
2	Height	feet	Min. 15 (as per attached Drawing)	
3	Thikness	mm	Min. 1.5	
4	Based plate dimension		As per attached drawing	
5	Based casting & anchoring of the pole		As per attached drawing	
17. Main Distribution Board (MDB):				
1	Brand Name		Insert	
2	Model No.		Insert	
3	Country of manufacturer		Insert	
4	Casing Sheet (Material)		Weather proof stainless steel / G.I Sheet 16 AWG or Better, Color: Silver/Gray	
5	Environment		Indoor	
6	Mounting On		Wall	
7	No of Busbar Plate	Nos	2	
8	Material of Busbar Plate		Copper	
9	Size of Busbar Plate		As required	
10	Grounding Strip/Plate		Yes	
11	Mountain Channel of CB & SPD & Fuse		Yes	
12	Grounding Cable Size (External)		Min. 25 RM	
13	Grounding Cable Size (Internal)		Min. 16 RM	
14	Dimension		16"x14"x7" or higher	
15	Painting		Powder Coating	
16	Cable Grand		Yes	
17	Door Lock		Yes	
18	Including / Fitted Following Accessories as per attached Drawing			

19	SPD (Surge Protection Device) Type-1		Against: Indirect lightning strikes causing induced or conducted overvoltages on the power distribution network. Protected Number of Poles: 2, Version: Plug-in Nominal AC Voltage of the System (U): 230 / 400 V Arrester Class: I Discharge Current: Nominal (kA) : Insert I (max, kA) : Insert Impulse Current: I (imp, 10 / 350 μ s) : Insert Maximum Continuous Operating Voltage (Uc): (L-PE) V : Insert (N-L) V : Insert Voltage Protection Level (Up, kV): Insert Short Circuit Withstand Icc (kA) : Insert Short-Circuit Protective Devices: Curve B Breakers $\leq$ 125 A or Better Curve C Breakers $\leq$ 125 A or Better gL Type Fuses $\leq$ 125 A or Better gG Type Fuses $\leq$ 125 A or Better Width in Number of Modular Spacings: 2, Indicator: Yes	
20	MCB		Brand: Insert Country of Origin: Insert, Protected Number of Poles: 2, Current Rating: 15A to 30 A (As Required), Voltage Rating: 230 V AC/400 V AC, Features: Overcurrent & Magnetic	
21	Fuse		Brand: Insert Number of Poles: 2, Current Rating (A): (As Required) Voltage Rating: 230 V AC/400 V AC	
18. Sub Distribution Board (SDB):				
1	Brand Name		Insert	
2	Model No.		Insert	
3	Country of manufacturer		Insert	
4	Casing Sheet (Material)		Weather proof stainless steel / G.I Sheet 16 AWG or Better, Color: Silver/Gray	
5	Environment		Indoor	
6	Mounting On		Wall	
7	No of Busbar Plate		2	
8	Material of Busbar Plate		Copper	
9	Size of Busbar Plate		As required	
10	Grounding Strip/Plate		Yes	

11	Mountain Channel of CB & SPD & Fuse		Yes	
12	Grounding Cable Size (External)		Min. 25 RM	
13	Grounding Cable Size (Internal)		Min. 16 RM	
14	Dimension		16"x14"x7" or Higher	
15	Painting		Power Coating	
16	Cable Grand		Yes	
17	Door Lock		Yes	
18	Including / Fitted Following Accessories as per attached Drawing			
19	SPD (Surge Protection Device) - Type-2		Against: Indirect lightning strikes causing induced or conducted overvoltages on the power distribution network. Protected Number of Poles: 2 Version: Plug-in Nominal AC Voltage of the System (U): 230 / 400 V Arrester Class: II Discharge Current: Nominal (8 / 20 μs) (kA) : Insert I (max, 8 / 20 μs) (kA) : Insert Impulse Current: I (imp, 10 / 350 μs) (kA) : Insert Maximum Continuous Operating Voltage (Uc): (L-PE) V : Insert (L-N) V : Insert (N-L) V : Insert Voltage Protection Level (Up, kV): Insert Short Circuit Withstand Icc (kA): Insert Short-Circuit Protective Devices: Curve B Breakers $\leq$ 125 A or Better Curve C Breakers $\leq$ 125 A or Better gL Type Fuses $\leq$ 125 A or Better gG Type Fuses $\leq$ 125 A or Better Width in Number of Modular Spacings: 2 Indicator: Yes	
20	MCB		Brand: Insert Country of Origin: Insert, Protected Number of Poles: 2, Current Rating: 15A to 30 A (As Required), Voltage Rating: 230 V AC/400 V AC Features: Overcurrent & Magnetic	

21	Fuse		Brand: InsertNumber of Poles: 2Current Rating (A): (As Required)Voltage Rating: 230 V AC/400 V AC	
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Guaranteed Technical Particulars
For 5 kW_p Grid Tied Solar System with Net Metering

The GTP of 5 kW Solar system is given for reference purpose only. Bidder shall submit the GTP of 10 KW output Solar system from manufacturer.

