POWER GRID COMPANY OF BANGLADESH LIMITED

Bidding Document
for

Design, Supply, Installation, Testing and Commissioning of 400kV outdoor GIS Substation at Bogura (west) & Rahan-pur and Upgradation/Extension of Gopalganj and Chapainawabganj (old) Substation on turnkey basis.

Volume 3 of 3

Issued on:	**08 September 2019**
Invitation for Bids No.	27.21.0000.101.07.129.19.4935
ICB No.	PGCB/ADB/3683/400KV/BOG-RAH-GOP/SS
Country:	**Bangladesh**

Employer:

Power Grid Company of Bangladesh (PGCB)
PGCB Head office Building, Jahirul Islam city, Avenue-3
Aftabnagar, Badda, Dhaka-1212, Bangladesh

Contents of the Tender Documents

Table of Contents **Page**

Table of Contents **Page**

1. Schedule A

Introduction and Preamble to the Price and Technical Schedules

Introduction & Preamble

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

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

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

The contractor is responsible for ensuring that all and/or and any item(s) of work required for the safe, efficient and satisfactory completion and functioning of the works, are included in the Proposed Price whether they be described in the specification or not.

The bid price shall include supply and delivery of mandatory spare parts, maintenance tools and test equipment.

The bid price shall include all other miscellaneous works required.

The "Schedule of Requirements" for equipment, materials and services and the detailed technical specifications of equipment and materials as included in Volume 3 of the bidding documents shall be read in conjunction with the scope of works described herein.

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 scope of work comprises the following:
The brief description of works under this contract is as follows.

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

Denomination	Description
A	400kV Switchgear
B	230 kV Switchgear
C	132 kV Switchgear
D	33 kV Switchgear

Denomination	Description
E	Transformers& Fire Fighting
F	Control, Protection, Substation Automation and Metering etc.
G	Traveling Wave type DFDR
H	Power Cable & GIL
I	MulticoreCables
J	Earthing and Lightning Protection
K	Batteries, Chargers and DC Distribution
L	LVAC Distribution
M	Civil works, Building and Foundations
N	Lighting, Small power and Air Conditioning
O	Fibre Optic Multiplexer Equipment for Communication and Protection
P	SCADA System for Telecontrol & Telemetering

The Contractor is to carry out the works taking full account of the limitations imposed by existing sites and the requirement to maintain all existing supplies during the construction works.

Any temporary works, structures, connections, etc., necessary to achieve this requirement are to be included in the bid price.

The works under this turnkey contract include the following:

- NEW 400/230/33kV GIS SUBSTATION AT **BOGURA (WEST)**
- NEW 400/132/33KV GIS SUBSTATION AT **RAHANPUR**
- Extension of Existing **400kV AIS Switchyard & Construction of New 230kV AIS Switchyard at existing GOPALGANJ 400/132kV SUBSTATION**
- Extension of **132kV AIS Bay at existing Chapainawabganj 132/33kV AIS SUBSTATION**

1.1 Detailed Scope of Work

To ensure adequate and reliable power supply for the upcoming Economic Zones in Rajshahi area which is known as the largest agricultural production zone of Bangladesh and to meet the rapidly growing demands of residential and commercial consumers in the southwest region of Bangladesh.

The overall objective of the project is to strengthen power transmission system in Bangladesh and enhance its reliability and efficiency. The project area comprisesBogura, Chapainawabganj, Rajshahi, Noagaon, Niyamatpur, Gopalganj areas. The western areas such as Bogura, Chapainawabganj, Rajshahi, Noagaon, Niyamatpur are major grain cultivation zone of Bangladesh. Due to inadequate surface water supply, cultivation mostly depends on ground water. Hence electricity demands is at its peak level during the irrigation season. There is not enough generation source in the region, which means power has to come from a long distance. Presently electricity is transmitted at 132 kV voltage level in these areas. Long Distance, lower transmission voltage, higher demand and lack of reactive power compensation result in severe low voltage problem in this area. Lower voltage reduces production rate and causes damage to electrical equipment such as induction motor. On the otherhand, Economic Zone Authority (BEZA) has already planned to establish Panchagar EZ, Nilphamari EZ, Sirajganj EZ and Natore EZ in this area.Gopalganj and

Faridpur are located in the southern part of Bangladesh. After completion of the Padma Bridge project, large-scale industrialization is expected to occur at Gopalganj, Faridpur, and Barishal area. Bangladesh Economic Zone Authority (BEZA) has also planned to establish Bhola EZ, Barishal EZ and Gopalganj EZ in this area. Within a few years, the electricity demand of this area is expected to rise significantly. Besides, it is also necessary to establish secondary transmission infrastructure for evacuation of bulk amount of electricity to be imported from adani group at Rahanpurarea to the major load centers. 400kV bogura Substation will be a hub in near future. In this regard, Power Grid Company of Bangladesh Ltd. has taken action to implement the proposed project in the southwestern region of the country.

1.1.1 NEW 400/230kV OUTDOOR GIS SUBSTATION AT BOGURA (WEST)

Description of Works:

The scope of work under this turnkey project is design, supply, delivery, installation, testing & commissioning of new 400/230/33kV Gas Insulated Switchgear (GIS) substations at **BOGURA.**

The scope of work also includes design, supply, delivery, installation, testing & commissioning of 400/235/34.5kV,Autotransformerand associated control, automation, protection, fiber optic multiplexer equipment for communication & protection, and civil works.

Proposed **Bogra** 400/230 kV Substation shall be located in the Kahaloo thana of Bogra. However, the exact location and measurement of the proposed land with road layout may be obtained from Project Director Office.

420kV Gas Insulated Switchgear (GIS):

- Complete 420kV GIS consisting of **Six (06)** line bays and **two** (02) transformer bays to connect **Six (06)** new 420kV lines (Rahanpur -1 & 2; Ruppur-1 & 2; Kaliakoir-1&2) &**two** new 400/235/34.5kV 3-phase Autotransformer.
- A route survey shall have to be performed by the EPC to confirm that 750MVA three-phase transformer transport to the site is possible using existing roads. Three single-phase bank Autotransformer is secondary alternative to three-phase transformer if transportationposes a real threat.
- One 400 kV bus reactor bay for one set of 420 kV, 125 MVAR, bus reactor.
- Space provision shall be kept for future extension of Six (06) 420kV bays and two (02) transformer bays.
- The position of Bus PT with High Speed ES shall be kept such that, it shall decrease the interruption hours when extension.
- **The configuration of the 420kV busbar shall be one & Half Breaker busbar scheme.** Jointing plugs shall be kept in GIS hall for adding future bays and jointing plugs required for connecting GIS of different makes.
- GIS Design shall consider appropriate Buffer zone and section in Busbar & GIS compartment suitable for best MRE practice so as to minimize interruption time & maintenance complexity.

230kV Gas Insulated Switchgear (GIS):

- Complete 230kV GIS consisting of **Eight (08)** line bays, **two** (02) transformer bays and **two (02)** bus-coupler bays, two (02) bus-section bays to connect **Eight (08)** new 230kV lines (LILO of Bogra-Barapukuria line; Boropukuria-3 & 4, Naogaon-1&2) &**two** new 400/230/33kV transformers bank;

- Space provision shall be kept for future extension of Eight (08) 230kV bays and two (02) transformer bays.

- The position of Bus PT with High Speed ES shall be kept such that, it shall decrease the interruption hours when extension.

- The configuration of the 230kV busbar shall be double busbar scheme with section. Jointing plugs shall be kept in GIS hall for adding future bays and jointing plugs required for connecting GIS of different makes.

- GIS Design shall consider appropriate Buffer zone and section in Busbar & GIS compartment suitable for best MRE practice so as to minimize interruption time & maintenance complexity.

132kV Gas Insulated Switchgear (GIS):

Deleted

132kV AIR Insulated Switchgear (AIS):

Deleted

33kV AIS Insulated Switchgear (AIS):

Complete 33kV AIS with VCB, CT, LA, DS consisting of two transformers bays, two earthing & auxiliary transformer bays to connect 33kV side of two new 400/235/34.5kV transformers and two earthing & auxiliary transformer; space provision shall be kept for future extension.

The configuration of the 33kV busbar for each transformer shall be single busbar scheme.

Transformer:

- Two 520/750 MVA, 400/235/34.5 kV outdoor type three phase autotransformers consisting three single phase bank.
- Two 33/0.4 kV, 500kVA outdoor type earthing & auxiliary transformers connected to 33kV busbar which link to each 400/235/34.5 kV transformer tertiary side to supply the substation auxiliary loads and earthing.

Control, Protection, Substation Automation & Metering:

Associated control, metering, protection equipment, synchronizing scheme and substation automation system 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 SPRs can be controlled and monitored through SAS.
The contractor shall provide with their Bid Detail BOQ for complete SAS system as per Bid requirement .

SCADA system for Telecontrol and Telemetering:

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 Biddut Bhaban for integration of complete new 230/132kV 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 form NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station at NLDC and Biddut Bhaban are to be carried out.

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

Digital Fault & Disturbance Recorder (DFDR):

Supply, installation, testing & complete commissioning of DFDR at Bogra 400/230kV substation. The fault locating technology of the DFDR to be supplied for 400kV voltage level shall be Travelling wave technology and for 230kV & below the technology shall be typical. The contractor shall provide with their Bid Detail BOQ for complete DFDR system as per Bid requirement.

Fibre Optic Multiplexer Equipment for Communication and Protection:

Indoor type Fibre Optic Multiplexer and communication Equipment for protection & communication and integration with existing communication network (i.e. NLDC Rampura and Biddut Bhaban) of PGCB. The contractor shall provide with their Bid Detail BOQ for complete Fibre Optic Multiplexer Equipment system as per Bid requirement.

DC and LVAC System:

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with 25% spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board. The system shall be comprises with a backup/standby set.

Land Development, Civil Works, Building and Foundation:

Complete design, supply and construction of all civil items required for land development.

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, outdoor lighting system, cable trenches, septic tank, earth filling, surfacing, drainage, security fences, guard house, 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 two storied Multi-use building including control room, GIS room, capacitor bank room, EOT crane etc.

Mandatory Spares, Maintenance tools & Test Equipment:

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, maintenance tools & test equipment. Test equipment is to be supplied from Europe, USA or Japan origin. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

1.1.2 NEW 400/132kV OUTDOOR GIS SUBSTATION AT RAHANPUR (CHAPAINAWABGANJ)

Description of Works:

The scope of work under this turnkey project is design, supply, delivery, installation, testing & commissioning of new 400/230/33kV Gas Insulated Switchgear (GIS) substations at **RAHANPUR.**

The scope of work also includes design, supply, delivery, installation, testing & commissioning of 400/135/34.5kV Power Transformer and associated control, automation, protection, fiber optic multiplexer equipment for communication & protection, and civil works.

Proposed **Rahanpur** 400/132kV Substation shall be located in the Nacholo Thana of Chapainawabganj. However, the exact location and measurement of the proposed land with road layout may be obtained from Project Director Office.

420kV Gas Insulated Switchgear (GIS):

- Complete 420kV GIS consisting of **four (04)** line bays, **two** (02) transformer bays and **one** bus-coupler bay to connect **Two (02)** new 420kV lines (Bogra -1 & 2) &**two (02)** new 400/135/34.5kV transformers;
- One 400 kV bus reactor bay for one set of 420 kV, 125 MVAR, bus reactor.
- Space provision shall be kept for future extension of Six (06) 420kV bays and two (02) transformer bays.
- The position of Bus PT with High Speed ES shall be kept such that, it shall decrease the interruption hours when extension.
- The configuration of the 420kV busbar shall be Double busbar with bypass isolator scheme. Jointing plugs shall be kept in GIS hall for adding future bays and jointing plugs required for connecting GIS of different makes.

- GIS Design shall consider appropriate Buffer zone and section in Busbar & GIS compartment suitable for best MRE practice so as to minimize interruption time & maintenance complexity.

230kV Gas Insulated Switchgear (GIS):

Deleted

132kV Gas Insulated Switchgear (GIS):

- Complete 132kV GIS consisting of **Six (06)** line bays, **two** (02) transformer bays and **one** bus-coupler bay to connect **Six (06)** 132kV lines (LILO of Rahanpur 132kV-Nyamatpur double circuit line; Chapai-Nawabganj-1,2 line) &**two** new 420/135/34.5kV transformers;

- Space provision shall be kept for future extension of Eight (08) 132kV bays and two (02) transformer bays.

- The position of Bus PT with High Speed ES shall be kept such that, it shall decrease the interruption hours when extension.

- The configuration of the 230kV busbar shall be double busbar scheme. Jointing plugs shall be kept in GIS hall for adding future bays and jointing plugs required for connecting GIS of different makes.

- GIS Design shall consider appropriate Buffer zone and section in Busbar & GIS compartment suitable for best MRE practice so as to minimize interruption time & maintenance complexity.

132kV AIR Insulated Switchgear (AIS):

Deleted

33kV AIS Insulated Switchgear (AIS):

Complete 33kV AIS with VCB, CT, LA, DS consisting of two transformers bays, two earthing & auxiliary transformer bays to connect 33kV side of two new 400/135/34.5kV transformers and two earthing & auxiliary transformer; space provision shall be kept for future extension.

The configuration of the 33kV busbar for each transformer shall be single busbar scheme.

Transformer:

- Two 520 MVA, 400/235/34.5 kV outdoor type three phase auto transformers;
- Two 33/0.4 kV, 500kVA outdoor type earthing & auxiliary transformers connected to 33kV busbar which link to each 400/135/34.5 kV transformer tertiary side to supply the substation auxiliary loads and earthing.

Control, Protection, Substation Automation & Metering:

Associated control, metering, protection equipment, synchronizing scheme and substation automation system 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 SPRs can be controlled and monitored through SAS.
The contractor shall provide with their Bid Detail BOQ for complete SAS system as per Bid requirement .

SCADA system for Telecontrol and Telemetering:

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 Biddut Bhaban for integration of complete new 230/132kV 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 form NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station at NLDC and Biddut Bhaban are to be carried out.