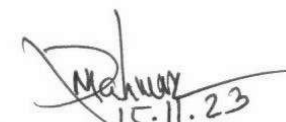
(To be filled up by the Seal & Signed by bidder otherwise the bid will be rejected)

SL. No	Description	PGCB's Requirements	Manufacturer's /Bidders Guaranteed Particulars
Description of the Solar System:			
Supplying, Installation, Testing & Commissioning of 5 kW _p Grid Tied solar system for Net Metering with required quantities of mono crystalline silicon solar PV modules & Inverter, Surge Protection Device, Energy meter & others necessary/compatible accessories etc. as per following standards, specifications and certifications.			
1.0 SOLAR PV MODULE SYSTEM			
1.1	Manufacturer Name	Canadian Solar/Jinko Solar/Longi Solar/JA solar/TW solar/GCL solar/LEFN solar.	
1.2	Manufacturer Address	To be mentioned	
1.3	County of Origin	To be mentioned	
1.4	Country of Manufacturing	To be mentioned	
1.5	Cell Type	Mono-crystalline/ Mono-crystalline PERC	
1.6	Model	To be mentioned	
1.7	Capacity/Module	Min. 540 watt	
	Serial no.	To be in panel	
1.8	Electrical Parameters at (STC) Conditions/PV module		
1.9	Max Power (P _{max})	Min. 540 W	
1.10	Max Power Voltage(V _{mp})	40-45 V	
1.11	Max Power Current (I _{mp})	>12.5 A	
1.12	Open Circuit Voltage (VOC)	>47 V	
1.13	Short Circuit Current(I _{sc})	>13 A	
1.14	Module Efficiency	>20.5%.	
1.15	Max System Voltage)	DC 1500V (TUV/IEC/ UL)/1000V(CUL/IEC)	
1.16	Series Fuse Rating	25-30 A	
1.17	Power Tolerance(max.)	3%	
1.18	Output power Degradation criteria	98% rated output at 1 st year	
1.19		>90% rated output at 12 th year	
1.20		>80% rated output at 25 th year	
1.21	Mechanical Data:		
1.22	Frame	Aluminum	
1.23	Jbox IP class	IP68	
1.24	Reverse protection Diode	Yes.	
1.25	Dimension	To be mentioned	
1.26	Weight	To be mentioned	
1.27	Glass	2.0 mm or higher with anti-reflective coating	
1.28	Output Cables	4 sqmm, symmetrical. length >350 mm	
1.29	Connector	MC4 or compatible	
1.30	Temperature Characteristics :		
1.31	Operating Temperature (° C)	0 to +85 or higher.	


Md. Faruk Hossain
Assistant Engineer
Design & Quality Control
PGCB Ltd.

Md. Faruk Hossain
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Executive Engineer
RTS, PGCB, Dhaka.


Dewan Md. Gias Mahmud
Executive Engineer
GMD, PGCB, Aricha
Manikganj-1802.


15.11.23
(Md. Mijanour Rahman)
ID No-00311
Superintending Engineer
RTS, PGCB, Dhaka

1.32	Temp. Coeff. of VoC	>-0.26%/°C	
1.33	Temp. Coeff. of Isc	>0.045%/°C	
1.34	Tests, Certifications and warranties:		
1.35	Standard Tests	IEC (BDS IEC 61730) (Part 2):2019 IEC (BDS IEC 62108:2020) IEC (BDS IEC 60891:2020) IEC (BDS IEC 61215-2:2019)	
1.36	System certification quality audit	ISO 9001, ISO14001, ISO45001	
1.38	Certifications	TUV, CE, UL, etc.	
1.39	Extreme Wind and snow loads testing	2400 Pascal for wind 5400 Pascal for snow(minimum)	
1.40	Operating Lifetime	25 Years(min.)	
1.41	Capacity Test	85% of rated power of each module should be shown at site test before installation. Overall capacity of the system should be >80% at site test.	