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

Digital Fault & Disturbance Recorder (DFDR):

Supply, installation, testing & complete commissioning of DFDR at Rahanpur 400/132kV substation. The fault locating technology of the DFDR to be supplied for 400kV voltage level shall be Travelling wave technology and for 230kV & below the technology shall be typical. The contractor shall provide with their Bid Detail BOQ for complete DFDR system as per Bid requirement.

Fibre Optic Multiplexer Equipment for Communication and Protection:

Indoor type Fibre Optic Multiplexer and communication Equipment for protection & communication and integration with existing communication network (i.e. NLDC Rampura and Biddut Bhaban) of PGCB. The contractor shall provide with their Bid Detail BOQ for complete Fibre Optic Multiplexer Equipment system as per Bid requirement.

DC and LVAC System:

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with 50% spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board. The system shall be comprises with a backup/standby set.

Land Development, Civil Works, Building and Foundation:

Complete design, supply and construction of all civil items required for land development.

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, outdoor lighting system, cable trenches, septic tank, earth filling, surfacing, drainage, security fences, guard house, 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 two storied Multi-use building including control room, GIS room, capacitor bank room, EOT crane etc.

Mandatory Spares, Maintenance tools & Test Equipment:

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, maintenance tools & test equipment. Test equipment is to be supplied from Europe, USA or Japan origin. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

1.1.3 UPGRADATION OF 400/132kV AIS SUBSTATION AT GOPALGANJ BY ERECTING 400/230kV SWITCHYARD

The Gopalganj 400/132kV substation is to be built under another project of PGCB. Under this South-west project, scope of work include extension of two (02) 400kV AIS transformer bays and construction of new 230kV AIS switchyard at Gopalganj 400/132kV AIS Substation. The busbar scheme for existing 400kV system is one & half breaker busbar scheme.

400kV Gas Insulated Switchgear (GIS):
Deleted

400kV Air Insulated Switchgear (AIS):

- Two (02) transformer bays, 400/230kV, 520/750MA,3-phase, outdoor Autotransformer.
- A root survey shall have to be performed by the EPC to confirm that 750MVA three-phase transformer transport to the site is possible using existing roads. Three single-phase bank Autotransformer is secondary alternative to three-phase transformer if transportation poses a real threat.
- Extension of 400kV Bus (Bus shall be extended considering there shall be provision for entering two line bays in between 400kV Transformer bays & existing Aminbazar-1,2 line bays)
- Re-location of Bus LA, ES & CVT

230kV Air Insulated Switchgear (AIS):

- Construction of new 230kV Switchyard consisting of
  - Four (04) 230 kV line bays to connect two 230kV double circuit overhead line (Barisal-1 & 2, Faridpur 1&2);
  - Two (02) 230 kV transformer bays for LV side of two 400/230/33 kV transformer;
  - Space for future extension of four (4) incoming circuits for future provision
  - Space for future extension of two (2) transformer bay for future provision

33kV Air Insulated Switchgear (AIS):

Complete 33kV AIS with VCB, CT, LA, DS consisting of two transformers bays, two earthing & auxiliary transformer bays to connect 33kV side of two new 132/34.5kV transformers, two earthing & auxiliary transformer; space provision shall be kept for future extension.
The configuration of the 33kV busbar for each transformer shall be Single Busbar scheme.

Transformer:

- Two (2) sets of 3-phase, 400/230/33kV,750 MVA auto transformers with 33kV switchgears
- Two (2) sets of 33kV Switchgear bays for station auxiliary transformers
- Two (2) station auxiliary transformers with the capacity of 3-phase, 33/0.415kV, 300 kVA

Control, Protection, Substation Automation & Metering:

Associated control, metering, protection equipment, synchronizing scheme and substation automation system 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 SPRs can be controlled and monitored through SAS.
The contractor shall provide with their Bid Detail BOQ for complete SAS system as per Bid requirement .

SCADA system for Telecontrol and Telemetering:

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 Biddut Bhaban for integration of complete new 230/132kV 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 form NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station at NLDC and Biddut Bhaban are to be carried out.

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

Digital Fault & Disturbance Recorder (DFDR):

Supply, installation, testing & complete commissioning of DFDR at Rahanpur 400/132kV substation. The fault locating technology of the DFDR to be supplied for 400kV voltage level shall be Travelling wave technology and for 230kV & below the technology shall be typical. The contractor shall provide with their Bid Detail BOQ for complete DFDR system as per Bid requirement.

Fibre Optic Multiplexer Equipment for Communication and Protection:

Indoor type Fibre Optic Multiplexer and communication Equipment for protection & communication and integration with existing communication network (i.e. NLDC Rampura and Biddut Bhaban) of PGCB. The contractor shall provide with their Bid Detail BOQ for complete Fibre Optic Multiplexer Equipment system as per Bid requirement.

DC and LVAC System:

Complete set of DC and LVAC system with all necessary materials required for the plant being installed with 50% spares for future use of 110V DC battery & battery charger, 48 V DC battery & battery charger, DC distribution board and LVAC distribution board. The system shall be comprises with a backup/standby set.

Land Development, Civil Works, Building and Foundation:

Complete design, supply and construction of all civil items required for land development.

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, outdoor lighting system, cable trenches, septic tank, earth filling, surfacing, drainage, security fences, guard house, 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 two storied Multi-use building including control room, GIS room, capacitor bank room, EOT crane etc.

Mandatory Spares, Maintenance tools & Test Equipment:

Supply of complete mandatory spare and spare parts of transformer, switchgear, control equipment, protection relays, meters, maintenance tools & test equipment. Test equipment is to be supplied from Europe, USA or Japan origin. Printed catalogue, operation and service manual are to be provided. The materials shall have to be handed over to the designated store as per instruction of the Engineer.

1.1.4 EXTENSION OF 132kV AIS BAYS AT CHAPAINAWABGANJ (OLD) SUBSTATION

The Chapainawabgonj (old) Substationis an existing 132/33kV AIS substation of PGCB. Under this project, scope of work include extension of two (02) GIS bays at Chapainawabgonj (old) SubstationAIS Substation. The busbar scheme for 132kV bus is Main & Transfer bus with Bypass Isolator.

132kV Gas Insulated Switchgear (GIS):

- Two (02) nos 132 kV line bays to connect one 132 kV double circuit overhead line (Rahanpur-1 & 2,)

33kV Air Insulated Switchgear (AIS):

Deleted

Transformer:

Deleted

Control, Protection, Substation Automation & Metering:

Associated control, metering, protection equipment, synchronizing scheme and substation automation system for extension of substation. The existing Relays are of Electro-mechanical type and there is no SAS. However, the proposed Relay shall be Numerical type with SAS functionality. ~~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 SPRs can be controlled and monitored through SAS.~~

Digital Fault & Disturbance Recorder (DFDR):

Deleted

Fibre Optic Multiplexer Equipment for Communication and Protection:

Extension of Indoor type Fibre Optic Multiplexer & communication Equipment (protection & communication) and integration with existing communication network (i.e. NLDC Rampura and Biddut Bhaban) of PGCB.

SCADA system for Telecontrol and Telemetering:

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 Biddut Bhaban for integration of complete new 230/132kV 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 form NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station at NLDC and Biddut Bhabanare to be carried out.

DC and LVAC System:

Extension of Complete set of DC and LVAC system with all necessary materials required for the plant being installed with 25% 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:

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, outdoor lighting system, cable trenches, septic tank, earth filling, surfacing, drainage, security fences, guard house, earthing & lightning protection, switchyard lighting, etc.

1.2 Training and Inspection

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

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

SL	Description	No. of Engineer	Duration (Days) excluding travelling time
1.	HV GIS Substation & Equipment Design and Testing as per IEC	04	14
2.	Project , Contract and finance management	04	14

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

SL	Description	No. of Engineers	Duration (Days) excluding travelling time	No. of Trip/ Visit
		Each Visit		
1.	Transformers	02	10	3 visit: 01 for 400/132kV Tr& 02 for 400/230kV Tr.
2.	GIS	02	10	02 visit: 01 for 400/230kV GIS & 01 for 400/132kV GIS
3.	Circuit Breaker (400 & 230kV)	02	7	01
4.	Bus Reactor	03	7	01
5.	Disconnector (400 & 230kV)	02	07	01
6.	Instrument Transformer (400 & 230kV)	02	07	02 (1 for CT & 1 for PT)
7.	Lightning Arrester (400,230 & 132KV)	02	7	01
8.	Control, protection&SAS	02	05	01
9.	Communication Equipment and SCADA gateway	02	05	01
10.	DC system	02	05	01

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

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

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

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

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

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

For other Equipment (DS, IT set, LA set, battery & charger) 10% the Supplied quantity shall face witness of Employers Engineers.

(c) Local Training:

SL	Description	No. of Engineer	Duration (days)
1.	Earthing System Design software, AutoGrid Pro	10	07
2.	Computer Aided Design Software: PSCAD – Advance level	10	14
3.	Swicchgear Protection	10	14

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

SL	Description	No. of Engineer	Duration (days)
1.	HV GIS switchgears	25	06
2.	transformers	20	06
3.	Protection & Substation automation system	25	06
4.	Fiber optic multiplexer & digital PABX	15	06

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

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

1.2.1 Training Contents

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

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

SL	Topics	Contents	Duration
1.	Transformer Design	1. Practical transformer design: a) Electrical Design: Short Circuit, Dielectric & Thermal Design b) Mechanical Design: External (Tank, Stifner,, Conservator, Cooling(Cooler, Fan,Pump) & Internal (Clamping, Fitch Plate, lead structure) 2. Manufacturing Process : Coil, Core & Post Vapour Drying	5 days
		Computer Aided Design	
		Testing as per IEC: Pros & Cons - Routine, Design & Special test	
2.	Substation Design	Layout design of AIS & GIS Substation upto 800kV	3 days
		Selection of Continuous & Short circuit Current rating of	

		series equipment	
		Selection of Protection Scheme & SAS Protocol	
		Different Calculations: DSLP Calculation, CT-PT sizing, DC System Design, Earthing design for AIS & GIS Switchyard, Conductor sizing for Bus & cable sizing, Cantilever strength Sizing, Lighting Design for Indoor & Outdoor, LVAC system Design including HVAC Design	
3.	Circuit Breaker design	Selection of CB arc extinction principle Operating mechanism Design Arcing chamber design for EHV (400kV & above) CB Arcing Contact design Testing as per IEC	2 days
4.	Lightning Arrester Design	Design of ZnO Block for HV to EHV , Design of Energy Absorption Capability , Selection of Voltage rating & current rating, Design of housing, Design of DC LA Testing as per IEC	2 day

1.2.3 Earthing System Design software, AutoGrid Pro

SL	Topics	Contents	Duration
5.	Earthing system Design using AutoGrid Pro	Theory of Earthing system design	7 days
		Soil resistivity, Testing methods & models,	
		Fault current distribution	
		Single layer &multi layer method for Earthing system design : Detailed system Design	
		Lightning system design	
		Effect of Electromagnetic transients (Lightning, Capcitor bank switching etc.) on Earthing system design	
		Earthing system design for GIS Switchyard & Building	

1.2.3.1 PSCAD Training

SL	Topics	Contents	Duration
6.	PSCAD	Transformer Energization (In-rush energizing & Representing different core types, Network resonance, Unbalanced loading, Ferroresonance)	14 days
		Transient Overvoltage (TOV) studies: (Line energizing , Capacitor bank back-to-back switching, selection of in-rush and out-rush reactors, Breaker restrike, Energy dissipation of surge arrestors, arrestor rating, and the selection of arrestors ,Transient recovery voltage (TRV) across breakers)	
		Lightning Impulse Co-ordination study, Switching Impulse Analysis , Selection of BIL accordingly	
		Analysis of HVDC system transients	

		PSCAD Fundamentals, PSCAD Environment and Overview of Some Useful Features, Creating a Simple Case in PSCAD, Transformer Model and Inrush current Analysis, Induction Motor and Startup Transients, Transmission line and Cable Modelling in PSCAD, Ferranti Effect and Mitigation using Shunt Reactors, PSCAD Model development for Transient Studies, PSCAD Features to Efficiently Performs Simulations (Multiple Run, Snapshot, Python Automation), Synchronous machine model and its controls, Insulation Coordination Studies, Switching Studies, Lightning Studies (Network Resonances,Temporary Overvoltage),Transient Recovery Voltage analysis, Introduction to Power Electronics	

1.2.3.2 Switchgear Protection Training

SL	Topics	Contents	Duration
Basic Module			
1.	Line Impedence Protection	1. Basic principles of impedance protection 2. Zones of impedance protection 3. Zone 1 extension scheme 4. Mho and Quadrilateral characteristics 5. Zone reach calculation (ph-ph and ph-ground) 6. Load encroachment area: basics, setting calculation and testing 7. Power swing detection: basics, setting calculation and testing 8. Pole slip protection: basics, setting calculation and testing 9. Fuse failure detection: basics, setting calculation and testing 10. Switch on to fault: basics, setting calculation and testing 11. Communication aided schemes, their advantages and disadvantages: a. Direct transfer trip b. Permissive under-reach transfer trip c. Permissive over-reach transfer trip d. Current reversal guard logic e. Weak-end infeed condition f. CB echo logic g. Blocking and unblocking schemes 12. Testing of various functions	14 days
2.	Auto-reclosing	1. Application of auto-reclosing a. Dead time b. Reclaim time c. Single shot or multi shot 2. Operation features and cycles of auto-reclose 3. Auto-reclose lock-out 4. Auto-reclosing of HV distribution networks 5. Factors influencing HV auto-reclosing scheme 6. Auto-reclosing of EHV transmission lines 7. High-speed auto-reclosing of EHV system 8. Single phase auto-reclosing 9. High-speed auto-reclosing of lines employing distance	

		schemes 10. Delayed auto-reclosing of EHV system 11. Auto-reclose schemes 12. Master and follower auto-reclosing 13. Setting calculation 14. Testing	
3.	Line Differential Protection	1. Line differential protections principles 2. Biased differential characteristics 3. Harmonics component blocking 4. Differential stability with Open CT, CT saturation and external faults 5. Unrestrained differential tripping 6. Negative sequence differential protection 7. Communication principles of line differential protection 8. High impedance line differential protection 9. Additional line differential protections: a. Phase to phase current variation b. Zero sequence current variation	
4.	Current Protection	1. Over-current and earth-fault protection: Time based characteristics a. Directional b. Non-directional 2. Relay co-ordination procedure 3. Breaker failure protection 4. Stub protection 5. Broken conductor check: basics, setting calculation and testing 6. Communication aided scheme for earth-fault protection 7. Over current and earth fault setting calculation for various types of networks 8. Testing of different functions	
5.	Transformer Protection	1. Types of faults in transformer 2. Magnetizing inrush of transformer 3. Thermal protection a. Oil temperature monitoring b. Winding temperature monitoring 4. Transformer differential protection 5. CT requirement for differential proteciton 6. Biased differential characteristics 7. Harmonics component blocking 8. Filtering zero sequence components 9. Differential stability with open CT, CT saturation, magnetizing inrush and external fault 10. Negative sequence differential protection 11. High impedance differential protection a. Ratio correction b. Phase compensation c. Zero sequence elimination 12. Restricted earth-fault protection for different types of transformers: a. Low impedance b. High impedance i. Current operated ii. Voltage operated 13. Fault current calculation for different types of transformers in different types of faults	

		14. Auto transformer protection 15. Earthing transformer protection 16. Overfluxing protection 17. Oil and Gas protection: a. Pressure relief device b. Buccholz protection c. Sudden pressure rise protection 18. Neutral displacement detection 19. Balanced earth fault 20. Sensitive earth fault 21. Setting calculation for different protections 22. Transformer testing procedures 23. Testing procedures of all protection functions	
6.	Busbar Protection	1. Types of busbar faults 2. Protection requirements a. Speed b. Stability c. Zone coverage 3. Types of busbar protection 4. Different bus arrangements and their protection schemes 5. Principles of bus differential protection 6. Biased characteristics of bus differential protection 7. CT requirements and location for bus differential protection 8. High impedance differential protection a. Principle b. Stability c. Setting calculation 9. Low impedance differential protection a. Principle b. Stability c. Setting calculation 10. Secondary circuit supervision 11. Stability for open CT, CT saturation, Disconnector switch movement 12. External and internal fault discrimination a. Amplitude measurement b. Phase angle comparison 13. Discriminating and check features 14. Numerical busbar protection relays a. Types b. Principles c. Communication principles	
7.	Fault Calculation	1. Different Types of faults 2. Symmetrical component analysis of three phase network 3. Positive, negative and zero sequence network of different faults 4. Fault equations of different faults 5. Current and voltage distribution of network due to fault 6. Current distribution of different types of transformers due to different types of faults 7. Effect of earth fault in different types of earthed systems 8. Sequence equivalent circuits of different types of transformers 9. Fault current calculation of different types of networks	
8.	Protective Relays	1. Brief introduction, description and overview of each supplied protective relay.	

		2. Setting calculation guidelines of all protection functions including examples for each supplied protective relay. 3. Procedure of parameterization of supplied relays 4. Testing procedure of the supplied relays 5. Comprehensive handling procedure of engineering software	
9.	SAS	1. Basic concept 2. Description of the architecture 3. Operation and Maintenance procedure 4. Procedure of Troubleshooting 5. Procedure of Engineering 6. Procedure of reporting	

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

1.3 Requirements

1.3.1 Technical Requirements for 400/230kV Outdoor GIS Substationat Bogura (W)

SECTION I

400/230 kV OUTDOOR GIS SUBSTATION

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

Item **Description**

1A **420kV Outdoor Type Gas Insulated Switchgear (GIS) at Bogura (West)**

Busbar configuration is one and half scheme.

Item No	Sub-item	Requirements	Quantity
A	**420 kV Outoor Type Gas Insulated Switchgear (GIS), equipment connection and steel structures**		
The 420kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A to this section and shall comprise the following:-			
1A1	**420kV GIS Diameter including Line and Transformer**		**Two(02) Sets**
	i.	420kV, 5000A, 63kA/3s, single phase Enclosure one and half busbar	1 Lot
	ii.	420kV, 4000A, 63kA/3s, three phase, single pole operation/electrical gang operation (as required) circuit breaker complete with spring-stored energy operating mechanism, CSD as Phase switching control device.	1 Set

Item No	Sub-item	Requirements	Quantity
		[For line switching, Pre insertion resistor (PIR) is also acceptable instead of control switching device. In this case of line & transformer switching with same breaker (i.e. Mid breaker), two nos. CSD are required]	
	iii.	420kV, 4000A, 63kA/3s, three phase, gang operated circuit breaker complete with spring-stored energy operating mechanismCSD as Phase switching control device [For line switching: Pre insertion resistor (PIR) is also acceptable instead of control switching device. In this case of line & transformer switching with same breaker (i.e. Mid breaker), combination of PIR & CSD is required]	2 Sets
	iv.	420kV, 4000A, 63kA/3s, three phase busbar disconnector complete with motor operating mechanism	8Sets
	v.	420kV, 63kA/3s, three phase, three position earth switch complete with motor operating mechanism	8 Sets
	vi.	420kV, 4000A, 50kA/3s three phase line disconnector integral with high speed earth switch complete with motor operating mechanism	1 Set
	vii.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main 1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main 2 Protection - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 - 2000-4000/1A, Class 5P20, 30VA for BCU,DFDR, CSD Burden shall be finalized by CT sizing calculation during execution stage. Accuracy class and VA shall be defined for all ratio	12Nos
	viii.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main BB1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main BB2 Protection - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 - 2000-4000/1A, Class 5P20, 30VA for BCU,DFDR, CSD	6 Nos.
	x	400kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (20-200 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi.	Local Control Cubicle	1 No.
	xii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xiii	Partial Discharge Monitoring terminal for each compartment	1 Lot
1A2	**420kV GIS Diameter with both bays Line**		**Two(02) Sets**
	i.	420kV, 5000A, 63kA/3s, single phase Enclosure one and half busbar	1 Lot
	ii.	420kV, 4000A, 63kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism,CSD as Phase switching control device.	3 Sets

Item No	Sub-item	Requirements	Quantity
		[For line switching: Pre insertion resistor (PIR) is also acceptable instead of control switching device. In this case of line & transformer switching with same breaker (i.e. Mid breaker), combination of PIR & CSD is required]	
	iii.	420kV, 4000A, 63kA/3s, three phase busbar disconnector complete with motor operating mechanism	8 Sets
	iv.	420kV, 63kA/3s, three phase, three position earth switch complete with motor operating mechanism	8 Sets
	v.	420kV, 4000A, 50kA/3s three phase high speed earth switch complete with motor operating mechanism	2 Set
	vi.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main 1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main 2 Protection, DFDR - 2000-4000/1A, Class 5P20, 30VA for 50BF Protection - 2000-4000/1A, Class 5P20, 30VA - 2000-4000/1A, Class 5P20, 30VA	12 Nos
	vii.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main BB1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main BB2 Protection, DFDR - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 , BCU - 2000-4000/1A, Class 5P20, 30VA	6 Nos.
	viii..	400kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (20-250 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	ix.	Local Control Cubicle	1 No.
	x.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xi.	Partial Discharge Monitoring terminal for each compartment	1 Lot
1A3	**420kV GIS Diameter for Bus Reactor bay**		**One (1) Set**
	i.	400kV, 5000A, 63kA/3s, single phase Enclosure one and half busbar	1 lot
	ii.	420kV, 4000A, 63kA/3s, three phase, gang operated circuit breaker complete with spring-stored energy operating mechanism CSD as Phase switching control device [For line switching: Pre insertion resistor (PIR) is also acceptable instead of control switching device. In this case of line & transformer switching with same breaker (i.e. Mid breaker), combination of PIR & CSD is required]	3 Set
	iii.	420kV, 4000A, 63kA/3s, three phase busbar disconnector complete with motor operating mechanism	8 Sets

Item No	Sub-item	Requirements	Quantity
	iv.	420kV, 63kA/3s, three phase, three position earth switch complete with motor operating mechanism	8 Sets
	v.	420kV, 4000A, 63kA/3s three phase high speed earth switch complete with motor operating mechanism	2 Sets
	vi.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main 1 Differential Protection - 2000-4000/1A, Class 5P20, 30VA for Main 2 Differential Protection, DFDR - 2000-4000/1A, Class 5P20, 30VA for Main BB1 Protection,50BF Protection - 2000-4000/1A, Class 5P20, 30VAfor Main BB2 Protection, - 2000-4000/1A, Class 5P20, 30VA	12 No.s
	vii.	420kV, 63kA/3s single phase, 5-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main BB1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main BB2 Protection, DFDR - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 , BCU - 2000-4000/1A, Class 5P20, 30VA	06 No.s
	viii.	420kV single phase voltage transformer with windings as follows: -400,000/√3:110/√3:110/√3:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection	6 No.s
	ix.	400kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (50-250 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	x.	Local Control Panel	1 set
	xi.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xii.	Partial Discharge Monitoring terminal for each compartment	1 Lot
1A4	400kV, 5000A one and half busbarwith **VT/ES,** each comprising:		Two (2) Sets
	i.	420kV, 5000A, 63kA/3s, single phase encloser busbars	1 lot
	ii.	420kV single phase voltage transformer with windings as follows: -400,000/√3:110/√3:110/√3V, Class 0.2,10VA for Metering and Class 3P, 25VA for Protection	6 Nos.
	iii.	420kV, 50kA/3s, three phase, three position high speed earth switches complete with motor operating Mechanism	2Nos.
	iv.	Local Control Cubicle	1 No.
	v.	Partial Discharge Monitoring terminal for each compartment	1 Lot
1A5	Surge Arrester for Busbar		
	i.	420kV, 5000A, 63kA/3s, single phase encloser busbars	1 lot

Item No	Sub-item	Requirements	Quantity
	ii.	396kV rated at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arresters compartment for busbar	Six (06) No.s
	iii.	Partial Discharge Monitoring terminal for each compartment	1 Lot

420kV Air Insulated Switchgear (AIS)

1A6	deleted
1A7	Twenty-seven (27) nos. of single-phase, 3 secondary windings, 420kV, 50Hz, 1425kVp BIL, capacitor type voltage transformers
1A8	Twenty-seven (27) nos. of 390kV rated voltage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arresters
1A9	Twelve (12) nos. of Wave traps, single phase, 420kV, 4000A,63kA/3s, 1mH
1A10	One(1)lotofrigidtubularbusand/orstrandedconductorsincludingaccessories for each-connection as required for completing 400kV GIS Switchyard
1A11	One (1) lot of insulator and fittings including all necessary clamps and connectors as required for completing 400kV GISSwitchyard
1A12	One(1) lot of steel structures for gantry and equipment supports required for completing 420kV busbar and switchgear including all necessary accessories required for completing 420kV GIS Switchyard

tem No	Sub-item	Requirements	Quantity
B	**245 kV Outdoor Type Gas Insulated Switchgear (GIS), equipment connection and steel structures**		
The 245kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A to this section and shall comprise the following:-			
1B1	**245kV GIS Line Feeder Bays, each comprising:**		**Eight(8) Sets**
	i.	245kV, 4000A, 50kA/3s, three phase Enclosure double busbar	1 Lot
	ii.	245kV, 3150A, 50kA/3s, SF6, three phase, single pole operation circuit breakercomplete with spring-stored energy operating mechanism	1 Set
	iii.	245kV, 3150A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	245kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	245kV, 3150A, 50kA/3s three phase line disconnector complete with motor operating mechanism	1 Set

tem No	Sub-item	Requirements	Quantity
	vi.	245kV, 50kA/3s three pole, make proof (high speed) type earthing switch complete with motor operating mechanism	1 Set
	vii.	245kV, 50kA/3s single phase, 3-core, current transformer with cores as follows: - 2400-32001A, Class 5P20, 30VA for Main 1 Protection - 2400-3200/1A, Class 5P20, 30VA for Main 2 Protection, - 2400-3200/1A, Class 5P20, 30VA for DFDR [Actual Burden shall be finalized at execution time based on sizing calculation. Accuracy & VA shall have to be defined for all ratio]	3 Nos.
	viii.	245kV, 50kA/3s single phase, 3-core, current transformer with cores as follows: - 1600-3200/1A, Class 0.2S,10VA for Metering 1 - 1600-3200/1A, Class 0.2S,10VA for Metering 2 , BCU - 3200/1A, 5P20, 30VA for Busbar Differential Protection and Breaker Failure	3 No.s
	ix.	245kV single phase voltage transformer with windings as follows: -230,000/√3:110/√3:110/√3 V:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection	3 Nos.
	x.	245kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (20-150 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi.	Local Control Cubicle	1 No.
	xii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xiii	Partial Discharge Monitoring terminal for each compartment	1 Lot
1B2	**245kV GIS Auto Transformer Feeder Bays, each comprising:**		**Two (2) Sets**
	i.	245kV, 4000A, 50kA/3s, three phase Enclosure double busbar	1 lot
	ii.	245kV, 3150A, 50kA/3s, three phase, gang operation circuit breaker complete with spring-stored energy operating mechanism	1 Set
	iii.	245kV, 3150A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	245kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	245kV, 3150A, 50kA/3s, three phase line disconnector complete with motor operating mechanism	1 set
	vi.	245kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2500-3200/1A, Class 5P20, 30VA for Main 1 Protection - 2500-3200/1A, Class 5P20, 30VA for Main 2 Protection, DFDR - 3200/1A, Class 5P20, 30VA for DFDR	3 Nos.