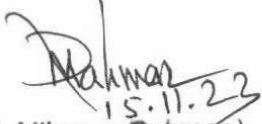
2.0 GRID TIED INVERTER

2.1	Manufacturer Name	Grandglow/Sungrow/ABB/Huawei/Sunways//Canadian Solar etc.	
2.2	Model	To be mentioned	
2.3	Manufacturer Address	To be mentioned	
2.4	County of Origin	To be mentioned	
2.5	Country of Manufacturing	To be mentioned	
2.6	Type	Grid TIE(Net metering)	
2.7	INPUT(DC)		
2.8	Max. PV Input power(Wp)	8000	
2.9	Max. PV Input voltage(Vp)	1100	
2.10	Min. PV input Voltage(V)	150	
2.11	Startup voltage(V)	180	
2.12	Rated Input Voltage(V)	550-650	
2.13	MPPT Input voltage Range(V)	160-850 or higher	
2.14	MPPT input port quantity	2 no.	
2.15	Input string quantity/port	1 no.	
2.16	PV Input Current (Imp) max.	15 A	
2.17	DC short circuit Current (Isc) max.	18 A	
2.18	OUTPUT(AC)		
2.19	Rated AC output Power	5000W	
2.20	Max. Apparent Power	5500VA	
2.21	Grid Connection type	3L/N/PE	
2.22	Rated AC Voltage	230/415V	
2.23	AC voltage range	330V-470V or wide range.	
2.24	Rated Frequency(Hz)	50	
2.25	Power network frequency range	45Hz ~ 55Hz	
2.26	Max. Output current at rated power	To be mentioned	
2.27	Total harmonic distortion(THD) (current)	<3% at rated power.	
2.28	Efficiency(%)	Min. 97%	
2.29	Power factor/adjustable PF	>0.99(0.8 Leading to 0.8 Lagging)	
2.30	MPPT efficiency	>99.0%	


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 PGCB Ltd.


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 GMD, PGCB, Aricha
 Manikganj-1804


 (Md. Mijanour Rahman)
 ID No-00311
 Superintending Engineer
 RTS PGCB Dhaka

2.31	Noise Level	To be mentioned	
2.32	FUNCTION		
2.33	Display	LED/LCD/OLED	
2.34	Remote Monitoring	Yes(with mobile app. and website).	
2.35	Data Logging	Yes	
2.36	Grid Monitoring	Yes	
2.37	PROTECTION		
2.38	AC Short Ckt protection	Yes	
2.39	AC over Voltage Protection	Yes	
2.40	DC reverse protection	Yes	
2.41	DC switch	To be mentioned	
2.42	Over Temperature Protection	Yes	
2.43	PV string Current Monitoring	Yes	
2.44	Input DC/output AC surge Protection	Yes	
2.45	Safety Protection	Anti-islanding, RCMU, ground fault monitoring	
2.46	Standard and Certification	BDS IEC 62109-1/2, BDS IEC 61727-1/2-2020	
2.47	Communication		
2.48	Standard communication mode	RS485/WLAN	
2.49	General Data :		
2.50	Operating Ambient temperature range	0°C~+50°C or wider range.	
2.51	Topology	Transformer less	
2.52	Protection level	IP65	
2.53	Permissible relative humidity range	0~100% Non-condensing	
2.54	Max. Working altitude	To be mentioned	
2.55	Cooling method	Natural cooling/Smart Fan Cooling	
2.56	Weight	To be mentioned	
2.57	Size(W*H*D)	To be mentioned.	
2.58	Operating Lifetime	To be mentioned	
3.0	Double Pole (DP) solar SPD (Surge Protection Device) for PV		
3.1	Type	PV arrester	
	Arrester Class	I, II	
3.2	Manufacturer	Phoenix Contact/ABB/Siemens/ Schneider Electric etc.	
3.3	Country of Origin	USA/EU/UK/Japan/South Korea etc.	
3.4	Country of manufacturer	To be mentioned	
3.5	Model	To be mentioned	
3.6	Nominal Continuous operating Voltage	600 VDC	
3.7	Rated Voltage of SPD	1000VDC	
3.8	Maximum continuous operating voltage UCPV	1170 V DC	
3.9	Rated Nominal discharge current In (8/20) μ s	15 kA or higher	
3.10	Maximum discharge current I _{max} (8/20) μ s	30 kA or higher	
3.11	Response time t _A	≤ 25 ns	
3.12	Connection configuration	Y	