tem No	Sub-item	Requirements	Quantity
	vii.	245kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2500-3200/1A, Class 0.2S, 10VA for Metering 1 - 2500-3200/1A, Class 0.2S, 10VA for Metering 2, BCU - 3200/1A, Class 5P20, 30VA for Busbar Differential Protection and Breaker Failure	3 No.s
	viii.	245kV single phase voltage transformer with windings as follows: -230,000/√3:110/√3:110/√3:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection	3 Nos.
	ix.	245kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (50-250 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi.	Local Control Panel	1 set
	xii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xiii	Partial Discharge Monitoring terminal for each compartment	1 Lot
1B3	**245kV Bus Coupler Bays , each comprising:**		**Two (2) Sets**
	i.	245kV, 4000A, 50kA/3s, three phase double busbar	1 lot
	ii.	245kV, 4000A, 50kA/3s, three phase, gang pole operation circuit breaker complete with spring-stored energy operating mechanism	1 Set
	iii.	245kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motoroperating mechanism	2 Sets
	iv.	245kV, 4000A, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism, on either side of circuit breaker.	2 sets
	v.	245kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 4000/1A class 0.2S, 10VA for measuring - 4000/1A, Class 5P20, 30VA for Protection - 4000/1A, Class 5P20, 30VA for Main Bus Differential Protection	3 Nos.
	vi.	245kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 4000/1A, Class 5P20, 30VA for Protection - 4000/1A, Class 5P20,30VA for Busbar Differential Protection and Breaker Failure	3 Nos.
	vii.	Local Control Panel	1 set
	viii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
1B4	**245kV Bus Section Bays , each comprising:**		**2 (Two) Sets**
	i.	245kV, 4000A, 50kA/3s, three phase double busbar	1 lot
	ii.	420kV, 4000A, 50kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanismwith CSD	1 set

tem No	Sub-item	Requirements	Quantity
	iii.	245kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 sets
	iv.	245kV, 50kA/3s, three phase earth switch complete with motor operating mech-anism, on either side of circuit breaker	2 sets
	v.	245kV, 4000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 4000/1 A, 5P20, 30VA for Bus Differential Protection 1 and Breaker Failure Protection - 4000/1 A, 5P20, 30VA for Bus Differential Protection 2 - 4000/1 A, Class 5P20, 30VA for BCU & DFDR	3 Nos.
	vi.	245kV, 4000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 4000/1 A, 5P20, 30VA for Bus Differential Protection 2 - 4000/1 A, 5P20, 30VA for Bus Differential Protection 1 - 4000/1 A, Class 0.2S for Metering and BCU	3 Nos.
	vii.	Local Control Panel	1 No.
	viii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for multi-core cables, busbar end co-vers or link to adjacent switchgear panel as appropriate	1 Lot
	ix.	Partial Discharge Monitoring terminal for each compartment	1 Lot
1B5	245kV GIS Double Busbar with **VT/ES,** each comprising:		Two (2) Sets
	i.	245kV, 4000A, 50kA/3s, three phase double busbars	1 lot
	ii.	245kV single phase voltage transformer with windings as follows: -230,000/√3:110/√3:110/√3V, Class 0.2,10VA for Metering and Class 3P, 25VA for Protection	6 Nos.
	iii.	245kV, 50kA/3s, three pole, three position, make proof type earth switches complete with motor operating Mechanism	2 sets
	iv.	Local Control Panel	1 No.
	v.	Partial Discharge Monitoring terminal for each compartment	1 Lot

245kV Air Insulated Switchgear (AIS)

1B6	Thirty (30) nos. of 216kV rated voltage at 50°C, 10kA nominal discharge current, 50Hz, gap-less metal oxide type, single phasesurge Arresters
1B7	One(1) lot of rigid tubular conductor and/or stranded conductors including accessories for each connection as required for completing extension of 245kV AIS Switchyard
1B8	One (1) lot of insulator and fittings including all necessary clamps and connectors as required for completing extension of 245kV AIS Switchyard.
1B9	One (1) lot of steel structures for gantry and equipment supports required for completing 245kV switchgear including all necessary accessories required for completing 245kV Switchyard

1C **145 kV Outoor Type Gas Insulated Switchgear (GIS), equipment connection and steel structures**

145 kV Indoor Type Gas Insulated Switchgear (GIS)

Deleted

1D	36kV **Switchgears and Connections with Auto Transformer & Earthing / Auxiliary**Tra-formers
	The36kV switchgears shall comply with the particular requirements as detailed intheSchedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-
1D1	Two (02) sets of 36kV, 800A, 31.5kA/1sec, 50Hz, 170kVp BIL, vacuum circuit breakerwith spring-stored energy operating mechanism
1D2	Four(04) sets of 36kV, 800A, 31.5kA/1sec, 50Hz, 170kVp BIL, single vertical break/double break, post type, motoroperated disconnector with (02 set) & without (02 set) earth switch
1D3	Six (06) nos. of single-phase, 4-secondary windings 36kV, 31.5kA/1sec, 50Hz,170kVp BIL, Current transformers with winding as follows: - 100/1A, Class 0.2S, 10VA for Metering 1 & Metering 2 - 800/1, class 5P20, 30VA for protection - 800/1, class 5P20, 30VA for protection - 800/1, class 5P20, 30VA for protection
1D4	Six (06) nos. of single-phase, 3-secondary windings (33/√3kV / 110/√3V / 110/√3V), 36kV, 31.5kA/1sec, 50Hz, 170kVp BIL, inductive voltage transformers
1D5	Six (06) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arrester
1D6	One (1) lot of Gantry steel structures for Bus & Equipment, Conductor for 36kV,3000A Bus bar & equipment, 36kV XLPE cable for Tertiary side connection from power transformer, Insulator and fittings including all necessary clamps and connectors, cable trench required to complete 33kV switchyard.

1E	**Transformers & Fire Fighting**
1E1	Two (02) sets of 400/235/34.5 kV, 520/750 MVA (ONAN/ONAF), three phase outdoor type auto transformer equipped with delta connected 33 kV tertiary winding (brought out to terminal bushings) for the purpose of supplying the substation auxiliary power requirements. Direct Hot Spot Temperature measurement facility using fiber optic shall be available.

1E2	Two (02) sets of On-line Dissolved Gas & moisture monitoring system for 400/230/33kV auto transformers bank
1E3	Two (2) sets 33/0.415 kV, 500kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers without neutral earthing resisters, associated Bushing & outdoor neutral CTs and steel support structures including all necessary connections. The delta connected tertiary windings of two new 400/132/33kV 3 phase transformers shall supply the two 33/0.415 kV, auxiliary Zig-Zag transformer for the purpose of supplying the substation auxiliary power requirements.
1E4	Two (02) sets of Deionized water mist type fire suprresion or Fast Depressurization System as transformer fire prevention system for three phase outdoor type 520/750MVA auto transformer

1F	**Control, Protection, Substation Automation & Metering**
	400 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
1F1	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation System including event recording function for Six (6) sets of 400KV overhead line circuits bays.
1F2	Control, Monitoring, Protection (Main-1 & Main-2) & Substation Automation System including event recording function for two (2) sets of 400/230/33kV, three phase, auto power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
1F3	One (1) set of Busbar protection (Main-1 & Main-2 for each Bus) for 400kV system.
1F4	One (01) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArhmeters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	230 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
1F5	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation System including event recording function for Eight (8) sets of overhead line circuits bays.
1F6	Control, Monitoring, Protection & Substation Automation System icluing event recording function for two (2) sets of 400/230/33kV, three phase, power power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
1F7	Control, Monitoring, Protection & Substation Automation System including event recording function for two (2) sets of bus coupler bays
1F8	Control, Monitoring, Protection & Substation Automation System including event recoring function for two (2) sets of bus section bays
1F9	One (1) set of Busbar protection (BB-1 & BB2) for 230kV system.

1F10	One (01) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArhmeters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	33kV Station Power System
1F11	Control, Monitoring, Protection & Substation Automation System including event recording function for 33kV station power system. Substation Automation System shall include 33kV side of 33/0.415kV Transformercontrol & protection. and
1F12	One (01) lot of Programmable & recordable digital 3-phase,4wire import and export MWh and MVArh tariff meters (accuracy class 0.2)0.415kV side.Tariff Metering for 0.415kV side is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	Substation Automation system
1F13	Complete SAS including all required equipment & accessories excluding protection panel &re-lay for the whole Substation. SAS system shall include BCUs, Server PC (Hot & standby) with SAS software , Operator workstation (Main & redundant), Firewall, 55'' LCD Monitor, Ethernet Switches, GPS system, Printers, Engineering PC & software, panels, Cables etc.

1G	**Traveling Wave type DFDR**
1G1	Independent standalone traveling wave type Digital Fault and Disturbance recorder (DFDR) to monitor complete substation including all bays for 420kV GIS, 245kV GIS and Bus reactor section as per drawing.

1H	**GIL & Power Cable**
1H1	One (01) lot of36kV, 300 mm^2 XLPEpower cable for connection between tertiary side of Power transformer & 33/0.4kV Auxiliary transformer.

1I	**Multicore Cables**
1I1	One (1) lot complete set of multicore low voltage 06/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided.
1J	**Earthing and Lightning Protection**
1J1	One (1) lot supplyand 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. If soil resistivity is different for different layer, calculation and GPR shall have to shown using software like Auto Grid pro.

1J2	.One (1) lot of supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in Rez-vig mathod. Required number of Lightning Mast (for switchyard & Building) shall be provided as per DSLP calculation during detail design stage.
1J2	Two (2) sets of 3-phase portable (maintenance) earthing equipment devices with connectors and telescopic glass fibre operating pole suitable for plant supplied ~~(400kV and 230kV voltageswith 63KA and 50kA rated earthing clamp)~~ . Manufacturer shall be European or American origin.
1K	**Batteries, Chargers and DC Distribution**
1K1	110V substation Ni-Cd batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment including pow ering two (2) 240V, 50Hz, 5 kVA Inverter with AC bypass system & automatic change-rover facility being supplied. 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 400Ah & 300Ah at the 5-hour rate of discharge and total battery cell quantity not less than 94 nos for 400kV & 230kv System respectively. During execution stage, the capacity shall be confirmed with calculation by the contractor considering the bays under scope of work and future bays ~~as per clause 8.4.3 of section 8 of Volume 2 of 3 of the biding document.~~ The battery with higher capability if required after calculation, shall be supplied within the same price. ii. Two (2) sets of battery chargers complete, each charger shall not be less than 150A & 120A rating and input voltage three phase 50Hz, 415V AC for 400kV & 230kv System respectively. The rating shall be based on battery boost charging rate & continuous DC load. The higher charging rated charger than minimum specified, if required after calculation, shall be supplied within the same price. iii. Two (2) set of DC distribution board The DC distribution board shall be with 50% overall spare switches for future use & the MCB must be of DC type. iv. Two (2) sets of Online 240V, 50Hz, 3kVA Inverter powered from 110V DC distribution board and AC distribution board as bypass circuit for Substation Automation System. v. One (01) lot of Insulation Monitoring System for complete DC system. Fault detection for each feeder & fault location feature shall be available. Two (2) sets of batteries and battery chargers shall be located in the SPRs and shall be used for the first main and second main DC supplies for 400kV & 230kV switchyards. All DC status (DC voltage status for each bus including coupling breaker on /off status, fail

	with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
1K2	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, protect tion. One set shall be used as standby supply. The system shall generally be as shown in bid drawing and shall include: i. Two (2) sets of 48V 100% batteries complete, each capacity shall not be less than 150Ah at the 5-hour rate of discharge and total battery cell quantity not less than 42 nos. The battery with higher capability if required after calculation shall be supplied within the same price. ii. Two (2) sets of 48V battery charger, 75A and input 415V,50Hz AC The charger with higher capability if required after calculation shall be supplied within the same price. iii. Two (2) sets of DC distribution board The DC distribution board shall be suitable to connect the new fibre optic multiplexer equipment for communication and protection with 50% overall spare switches for future use & the MCB shall be of DC type. 48V DC system and distribution equipment shall be located in the Main Control Building. All 48V DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
1L	**LVAC Distribution**
1L1	One (1) lot of LVAC switchboard for 400/230kV substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey project. All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm) shall be incorporated in substation automation system. The AC distribution board shall be with 50% overall spare switches for future use.
1L2	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 earthing/auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check). Substation Automation System shall include the metering for all incoming LVAC source feeder (400/230/33kV part).
1M	**Civil Works, Building and Foundation**

1M1	One (1) lot of complete Land development (filling / cutting soil and leveling up to finished level and within property) with carried/dredged earth filling required for civil constructionof 400kV & 230kV GIS switchyards, Transformer yard and Bus reactor bays.
1M2	One (1) lot of Complete design, supply and construction of all civil items required for the outdoor works filling/cutting soil and levelling up to finished level and within the property line suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches including soak pit, septic tank, switchyard drainage system including outfall, fences, guard house, sentry post, boundary wall, gates, PVC pipes etc., switchyard surface finishing and gravel surfacing etc.
1M3	Complete design, supply and construction of all civil items and facilities required for the 400kV &230kV GIS and 400kV, 230kV & 33kV panel and Main Operation building (two storied).
1M4	One (01) Lot of testing of pile Foundation , Compression & uplift on random basis.
1M5	One (1) lot of complete design, supply and construction of fire alarm & fire fighting system for CRB. Fire extinguishers shall be supplied as per section 12.7 of Volume 2 of 3, for main control building.
1M6	One (1) lot of design and construction of fire fighting system for 400/230kV auto transformers including pipe network, panel, alarm and all accessories for complete system.
1N	**Lighting, Small Power, Air Conditioning and Ventilation**
1N1	One (1) lot of complete design, supply, installation and commissioning of equipment to provide indoor lighting (LED type) , LV power supply, air conditioning system, ventilation system and emergency DC lighting for the substation
1N2	One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) for security, roadway, switchyard and emergency DC lighting at strategic locations for equipment operation and inspection.
1N3	Complete solar system (1kW solar panel) including 12V VRLA type maintenance free battery and other accessories for Substation emergency DC Lighting.
1O	**Fibre Optic Multiplexer Equipment for Communication and Protection**
	Multiplexer at Loacl end
1O1	The equipment to be supplied, installed and commissioned shall be as shown on bid drawing. One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment at local end substation with necessary works to interface with connecting substations is to be provided with the following minimum services: - 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC) - 21 or 87 (built in 21) relay carrier signal (main and back-up) - SCADA data from switchgear and control system through SAS - Hot-line telephone system - Substation LAN system
1O2	Othe Indoor equipment:
	One lot of other indoor equipment like New digital PABX card with subscriber telephone sets, IP phones, MDF etc for the complete substation including necessary works to interface with the system.

1O3	Outdoor equipment:
	outdoor terminal box at gantry, Armoured Underground optical fibre cables (48 cores) from gantry of 400kV and 230kV double circuit transmission line termination point to MDF (Main distribution structure at each Frame) to be installed in control room , pigtail cables with adequate length.
1O4	Supply/Extension of Indoor Fibre Optic Multipexer Equipment at remote end sunstations each comprising
	Design, supply, installation and commissioning of complete set of fibre optic multiplexer equipment at the related substations to interface with existing system is to be provided with the following minimum services: - 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC) - 21 or 87 (built in 21) relay carrier signal (main and back-up) - SCADA data from switchgear and control system through SAS - Hot-line telephone system - Substation LAN system
1O5	PLCC System:
	One (1) lot of the equipment to be supplied, installed and commissioned shall be as per the approved SLD.
	400kV 3 sets:- Indoor PLC equipment including teleprotection at Bogura (W) Substation for (direction Bagura-Rahanpur1 & 2, Ruppur-1 & 2 and Kaliakoir-1 & 2) 400 kV line. 12 nos.:- line matching units for phase to phase circuit coupling for 400kV lines at Gopalganj Substation. Additionally, if any Interfaces are required for system configuration at each remote end substation, then interface devices shall be installed in each existing system as a lot.
1P	SCADA system for Telecontrol and Telemetering
1P1	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 station at Biddyut Bhaban for integration of complete new 400kVBogura, 400kV Rahanpur, 230KV Gopalganj and extension of 132kV Chapainawabganj substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station of NLDC at Rampura & Biddyut Bhaban are to be carried out. Scope of supply work shall include of 02 (two) no's of industrial gateways (Hot & standby) with redundant Ethernet switches, one hardware firewall, cables, separate panel with wiring & all other accessories . The panel of SCADA system shall be separate than SAS panels & shall be located in Main Control Room building. The Engineering PC & software of SAS shall

	be useable for engineering of SCADA system also. Therefore, necessary hardware & soft-ware shall be installed here.

Section-II **Mandatory Spares, Erection & Test Equipment**

Supply of complete spares and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment as per quantity mentioned in Schedule B. Testing Equipment shall have to be supplied from Germany, USA, UK and Japan. The materials shall have to be handed over to the designated store as per instruction of the Employer.

A sample tool list to be submitted for each of the substations is as follows:

Serial No	Name	Quantity
1.	Socket Wrench Set	1 Set
2.	Adjustable Wrench Set wiith Grip (6”,8”,12”,15”)	1 Set
3.	Ratchet Wrench Set	1 Set
4.	Open-endWrench Set	1 Set
5.	Ring/Ball Wrench Set	1 Set
6.	Pipe Wrench (12”,18”,24”,	1 Set
7.	Allen Key Set	1 Set
8.	Hammer (1lb & 2lb)	1 Set
9.	Plier, 8 inch	1 No.
10.	Cutting Plier, 8 inch	1 No.
11.	Nose Plier, 8 inch	1 No.
12.	Screw Driver Set	1 Set
13.	Screw Driver (Star and Flat Big)	1 Set
14.	File (Flat)	1 No.
15.	File (Round)	1 No.
16.	Hakso Frame with blade	1 No.
17.	Safety Belt	4 Nos
18.	Ladder (Aluminium)	2 Nos.
19.	Helmet	6 Nos.
20.	Gas Cylinder Pipe Set	1 Set
21.	Multimeter (Fluke/Megger)	2 Nos
22.	Bucket	2 Nos.
23.	Shabol	2 Nos.
24.	Coppa	2 Nos
25.	Rope	200 m
26.	Duur Metal Box	1 No.
27.	Grinding Machine	1 No.
28.	Blower Machine	1 No.
29.	Mechanical Jug	1 No.
30.	Compressor Jug	1 No.
31.	Wire Cutter	1 No.
32.	Steel Cutter	1 No.

Serial No	Name	Quantity
33.	Chain Pulley (2 Ton)	1 No.
34.	Vice Set	1 No.
35.	Drill Machine	1 No.
36.	Crimping Tools	1 No.
37.	Lug Puncher	1 No.
38.	Steel Wire Brush	2 No.
39.	Blade type Knife	2 Nos.
40.	Wire Stripper	1 No.
41.	Grass Trimmer	1 No.
42.	Drill Bits	1 Set
43.	Tool Box	1 No.
44.	Hand Gloves (Leather)	1 No.
45.	Vacuum Cleaner	1 No.
46.	Chisel	1 No.
47.	Tester	1 No.
48.	Rivet Gun	1 No.
49.	PIB Tape, 1”	3 Nos.
50.	PVC Tape	4 Nos
51.	Steel Wire Brush	3 Nos.
52.	Chisel	2 Nos.
53.	Measuring Tape	1 No.

Refer to the BOQ for detail of other spares, testing kit, tools etc.
For Tools set, STANLEY, USA is preferable.

Section-III **Bus Reactor & Associated works**

EMTP Study, Bus Reactor and associated bay considering both Bogura (W) 400kV &Rahanpur 400kV sides [Requirement of Bus reactor and associated shall be determined by EMTP study which shall be carried out under this scope of work. The clause related to change of facilities (no. 39 of General Condition of Contracts-GCC) shall not be applicable for the works under this section-III.]

IIIA	**Works and Equipment for Bus Reactor Installation**
	The works for Bus reactor shall comply with Section 16 of the Technical Specification and the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-
1.IIIA1	EMTP study (for 400kV Bogura Substation) shall be performed by the contractor through Independent Expert with consent of Employer and shall include the following aspects but are not limited to i. to determine the requirement and the size of the Bus reactor at Bogura (W) 400kV Bus and resonance phenomena for Bogura (W) 400kV Substation. ii. to determine the requirement, rating (kV, kJ, kA etc.),location and the number of lighting arrester at Bogura 400kV switchyard iii. to determine the value of Pre Insertion Resistor iv. Switching Over Voltage study of Bogura-Rahanpur 400 kV Line v. Iinsulation co-ordination with detail surge arrester modelling and requirements for Point-on-Wave device and PIRs for each busbar.

	vi. Switching surge analysis for 400 kV Bogura (W) Substation – Re-closing time determination - Closing/Re-closing Over Voltage study - TRV analysis for circuit breaker The EMTP study shall have to be performed using PSCAD software and shall include training of six (06) Design Engineers of the Employer for two (2) weeks regarding the use of PSCAD software for typical EMTP study including/having example of the said EMTP study under this project. Soft copy with detail EMTP report & psacd files shall have to be submittedto Employer during execution work.
1.IIIA2	Four (4) sets of 420 kV, Size: 125MVAR (only for Bid purpose, the final size shall be as per the EMTP study to be done by the Contractor) (ONAN), three phase outdoor type Shunt Reactor as specified in the technical specifications of this Section. It is to be mentioned that, for change in MVar size of Shunt Reactor during execution based on EMTP study, the price shall be adjusted as follows: $\boldsymbol{P_N = 20\% \times P_0 \pm 80\% \times P_0 \times \frac{New\ Size}{Old\ Size}}$; $Where,$ $P_N = New\ price\ , P_0 = Original\ price\ (Corrected\ Bid\ price)$
1.IIIA3	Deleted
1.IIIA4	Three (03) no. of 390kV rated voltage, 303kV(rms) continuous operating voltage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arrestors
1.IIIA5	Control, Protection, Monitoring & Substation Automation System including event recording function for Bus Reactor as specified in the technical specifications and bid drawings of Volume 2 of 3 of the Bidding Document)
1.IIIA6	One (1) lot of rigid tubular bus [Aluminium of grade 63401 WP], flexible conductors, insulators, fittings including all necessary clamps and connectors required for completing 420kV busbar and switchgear connection for Bus Reactor bay as specified in the technical specifications and bid drawings of Volume 2 of 3 of the Bidding Document
1.IIIA7	One (1) lot of steel structures for gantry, equipment supports and civil works required for com pleting 420kV busbar and switchgear for Bus Reactor bay as specified in the technical specification and bid drawings of Volume 2 of 3 of the Bidding Document.

1.3.2 Technical Requirements for 400/132kV Outdoor GIS Substation at Rahanpur

Section I

400/132 kV OUTDOOR GIS SUBSTATION

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

Item **Description**

2A **400kV GIS Switchyard**

420kV Outdoor Type Gas Insulated Switchgear (GIS)

Item No	Sub-item	Requirements	Quantity
2A	**400 kV Outdoor Type Gas Insulated Switchgear (GIS), equipment connection and steel structures**		
The 420kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A to this section and shall comprise the following:-			
2A1	420kV GIS Line Feeder Bays, each comprising:		**Four(4) Sets**
	i.	420kV, 4000A, 50kA/3s, single phase Enclosure double busbar	1 Lot
	ii.	420kV, 4000A, 50kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism, PIR or CSD as Phase switching control device	1 Set
	iii.	420kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	420kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	420kV, 4000A, 50kA/3s three phase line disconnector complete with motor operating mechanism	1 Set
	vi	420kV,50kA/3s three phase high speed earth switch complete with motor operating mechanism	1 set
	vii.	420kV, 50kA/3s single phase, 4-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main 1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main 2 Protection, DFDR - 2000-4000/1A, 5P20, 30VA for DFDR - 2000-4000/1A, Class 5P20, 30VA	3 Nos
	viii	420kV, 50kA/3s single phase, 4-core, current transformer with cores as follows: - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 , BCU - 2000-4000/1A, 5P20, 30VA for Busbar BB1 Protection and Breaker Failure - 2000-4000/1A, 5P20, 30VA for Busbar BB2 Protection	3 Nos

Item No	Sub-item	Requirements	Quantity
	ix.	420kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (15-200 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	x	Local Control Cubicle	1 No.
	xi.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xii.	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A2	**420kV GIS Transformer Feeder Bays, each comprising:**		**Two (2) Sets**
	i.	420kV, 4000A, 50kA/3s, single phase Enclosure double busbar	1 lot
	ii.	420kV, 31500A, 50kA/3s three phase, gang operated circuit breaker complete with spring-stored energy operating mechanism, CSD as Phase switching control device	1 Set
	iii.	420kV, 3150A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	420kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	420kV, 3150A, 50kA/3s, three phase line disconnector complete with motor operating mechanism	1 set
	vi	420kV, 50kA/3s, three position earth switch line complete with motor operating mechanism	1 set
	vii.	420kV, 50kA/3s single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main 1 Protection - 2000-4000/1A, Class 5P20, 30VA for Main 2 Protection - 2000-4000/1A, 5P20, 30VA for DFDR, BCU	3 Nos.
	viii	420kV, 50kA/3s single phase, 4-core, current transformer with cores as follows: - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 , - 2000-4000/1A, 5P20, 30VA for Busbar BB1 Protection and Breaker Failure - 2000-4000/1A, 5P20, 30VA for Busbar BB2 Protection	3 Nos.
	ix.	420kV single phase voltage transformer with windings as follows: -400,000/√3:110/√3:110/√3:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection	3 Nos.
	x.	400kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (15-200 meter). Bidder shall consider 100meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi.	Local Control Panel	1 set

Item No	Sub-item	Requirements	Quantity
	xi.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
	xiii	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A3	**420kV Bus Coupler Bays , each comprising:**		**Two (2) Sets**
	i.	420kV, 4000A, 50kA/3s, single phase Enclosure double busbar	1 lot
	ii.	420kV, 4000A, 50kA/3s three phase, gang operated circuit breaker complete with spring-stored energy operating mechanism, CSD as Phase switching control device	1 Set
	iii.	420kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motoroperating mechanism	2 Sets
	iv.	420kV, 4000A, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism, on either side of circuit breaker.	2 sets
	v.	420kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A class 0.2S, 10VA for measuring and BCU - 2000-4000/1A, Class 5P20, 30VA for Main1 Bus differential protection - 2000-4000/1A, Class 5P20, 30VA for Main2 Bus differential protection	3 Nos.
	vi.	420kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Main2 Bus differential protection - 2000-4000/1A, Class 5P20, 30VA for Main1 Bus differential protection - 2000-4000/1A, Class 5P20, 30VA for DFDR	3 Nos.
	vii.	Local Control Panel	1 set
	viii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	
	ix.	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A4	**420kV GIS Bus Reactor bay each comprises with:**		One (01) set
	i.	420kV, 4000A, 50kA/3s, single phase Enclosure Double busbar	1 Lot
	ii.	420kV, 1600A, 50kA/3s, three phase, gang operated circuit breaker complete with spring-stored energy operating mechanismwith CSD as Phase switching control device	1 set
	iii.	420kV, 1600A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 set
	iv.	420kV, 1600A, 50kA/3s, three phase line disconnector complete with motor operating mechanism	1 set
	v.	420kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism	3 set
	vi	420kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A class 0.2S, 10VA for measuring and BCU - 2000-4000/1A, Class 5P20, 30VA for Main1 Bus differential protection - 2000-4000/1A, Class 5P20, 30VA for Main2 Bus differential protection	3 Nos.
	vii	420kV,50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Reactor differential protection	3 Nos.

Item No	Sub-item	Requirements	Quantity
		- 2000-4000/1A, Class 5P20, 30VA - 2000-4000/1A, Class 5P20, 30VA	
	viii	400kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (15-200 meter). Bidder shall consider 50meter for reference & bidding purpose. Actual payment shall be as per final design.	50 meter
	ix	Local Control Panel	1 No.
	x	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 lot
	xi	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A5	**420kV Bus Section Bays , each comprising:**		Two (2) sets
	i	420kV, 4000A, 50kA/3s, three phase double busbar	1 Lot
	ii	420kV, 4000A, 50kA/3s, three phase, single pole operation circuitbreaker complete with spring-stored energy operating mechanism with CSD as Phase switching control device	1 sets
	iii	420kV, 4000A, 50kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 sets
	iv	420kV, 50kA/3s, three phase earth switch complete with motor operating mechanism, on either side of circuit breaker	2 set
	v	420kV, 4000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1 A, 5P20, 30VA for Bus Differential Protection 1 and Breaker Failure Protection - 2000-4000/1 A, 5P20, 30VA for Bus Differential Protection 2 - 2000-4000/1 A, Class 5P20, 30VA for BCU & DFDR	3 No.
	vi	420kV, 5000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1 A, 5P20, 30VA for Bus Differential Protection 2 - 2000-4000/1 A, 5P20, 30VA for Bus Differential Protection 1 - 2000-4000/1 A, Class 0.2S for Metering	3 No.
	vii	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for multi-core cables, busbar end covers or link to adjacent switchgear panel as appropriate	1 Lot
	viii	Local Control Panel	1 set
	ix.	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A6	**420kV, 4000A Double Busbar with VT/ES, each comprising:**		2 set
	i.	420kV, 4000A, 50kA/3s, three phase double busbars	1 lot
	ii.	420kV single phase voltage transformer with windings as follows: -400,000/√3:110/√3:110/√3V, Class 0.2,10VA for Metering and Class 3P, 25VA for Protection	6 Nos.