Yamir

27.11.23 (M/S)

[Signature]

Mahmud
15.11.23

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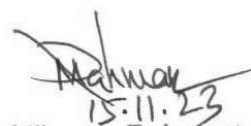
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3.13	Continuous operating current ICPV	< 20 μ A	
3.14	Direction of action	(L+)-PE & (L-)-PE & (L+)-(L-)	
3.15	Standards/specifications	IEC 61643-31(2018)	
4.0	Triple Pole SPD (Surge Protection Device) --Type-1		
4.1	Type	Type-I(For Direct Lightning/Transient Over Voltage)	
4.2	Manufacturer	Phoenix Contact/ABB/Siemens/Schneider Electric etc.	
4.3	Country of Origin	USA/EU/Japan/South Korea etc.	
4.4	Country of manufacturer	To be mentioned	
4.5	Model	To be mentioned	
4.6	Nominal System voltage	230/400VAC -240/415 VAC	
4.7	Nominal frequency fN	50 Hz	
4.8	Maximum continuous operating voltage UC (L-PE)	275 V AC	
4.9	Rated Nominal discharge current In (8/20) μ s	20 kA	
4.10	Maximum discharge current I _{max} (8/20) μ s	40 kA	
4.11	Response time tA	≤ 25 ns for(L-N) and ≤ 100 ns for(L-PE)	
4.12	Maximum continuous operating voltage MCOV (L-N)/ (L-G)/(L-L)	275 V AC/550V AC	
4.13	Arrester Class	I,II	
4.14	Direction of action	3L-N & N-PE	
4.15	Standards/specifications	IEC 61643-11(2011)	
5.0	Energy Meter		
5.1	Type	To be mentioned	
5.2	Display	LCD Digital	
5.3	Manufacturer	To be mentioned	
5.4	Country of Origin	To be mentioned	
5.5	Country of manufacturer	To be mentioned	
5.6	Model	To be mentioned	
5.7	Connection type	3 phase 4 wire	
5.8	Operating Voltage/Current	3x230V/400V, 10A(100A) or higher	
5.9	Operating Frequency	50 Hz	
5.10	Standard	IEC62053-21/23	
5.11	Class	Cl.1	
5.12	Imp/kWH	1000	
6.0	OTHER ACCESSORIES:		
6.1	Supplying, fitting fixing on a prepared board with housing 500 Volt grade following Double Pole MCB (DPMCB) having nominal current capacity 20 Ampere & minimum breaking capacity 6kA with thermal over current & instantaneous electromagnetic short circuit release provision. (Brand: ABB/Siemens/ Schneider/LS/Hyundai; Country of Origin:USA/UK/EU/JAPAN/KOREA)		
6.2	Supplying, fitting fixing on a prepared board with housing 500 Volt grade following Triple Pole MCB (TCMCB) having nominal current capacity 20 Ampere & minimum breaking capacity 6 kA with thermal over current & instantaneous electromagnetic short circuit release provision (Brand: ABB/Siemens/ Schneider/LS/Hyundai; Country of Origin:USA/UK/EU/JAPAN/KOREA)		


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6.3	Supplying, fitting fixing of 25 mm dia best quality uPVC C-grade pipe for water supply having specific gravity 1.35 - 1.45, and other physical, chemical, thermal, fire resistivity properties etc. as per BSTI approved manufacturer standards or ASTM, BS/ISO/IS standards fitted and fixed in position with sockets, bends, with all accessories such as round grating/domed roof grating, bends, sockets etc. approved and accepted by the Engineer. (length: 6000 mm each)	
6.4	Supplying, fitting fixing of Solar Pannel anti corrosive painted MS structure made of 37mm x 37 mm x 5 mm Angle having size of whole PV Module as per attached drawing.	
6.5	Supplying, fitting fixing 4.0 x 4 mm ² Power Cable	
6.6	Supplying, fitting fixing 2.0 x 4 mm ² Power Cable	
6.7	Supplying, fitting fixing 1.0 x 6 mm ² Ground Cable	
7.0	Certificate to be supplied with the tender documents: for item no. 1, 2 only)	
7.1	Manufacturer's EMC Certificate of Conformity	
7.2	Manufacturer's valid ISO certificate	
7.3	Manufacturer's Printed catalogue and Brochures	
7.4	Manufacturer Authorization Letter	

Seal & Signature of the Bidder/Tenderer

CSA' 21/10/11/14 ✓

Tanvir

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