Item No	Sub-item	Requirements	Quantity
	iii.	420kV, 50kA/3s, three phase, three position high speed earth switches com-plete with motor operating Mechanism	2 sets
	iv.	Local Control Panel	1 No.
	v.	Partial Discharge Monitoring terminal for each compartment	1 Lot
2A7	Surge Arrester for Busbar		
	i.	420kV, 4000A, 50kA/3s, three phase double busbars	1 lot
	ii.	390kV rated voltage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arresters	Six(06) No.s
	iii.	Partial Discharge Monitoring terminal for each compartment	1 Lot

420kV Air Insulated Switchgear (AIS)	
2A8	Twenty-one (21) nos. of single-phase, 3 secondary windings, 420kV, 50Hz, 1425kVp BIL, capacitor type voltage transformers
2A9	Twenty-one (21) nos. of 390kV rated voltage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arresters
2A10	Eight (08) nos. of Wave traps, single phase, 420kV, 4000A,50kA/3s, 1mH
2A11	One(1)lot of rigidtubular busand/orstrandedconductorsincludingaccessories for eachconnectionasrequiredforcompleting400kVGISSwitchyard
2A12	One (1) lot of insulator and fittings including all necessary clamps and connectors as required for completing 400kV GISSwitchyard
2A13	One(1) lot of steel structures for gantry and equipment supports required for completing 420kV busbar and switchgear including all necessary accessories required for com pleting 420kV GIS Switchyard

2B 230kV GIS Switchyard

245kV Outdoor Type Gas Insulated Switchgear (GIS)

Deleted

2C 132kV GIS Switchyard

132kV Outdoor Type Gas Insulated Switchgear (GIS)

Item No	Sub-item	Requirements	Quantity
2C	**145 kV Outdoor Type Gas Insulated Switchgear (GIS), equipment connection and steel structures**		
The 145kV GIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A to this section and shall comprise the fol-lowing:-			
2C1	**145kV GIS Line Feeder Bays, each comprising:**		**Six(6) Sets**
	i.	145kV, 4000A, 40kA/3s, three phase Enclosure double busbar	1 Lot
	ii.	145kV, 3150A, 40kA/3s, three phase, single pole operation circuit breaker complete with spring-stored energy operating mechanism	1 Set

Item No	Sub-item	Requirements	Quantity
	iii.	145kV, 3150A, 40kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	145kV, 50kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	145kV, 3150A, 40kA/3s three phase line disconnector complete with motor operating mechanism	1 Set
	vi	145kV, 40kA/3s, three pole, high speed earth switch complete with motor operating mechanism	1 set
	vii.	145kV, 40kA/3s single phase, 4-core, current transformer with cores as follows: - 2000-40001A, Class 5P20, 30VA for Main Protection - 2000-4000/1A, Class 5P20, 30VA for Backup Protection - 2000-4000/1A, Class 5P20, 30VA for DFDR, BCU [Actual Burden shall be finalized at execution time based on sizing calculation]	3 Nos.
	viii.	145kV, 40kA/3s single phase, 4-core, current transformer with cores as follows: - 2000-4000/1A, Class 0.2S,10VA for Metering 1 - 2000-4000/1A, Class 0.2S,10VA for Metering 2 - 2000-4000/1A, 5P20, 30VA for Busbar Differential Protection and Breaker Failure [Actual Burden shall be finalized at execution time based on sizing calculation]	3 Nos.
	ix..	145kV single phase voltage transformer with windings as follows: -132,000/√3:110/√3:110/√3 V:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection	3 Nos.
	x.	145kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (15-200 meter). Bidder shall consider 50 meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi.	Local Control Cubicle	1 No.
	xii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for GIL, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
2C2	**145kV GIS Transformer Feeder Bays, each comprising:**		**Two (2) Sets**
	i.	145kV, 3150A, 40kA/3s, three phase Enclosure double busbar	1 lot
	ii.	145kV, 3150A, 40kA/3s, three phase, gang operation circuit breaker complete with spring-stored energy operating mechanism	1 Set
	iii.	145kV, 3150A, 40kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	145kV, 40kA/3s, three phase, three position earth switch complete with motor operating mechanism at both sides of CB	2 Sets
	v.	145kV, 3150A, 40kA/3s, three phase line disconnector complete with motor operating mechanism	1 No.
	vi	145kV, 40kA/3s, three pole make proof type earth switch complete with motor operating mechanism	

Item No	Sub-item	Requirements	Quantity
	vii	145kV,40kA/3s, single phase, 4-core, current transformer with cores as follows: - 2500-4000/1A, Class 5P20, 30VA for Main 1 Protection - 2500-4000/1A, Class 5P20, 30VA for Main 2 Protection - 2500-4000/1A, Class 5P20, 30VA for DFDR, BCU	3 Nos.
	viii	145kV,40kA/3s, single phase, 4-core, current transformer with cores as follows: - 2500-4000/1A, Class 0.2S, 10VA for Metering 1 - 2500-4000/1A, Class 0.2S, 10VA for Metering 2 - 2500-4000/1A, Class 5P20, 30VA for Busbar Differential Protection and Breaker Failure Actual Burden shall be finalized at execution time based on sizing calculation	
	ix	145kV single phase voltage transformer with windings as follows: -132,000/√3:110/√3:110/√3:110/√3 V, Class 0.2, 10VA for Metering and Class 3P, 15VA for Protection Actual Burden shall be finalized at execution time based on sizing calculation	3 Nos.
	x	145kV Gas Insulated Line (GIL) with GIS-to-AIR Bushing, terminating chambers complete with support structure, etc. for incoming line feeder. The Length of GIL shall be different for different bay as per actual design (15-200 meter). Bidder shall consider 50meter for reference & bidding purpose. Actual payment shall be as per final design.	1 Lot
	xi	Local Control Panel	1 set
	xii	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for single-core cables, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot
2C3	**145kV Bus Coupler Bays , each comprising:**		**Two (2) Sets**
	i.	145kV, 4000A, 40kA/3s, three phase Encloser double busbar	1 lot
	ii.	145kV, 4000A, 40kA/3s, three phase, gang pole operation circuit breaker complete with spring-stored energy operating mechanism	1 Set
	iii.	145kV, 4000A, 40kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv.	145kV, 4000A, 40kA/3s, three phase, three position earth switch complete with motor operating mechanism, on either side of circuit breaker.	2 sets
	v.	145kV,40kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1A class 0.2S, 10VA for measuring - 2000-4000/1A, Class 5P20, 30VA for Protection, BCU - 2000-4000/1A, Class 5P20, 30VA for Bus Differential Protection	3 Nos.
	vi.	145kV,40kA/3s, single phase, 2-core, current transformer with cores as follows: - 2000-4000/1A, Class 5P20, 30VA for Protection, DFDR - 2000-4000/1A, Class 5P20,30VA for Busbar Differential Protection and Breaker Failure Actual Burden shall be finalized at execution time based on sizing calculation	3 Nos.
	vii.	Local Control Panel	1 set
	viii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, busbar end covers or link to adjacent switchgear panel, cables, metal support structure, grounding, etc. as appropriate	1 Lot

Item No	Sub-item	Requirements	Quantity
2C4	**145KV Bus Section Bays, each comprising:**		**Two (2) Sets**
	i	145kV, 4000A, 40kA/3s, three phase encloser double busbar	1 lot
	ii	145kV, 4000A, 40kA/3s, three phase, gang pole operation circuit breaker complete with spring-stored energy operating mechanism	1 Set
	iii	145kV, 4000A, 40kA/3s, three phase busbar disconnector complete with motor operating mechanism	2 Sets
	iv	145kV, 40kA/3s, three phase earth switch complete with motor operating mech-anism, one (1) on either side of circuit breaker	2 sets
	v	145kV, 4000A, 50kA/3s, single phase, 3-core, current transformer with cores as follows: - 2000-4000/1 A, 5P20, 30VA for bus differential protection - 2000-4000/1 A, 0.2S, 10 VA for metering - 2000-4000/1 A, Class 5P20, 30VA for BCU & DFDR	3 Nos.
	vi	145kV, 4000A, 40kA/3s, single phase, 2-core, current transformer with cores as follows: - 2000-4000/1 A, 5P20, 30VA for Bus Differential Protection - 2000-4000/1 A, 5P20, 30VA for protection	3 Nos.
	vii	Local Control Panel	1 No.
	viii.	Complete set of miscellaneous items required for safe and efficient operation of the switchgear, terminal arrangements for multi-core cables, busbar end covers or link to adjacent switchgear panel as appropriate	1 Lot
2C5	145kV GIS Double Busbar with **VT/ES,** each comprising:		Two (2) Set
	i.	145kV, 4000A, 40kA/3s, three phase encloser double busbars	1 lot
	ii.	145kV single phase voltage transformer with windings as follows: -132,000/√3:110/√3:110/√3V, Class 0.2,10VA for Metering and Class 3P, 25VA for Protection	3 Nos.
	iii.	145kV, 50kA/3s, three phase, three position earth switches complete with mo-tor operating Mechanism	2 sets
	iv.	Local Control Panel	1 No.

132kV Air Insulated Switchgear (AIS)

2C6	Twenty-four (24) nos. of 120kV rated voltage, 102kV(rms) continuous operating volage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arresters
2C7	One (1) lot of rigid tubular bus and/or stranded conductors including accessories for each connection as required for completing 132kV GIS Switchyard
2C8	One (1) lot of insulator and fittings including all necessary clamps and connectors as required for completing 132kV GIS Switchyard
2C9	One (1) lot of steel structures for gantry and equipment supports required for complet-

	ing 145kV busbar and switchgear including all necessary accessories required for completing 132kV GIS Switchyard

2D **36kV Switchgears and Connections with Auto Transformer & Earthing / AuxiliaryTraformers**

The36kV switchgears shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-

2D1 Two (02) sets of 36kV, 800A, 31.5kA/1sec, 50Hz, 170kVp BIL, vacuum circuit breaker with spring-stored energy operating mechanism

2D2 Four(04) sets of 36kV, 800A, 31.5kA/1sec, 50Hz, 170kVp BIL, single vertical break/double horizontal brteak, post type, motor operated disconnector with (02 set) & without (02 set) earth switch

2D3 Six (06) nos. of single-phase, 2-secondary windings 36kV, 800-1250/1, 31.5kA/1sec, 50Hz, 170kVp BIL, Current transformers with winding as follows:

- 10/1A, Class 0.2S, 10VA for Metering 1 & Metering 2
- 800-1250/1, class 5P20, 30VA for protection
- 800-1250/1, class 5P20, 30VA for protection
- 800-1250/1, class 5P20, 30VA for protection

2D4 Six (06) nos. of single-phase, 3-secondary windings (33/√3kV : 110/√3V :110/√3V), 36kV, 31.5kA/1sec, 50Hz, 170kVp BIL, inductive voltage transformers

1D5 Six (06) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arrester

1D6 One (1) lot of Gantry steel structures for Bus & Equipment, Conductor for 36kV,3000A Bus bar & equipment, 36kV XLPE cable for Tertiary side connection from power transformer, Insulator and fittings including all necessary clamps and connectors, cable trench required to complete 33kV switchyard.

2E	**Transformers&Fire Fighting**
2E1	Two (2) nos. of 400/135/34.5 kV, 400/520 MVA (ONAN/ONAF), three phase outdoor type Power transformer, equipped with the delta connected 33 kV tertiary winding (brought out to terminal bushings) for the purpose of supplying the substation auxiliary power requirements. Direct Hot Spot Temperature measurement facility using Fiber optic shall be available.
2E2	Two (2) nos. of On-line Dissolved Gas & moisture monitoring system for 400/135/34.5kV auto transformers.
2E3	Two (2) sets 33/0.415 kV, 500kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers without neutral earthing resisters, associated Bushing & outdoor neutral CTs and steel support structures including all necessary connections. The delta connected tertiary windings of two new 400/132/33kV 3 phase transformers shall supply the two 33/0.415 kV, auxiliary Zig-Zag transformer for the purpose of supplying the substation auxiliary power requirements.

2E4	Two (2) sets of Deionized water mist type fire suppression system or Fast Depressurization system as transformer fire prevension system for three phase outdoor type auto transformer

2F	**Control, Protection, Substation Automation & Metering**
	400 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
2F1	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation System including event recording function for **Four (04)** sets of overhead line circuits bays
2F2	Control, Monitoring, Protection (Main-1 & Main-2) & Substation Automation System including event recording function for **two (2)** sets of 400/132/33kV, three phase, power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
2F3	Control, Monitoring, Protection & Substation Automation System including event recording function for two (2) sets of bus coupler bays
2F4	Control, Monitoring, Protection & Substation Automation System including event recoingfunction for two (2) sets of bus section bays
2F5	One (1) set of Busbar protection (Main-1 & Main-2 for each Bus) for 400kV system.
2F6	Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArh meters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	145 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
2F7	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation System including event recording function for 06 (six) sets of overhead line circuits bays.
2F8	Control, Monitoring, Protection & Substation Automation System including event recording function for two (2) sets of 400/132/33kV, three phase, power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
2F9	Control, Monitoring, Protection & Substation Automation System including event record ing function for two (2) sets of bus coupler bays
2F10	Control, Monitoring, Protection & Substation Automation System including event recoing function for two (2) sets of bus section bays
2F11	One (1) set of Busbar protection for 132kV system.
2F12	Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArh meters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.

	Note: Only on/off monitoring of ES and measuring of bus PT shall be integrated with SAS within the contract price.
33kV Station Power System	
2F13	Control, Monitoring, Protection & Substation Automation System including event recording function for 33kV side of two (2) sets of 400/230/33 kV power transformer circuits bays. Protection for 33/0.4kV transformer shall also be provided.
2F14	Programmable & recordable digital 3-phase,4wire import and export MWh and MVArh tariff meters (accuracy class 0.2) 0.415kV side.Tariff Metering for 0.415kV side is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
Substation Automation system	
2F15	Complete SAS including all required equipment & accessories excluding protection panel &relay for the whole Substation. SAS system shall include BCUs, Server PC (Hot & standby) with SAS software , Operator workstation (Main & redundant), Firewall, 55'' LCD Monitor, Ethernet Switches, GPS system, Printers, Engineering PC & software, panels, Cables etc.

2G	**Traveling Wave type DFDR**
2G1	Independent standalone traveling wave type Digital Fault and Disturbance recorder (DFDR) to monitor complete substation including all bays for 420kV GIS, 145kV GIS as per drawing.
2H	**GIL & Power Cable**
2H1	One (01) lot of 36kV, 300 mm^2 XLPEpower cable for connection between tertiary side of Power transformer & 33/0.4kV Auxiliary transformer.

2I	**Multicore Cables**
21	One (1) lot complete set of multicore low voltage 06/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided.
2J	**Earthing and Lightning Protection**
2J1	One (1) lot of design, supply and installation of earthing system (outdoor switchyard equipment & Control Room) and lightning protection screen including connections, connectors and clamps, to suit the substation overall arrangement and provide supporting design calculations (for Building & Switchyard). Required number of Lightning Mast (for switchyard & Building) shall be provided as per DSLP calculation during detail design stage.
2J2	Two (2) sets of 3-phase portable (maintenance) earthing equipment devices with connectors and telescopic glass fibre operating pole suitable for plant supplied. (400kV and 132kV voltages)
2K	**Batteries, Chargers and DC Distribution**
2K1	110V substation Ni-Cd batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment including powering two (2) 240V, 50Hz, 5 kVA Inverter with AC bypass system & automatic change-rover facility being supplied. 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 400Ah & 300Ah at the 5-hour rate of discharge and total battery cell quantity not less than 94 nos for 400kV & 132kV system respectively. During execution stage, the capacity shall be confirmed with calculation by the contractor considering the bays under scope of work and future bays ~~as per clause 8.4.3 of section 8 of Volume 2 of 3 of the biding document~~. The battery with higher capability if required after calculation, shall be supplied within the same price. ii. Two (2) sets of battery chargers complete, each charge shall not be less than 150A & 120A rating and input voltage three phase 50Hz, 415V AC for 400kV & 132kV system respectively. The rating shall be based on battery boost charging rate & continuous DC load. The higher charging rated charger than minimum specified, if required after calculation, shall be supplied within the same price. iii. Two (2) set of DC distribution board The DC distribution board shall be with 50% overall spare switches for future use & MCB shall be of DC type . iv. Two (2) sets of Online 240V, 50Hz, 3kVA Inverter powered from 110V DC distribution board and AC distribution board as bypass circuit for substation automation system v. One (01) lot of Insulation Monitoring System for complete DC system. Fault detection for each feeder & fault location feature shall be available. Two (2) sets of batteries and battery chargers shall be located in the SPRs and shall be used for the first main and second main DC supplies for 400kV & 132kV switchyards. All DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
2K2	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, protecttion. One set shall be used as standby supply. The system shall generally be as shown in bid drawing and shall include: i. Two (2) sets of 48V 100% batteries complete, each capacity shall not be less than 150Ah at the 5-hour rate of discharge and total quantity not less than 42nos. ii. The battery with higher capability if required after calculation shall be supplied within the same price. iii. Two (2) sets of 48V battery charger, 75A and input 415V,50Hz AC The charger with higher capability if required after calculation shall be supplied within the same price.

	iv. Two (2) sets of DC distribution board The DC distribution board shall be suitable to connect the new fibre optic multiplexer equipment for communication and protection with 50% overall spare switches for future use. 48V DC system and distribution equipment shall be located in the Main Control Building. All 48V DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
2L	**LVAC Distribution**
2L1	One (1) lot of LVAC switchboard for 400/230kV substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey project. All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm) shall be incorporated in substation automation system. The AC distribution board shall be with 50% overall spare switches for future use.
2L2	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 earthing/auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check). Substation Automation System shall include the metering for all incoming LVAC source feeder (230/132/33kV part).
2M	**Civil Works, Building and Foundation**
2M1	One (01) lot of Design, supply and construction of Complete Land development with carried/dredged earth filling required for whole substation area.
2M2	One (1) lot of Complete design, supply and construction of all civil items required for the outdoor works filling/cutting soil and levelling up to finished level and within the property line suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches including soak pit, septic tank, switchyard drainage system including outfall, fences, guard house, sentry post, boundary wall, gates, PVC pipes etc., switchyard surface finishing and gravel surfacing etc.
2M3	Complete design, supply and construction of all civil items and facilities required for the 400kV & 132kV GIS and 400kV, 132kV & 33kV panel and Main Operation building (two storied).
2M4	One (01) Lot of testing of pile Foundation , Compression & uplift on random basis.
2M5	One (1) lot of complete design, supply and construction of fire alarm & fire fighting system for areas other than transformer yard. Fire extinguishers shall be supplied as per section 12.7 of Volume 2 of 3, for main control building and outdoors.
2M6	One (1) lot of design and construction of fire fightinh system for 400/132kV power transformers including pipe network, panel, alarm and Compressed Foam injection system.
2N	**Lighting, Small Power, Air Conditioning and Ventilation**
2N1	One (1) lot of complete design, supply, installation and commissioning of equipment to provide indoor lighting (LED type) , LV power supply, air conditioning system, ventilation system and emergency DC lighting for the substation.
2N2	One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) for security, roadway, switchyard and emergency

	DC lighting at strategic locations for equipment operation and inspection.
2N3	Complete solar system (1kW solar panel) including 12V VRLA type maintenance free battery and other accessories for Substation emergency DC Lighting
2O	**Fibre Optic Multiplexer Equipment for Communication and Protection**
2O1	**Multiplexer at Loacl end**
	The equipment to be supplied, installed and commissioned shall be as shown on bid drawing. One (1) lot complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment at local end substation with necessary works to interface with connecting substations is to be provided with the following minimum services: - 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC) - 21 or 87 (built in 21) relay carrier signal (main and back-up) - SCADA data from switchgear and control system through SAS - Hot-line telephone system - Substation LAN system
2O2	**Othe Indoor equipment:**
	One lot of other indoor equipment like New digital PABX card with subscriber telephone sets, IP phones, MDF etc for the complete substation including necessary works to interface with the system.
2O3	**Outdoor equipment:**
	Outdoor terminal box at gantry, Armoured Underground optical fibre cables (48 cores) from gantry of 400kV and 230kV double circuit transmission line termination point to MDF (Main distribution structure at each Frame) to be installed in control room , pigtail cables with adequate length etc.
2O4	**Supply/Extension of Indoor Fibre Optic Multipexer Equipment at remote end sunstations each comprising**
	Design, supply, installation and commissioning of complete set of fibre optic multiplexer equipment at the related substations to interface with existing system is to be provided with the following minimum services: - 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC) - 21 or 87 (built in 21) relay carrier signal (main and back-up) - SCADA data from switchgear and control system through SAS/RTU - Hot-line telephone system - Substation LAN system
2O5	**PLC Equipment:**
	One (1) lot of the equipment to be supplied, installed and commissioned shall be as per the approved SLD.
	<u>400kV</u> 2 set:- Indoor PLC equipment including teleprotection at Rahanpur Substation for (direction Rahanpur to Bogura-1 & 2 and other 400kV line-1&2) 400 kV line. 8 nos.:- line matching units for phase to phase circuit coupling for 400kV lines at Rahanpur

	Substation. Additionally, if any Interfaces are required for system configuration at each remote end substation, then interface devices shall be installed in each existing system as a lot
2P	**SCADA system for Telecontrol and Telemetering**
2P1	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 station at Biddyut Bhaban for integration of complete new 400KV, 230kV and 132kV (extension) substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station of NLDC at Rampura & Biddyut Bhaban are to be carried out. Scope of supply work shall include of 02 (two) no's of industrial gateways (Hot & standby) with redundant Ethernet switches, one hardware firewall, cables, separate panel with wiring & all other accessories . The panel of SCADA system shall be separate than SAS panels & shall be located in Main Control Room building. The Engineering PC & software of SAS shall be useable for engineering of SCADA system also. Therefore, necessary hardware & software shall be installed here. Additional 05 (five) No.'s of BCU for controlling 05 (five) No's of 33kV Load Shed Feeders shall be supplied. These 33kV BCU shall be considered in addition to required no. of BCUs for 33kV side of power transformers.

Section-II

Mandatory Spares, Erection & Test Equipment

Supply of complete spares and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment as per quantity mentioned in Schedule B. Testing Equipment shall have to be supplied from Germany, USA, UK and Japan.The materials shall have to be handed over to the designated store as per instruction of the Employer.

A sample tool list to be submitted for each of the substations is as follows:

Serial No	Name	Quantity
54.	Socket Wrench Set	1 Set
55.	Adjustable Wrench Set wiith Grip (6",8",12",15")	1 Set
56.	Ratchet Wrench Set	1 Set
57.	Open-endWrench Set	1 Set
58.	Ring/Ball Wrench Set	1 Set
59.	Pipe Wrench (12",18",24",	1 Set
60.	Allen Key Set	1 Set

Serial No	Name	Quantity
61.	Hammer (1lb & 2lb)	1 Set
62.	Plier, 8 inch	1 No.
63.	Cutting Plier, 8 inch	1 No.
64.	Nose Plier, 8 inch	1 No.
65.	Screw Driver Set	1 Set
66.	Screw Driver (Star and Flat Big)	1 Set
67.	File (Flat)	1 No.
68.	File (Round)	1 No.
69.	Hakso Frame with blade	1 No.
70.	Safety Belt	4 Nos
71.	Ladder (Aluminium)	2 Nos.
72.	Helmet	6 Nos.
73.	Gas Cylinder Pipe Set	1 Set
74.	Multimeter (Fluke/Megger)	2 Nos
75.	Bucket	2 Nos.
76.	Shabol	2 Nos.
77.	Coppa	2 Nos
78.	Rope	200 m
79.	Duur Metal Box	1 No.
80.	Grinding Machine	1 No.
81.	Blower Machine	1 No.
82.	Mechanical Jug	1 No.
83.	Compressor Jug	1 No.
84.	Wire Cutter	1 No.
85.	Steel Cutter	1 No.
86.	Chain Pulley (2 Ton)	1 No.
87.	Vice Set	1 No.
88.	Drill Machine	1 No.
89.	Crimping Tools	1 No.
90.	Lug Puncher	1 No.
91.	Steel Wire Brush	2 No.
92.	Blade type Knife	2 Nos.
93.	Wire Stripper	1 No.
94.	Grass Trimmer	1 No.
95.	Drill Bits	1 Set
96.	Tool Box	1 No.
97.	Hand Gloves (Leather)	1 No.
98.	Vacuum Cleaner	1 No.
99.	Chisel	1 No.
100.	Tester	1 No.
101.	Rivet Gun	1 No.
102.	PIB Tape, 1”	3 Nos.
103.	PVC Tape	4 Nos
104.	Steel Wire Brush	3 Nos.
105.	Chisel	2 Nos.
106.	Measuring Tape	1 No.

Refer to the BOQ for detail of other spares, testing kit, tools etc.
For Tools set, STANLEY, USA is preferable.

Section-III

Bus Reactor & Associated works

EMTP Study, Bus Reactor and associated bay considering both Bogura (W) 400kV & Rahanpur 400kV sides [Requirement of Bus reactor and associated shall be determined by EMTP study which shall be carried out under this scope of work. The clause related to change of facilities (no. 39 of General Condition of Contracts-GCC) shall not be applicable for the works under this section-III.]

2.IIIA	**Works and Equipment for Bus Reactor Installation**
	The works for Bus reactor shall comply with Section 16 of the Technical Specification and the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-
2.IIIA1	EMTP study (for 400kV Rahanpur Substation) shall be performed by the contractorand shall include the following aspects but are not limited to i. to determine the requirement and the size of the Bus reactor at Rahanpur 400kV Bus and resonance phenomena at Rahanpur 400kV Substation. ii. to determine the requirement, rating (kV, kJ, kA etc.), location and the number of lighting arrester at Rahanpur 400kV switchyard iii. to determine the value of Pre Insertion Resistor iv. Switching Over Voltage study of Bogura-Rahanpur 400 kV Line v. Iinsulation co-ordination with detail surge arrester modelling and requirementsPoint-on-Wave device and PIRs for each busbar. vi. Switching surge analysis for 400 kV RahanpurSubstation – Re-closing time determination - Closing/Re-closing Over Voltage study - TRV analysis for circuit breaker The EMTP study shall have to be performed using PSCAD software. Soft copy with detail EMTP report& pscad files shall have to be submitted to the Employer for approval during execution work. Note that, There shall be only one training for PSCAD software for typical EMTP study including/having example of the said EMTP study (Bogura & Rahanpur) under this project with duration of two (2) weeksof six (06) Design Engineers.

2.IIIA2	One (1) set of 420 kV, Size: 125MVAR (only for Bid purpose, the final size shall be as per the EMTP study to be done by the Contractor) (ONAN), three phase outdoor type Bus Reactor as specified in the technical specifications of this Section. It is to be mentioned that, for change in MVar size of Shunt Reactor during execution based on EMTP study, the price shall be adjusted as follows: $\boldsymbol{P_N = 20\% \times P_0 \pm 80\% \times P_0 \times \frac{New\ Size}{Old\ Size}}$; $Where,$ $P_N = New\ price\ , P_0 = Original\ price\ (Corrected\ Bid\ price)$
2.IIIA3	One (01) no. of 390kV rated voltage, 303kV(rms) continuous operating voltage at 50°C, 10kA nominal discharge current, 50Hz, gapless metal oxide type, single phase surge arrestor
2.IIIA4	Control, Protection, Monitoring & Substation Automation System including event recording function for Bus Reactor as specified in the technical specifications and bid drawings of Volume 2 of 3 of the Bidding Document)
2.IIIA5	Three (3) nos. of single-phase, 3-core, 420kV, 50kA/1sec, 200-400-800/1A, 50Hz, 1425kVp BIL, post type current transformer
2.IIIA6	One (1) lot of rigid tubular bus [Aluminium of grade 63401 WP], flexible conductors, insulators, fittings including all necessary clamps and connectors required for completing 420kV busbar and switchgear connection for Bus Reactor bay as specified in the technical specifications and bid drawings of Volume 2 of 3 of the Bidding Document
2.IIIA7	One (1) lot of steel structures for gantry, equipment supports and civil works required for completing 420kV busbar and switchgear for Bus Reactor bay as specified in the technical specifications and bid drawings of Volume 2 of 3 of the Bidding Document.

1.3.3 Techhnical Requirement for upgradation of 400/132 Gopalganj Substation to 400/230/132kV Substation by errecting 400/230kV AIS switchyard

Section-I **Gopalganj400/230kV AIS Substation**

The equipment to be designed, supplied, installed, tested & commissioned as stipulated in bid specification and shown in bid drawings (volume 2 of 3):

Item **Description**

3A **400 kV Air Insulated Switchgear (AIS)**

The 400kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-

3A1 Four(4) sets of 400kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL, live tank type, **gang operated,** SF6 gas circuit breakers with spring-stored energy operating mechanism.

CSD(**Control Switching Device)** is required for transformer switching which shall have to be considered for 400kV circuit breaker.

(For line switching: Pre insertion resistor (PIR) is also acceptable instead of control switching device. In this case of line & transformer switching with same breaker (i.e. Mid breaker), combination of PIR & CSD is required)

3A2 Deleted

3A3 Two (2) sets of 400kV, 3000A, 63kA/1sec, 50Hz, 1425kVp BIL,horizontal double break, post type, motor operated disconnectors **with**manual**earthing switch**.

3A4 Eight(08) sets of 400kV, 4000A, 63kA/1sec, 50Hz, 1425kVp BIL,horizontal double break, post type, motor operated disconnectors **without earthing switch**.

3A5 Deleted.

3A6 Deleted

3A7 Eighteen (18) nos. of single-phase, 6-core, 400kV, 63kA/1sec,4000-2000/1A, 50Hz, 1425kVp BIL,post type current transformer.

3A8 Six(6) nos. of single-phase, 3-core, 400kV, 50Hz, 1425kVp BIL, capacitor type voltage transformers.

3A9 Six(6) nos. of 390kV rated voltage, 312kV(rms) continuous operating voltage at 50˚c 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.

3A10 Deleted

3A11 One (1) lot of 400kV post type support insulators required for completing 400kV busbar and switchgear as specified in the technical specifications and bid drawings.

3A12 One(1) lot of rigid tubular bus [Aluminium of grade 63401 WP]/ flexible conductors, insulators, fittings including all necessary clamps and connectors required for completing 400kV busbar and switchgear connection as specified in the technical specifications and bid drawings.Bus capacity shall be 4000A.

3A13 One(1) lot of steel structures for gantry and equipment supports required for completing 400kV busbar and switchgear as specified in the technical specifications and bid drawings.

3B 245kV Air Insulated Switchgear (AIS)

The 245kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-

3B1	Four (04) sets 245kV, 3000A, 50kA/1sec, 50Hz, 1050kVp BIL, live tank type, single pole operated, SF6 gas circuit breakers with spring-stored energy operating mechanism.(for line bay).
3B2	Six (06) sets of 245kV, 3000A, 50kA/1sec, 50Hz, 1050kVp BIL, live tank type, Gang-pole operation, SF6 gas circuit breakers with spring-stored energy operating mechanism (for Transformer bay& Mid-breaker).
3B3	Six(06) sets of 245kV, 3000A, 50kA/1sec, 50Hz, 1050kVp BIL, double side break, post type, motor operated disconnectors withmanual earthing switch..
3B4	Twenty(20) sets of 245kV, 3000A, 50kA/1sec, 50Hz, 1050kVp BIL, double side break, post type, motor operated disconnectors without earthing switch.
3B5	Deleted
3B6	Two (2) sets of 245kV, 50kA/1sec, 50Hz, 1050kVp BIL, post type, motor operated busbar grounding switches
3B7	Fourty-two(42) nos. of single-phase, 6-core, 3000-2000/1A, 245kV, 50kA/1sec, 50Hz, 1050kVp BIL, post type current transformer.
3B8	Eighteen(18) nos. of single-phase, 3-core, 245kV, 50Hz, 1050kVp BIL, capacitor type voltage transformers.
3B9	Eighteen(18) nos. of 216 kV rated voltage, 210kV(rms) continuous operating voltage at 500c 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.
3B10	Deleted
3B11	One (1) lot of 245V post type support insulators required for completing 245kV busbar and switchgear as specified in the technical specifications and bid drawings.
3B12	One(1) lot of flexible conductors for bus and jumper, insulators, fittings including all necessary clamps and connectors required for completing 245kV busbar and switchgear connection as specified in the technical specifications and bid drawings.
3B13	One(1) lot of steel structures for gantry and equipment supports required for completing 245kV busbar and switchgear as specified in the technical specifications and bid drawings.

3C 145kV Air Insulated Switchgear (AIS)

Deleted

3D 33kV Air Insulated Switches and Connectionfor Auxiliary Transformers

The 33kV AIS shall comply with the particular requirements as detailed in the Schedule of Technical Requirements included as Appendix A1 to this section and shall comprise the following:-

3D1 Two(2) sets of 33kV, 630A, 31.5kA/1sec, 50Hz, 170kVp BIL, vacuum circuit breakers with-spring-stored energy operating mechanism.

3D2 Four(4) sets of 33kV, 630A, 31.5kA/1sec, 50Hz, 170kVp BIL, single vertical / double horizontal break, post type, motor operated disconnectors.

3D3 Six (06) nos. of single-phase, 2-secondary windings 36kV, 31.5kA/1sec, 50Hz, 170kVp BIL, Current transformers with winding as follows:

10/1A, Class 0.2S, 10VA for Metering 1 & Metering 2

800/1, class 5P20, 30VA for protection

3D4 Six (06) nos. of single-phase, 2-secondary windings (33/√3kV / 110/√3V / 110/√3V), 36kV, 31.5kA/1sec, 50Hz, 170kVp BIL, inductive voltage transformers

.

3D5 Six(6) nos. of 30kV rated voltage, 10kA nominal discharge current, 50Hz, Heavy duty station class, single phase surge arresters.

3D6 One(1) lot of Tertiary side connection between 33kV terminal to switches including necessary fittings, structures and conductors and XLPE for 400/230/33kV transformer.

3E Power Transformers&Earthing/Auxiliary Transformers

3E	**Transformers& Fire Fighting**
3E1	Two (2) nos. of 400/235/34.5 kV, 500/750 MVA (ONAN/ONAF), three phase outdoor type auto transformer, equipped with the delta connected 33 kV tertiary winding (brought out to terminal bushings) for the purpose of supplying the substation auxiliary power requirements
3E2	Two (2) nos. of On-line Dissolved Gas monitoring system for 400/230/33kV three phase auto transformers
3E3	Two (2) sets 33/0.415 kV, 500kVA three phase outdoor type earthing/auxiliary Zig-Zag transformers without neutral earthing resisters, associated Bushing & outdoor neutral CTs and steel support structures including all necessary connections. The delta connected tertiary windings of two new 400/132/33kV 3 phase transformers shall supply the two 33/0.415 kV, auxiliary Zig-Zag transformer for the purpose of supplying the substation auxiliary power requirements.

3E4	Two (2) sets of Compressed Air Foam (CAF) type or water sprinkler type or Fast Depressurization type transformer fire protector for three phase outdoor type 500/750MVA auto transformer
3E5	One (1) lot of Complete Fire Fighting system for Switchyard, Control Room &Switchyard Panel Room

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

3F	**Control, Protection, Monitoring, Substation Automation & Metering**
	400 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
3F1	Deleted
3F2	Control, Monitoring, Protection (Main-1 & Main-2) & Substation Automation System including event recording function for two (2) sets of 400/230/33kV, three phase, auto power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
3F3	One (1) set ofextension of Busbar protection (Main-1 & Main-2 for each Bus) for 400kV system.
3F4	One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArhmeters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	All the 400kV panels shall be installed in 400kV switchyard panel room.
	230 kV Circuits
	The equipment to be supplied, installed and commissioned is shown in bid drawings are comprising of:-
3F5	Control, Monitoring, Protection (Main-1 & Main-2 relay) & Substation Automation System including event recording function for Four (4) sets of overhead line circuits bays.
3F6	Control, Monitoring, Protection & Substation Automation System icluing event recording function for two (2) sets of 400/230/33kV, three phase, power power transformer circuits including transformer tap changer control, fan control & AVR as per 4.15 of section 4 and 5.12.12 of section 5 in volume 2 of 3
3F7	One (1) set of Busbar protection for 230kV system.
3F8	One (1) lot of Tariff metering panel to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArhmeters (accuracy class 0.2) for each 400 kV line and transformer feeders. For each feeder minimum two meters (main & check) shall be supplied. Substation Automation System shall include the metering for all the bays. Tariff

	Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.
	33kV Station Power System
3F9	Deleted
3F10	Deleted
	Substation Automation system
3F11	Extension of SAS including all required equipment & accessories excluding protection panel & relay for the whole Substation. SAS system shall include BCUs, Server PC (Hot & standby) with SAS software , Operator workstation (Main & redundant), Firewall, 55'' LCD Monitor, Ethernet Switches, GPS system, Printers, Engineering PC & software, panels, Cables etc.
	The existing SAS (approved) at Gopalganj 400/132kV Substation is Siemens, Germany.

3G	**DFDR**
3G1	One (01) lot of extension of Digital Fault and Disturbance recorder (DFDR) to monitor complete substation including all bays for 420kV AIS and 245kV AIS.

3H	**Power Cable**
3H1	Deleted

3I	**Multicore Cables**
3I1	One (1) lot complete set of multicore low voltage 06/1.1kV, XLPE insulated power and control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under the Contract. The overall substation cable routing and core schedules shall also be provided.
3J	**Earthing and Lightning Protection**
3J1	One (1) lot extension of 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. If soil resistivity is different for different layer, calculation and GPR shall have to shown using software like CYMGRD.
3J2	One (1) lot of extension of supply and installation of lightning protection screen for outdoor switchyard equipment & Control Room with necessary connectors and clamps, with design to suit the work under this project. Supporting calculation shall have to be shown in Rolling sphere mathod. Required number of Lightning Mast (for switchyard & Building) shall be provided as per DSLP calculation during detail design stage.
3J2	Two (2) sets of 3-phase portable (maintenance) earthing equipment devices with connectors and telescopic glass fibre operating pole suitable for plant supplied (400kV and 230kV voltages with 63KA and 50kA rated earthing clamp). Manufacturer shall be European or American origin.
3K	**Batteries, Chargers and DC Distribution**
3K1	110V substation Ni-Cd batteries complete with chargers and distribution switchboard to be supplied, installed and commissioned to provide all DC supplies to equipment including pow ering two (2) 240V, 50Hz, 5 kVA Inverter with AC bypass system & automatic change-rover

	facility being supplied. 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 100Ah at the 5-hour rate of discharge and total quantity not less than 94 nos. During execution stage, the capacity shall be confirmed with calculation by the contractor considering the bays under scope of work and future bays as per clause 8.4.3 of section 8 of Volume 2 of 3 of the biding documents. The battery with higher capability if required after calculation, shall be supplied within the same price. ii. Two (2) sets of battery chargers complete, each charger shall not be less than 175A rating and input voltage three phase 50Hz, 415V AC The rating shall be based on battery boost charging rate & continuous DC load. The higher charging rated charger than minimum specified, if required after calculation, shall be supplied within the same price. iii. Two (2) set of DC distribution board. The DC distribution board shall be with 50% overall spare switches for future use. iv. Deleted v. One (01) lot of Insulation Monitoring System for complete DC system. Fault detection for each feeder & fault location feature shall be available. Two (2) sets of batteries and battery chargers shall be located in the SPRs and shall be used for the first main and second main DC supplies for 230kV switchyards. All DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.
3K2	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, protecttion. The system shall generally be as shown in bid drawing and shall include: i. Deleted ii. Deleted iii. One lot of extension of two (2) sets of DC distribution board The DC distribution board shall be suitable to connect the new fibre optic multiplexer equipment for communication and protection with 50% overall spare switches for future use. 48V DC system and distribution equipment is ocated in the Main Control Building. All 48V DC status (DC voltage status for each bus including coupling breaker on /off status, fail with alarm) excluding control & protection Panel shall be incorporated in substation automation system. The DC status of control & protection Panel shall be incorporated to SAS by individual IED.

3L	**LVAC Distribution**
3L1	One (1) lot extension of LVAC switchboard for 400/230kV substation services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this turnkey project. All AC status excluding control &protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm, status of AC MCB/MCCB at SPR with fail alarm etc.) shall be incorporated in substation automation system. The AC distribution board shall be with 50% overall spare switches for future use.
3L2	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 earthing/auxiliary transformer feeder circuits. For each feeder minimum two meters (main & check). Substation Automation System shall include the metering for all incoming LVAC source feeder (400/230/33kV part).
3M	**Civil Works, Building and Foundation**
3M1	Deleted
3M2	One (1) lot of Complete design, supply and construction of all civil items required for the outdoor works filling/cutting soil and levelling up to finished level and within the property line suitable for switchyard gantry & equipment foundations, transformer foundations, blast walls, oil pit, entrance & internal roads, cable trenches including soak pit, septic tank, switchyard drainage system including outfall, fences, guard house, sentry post, boundary wall, gates, PVC pipes etc., switchyard surface finishing and gravel surfacing etc.
3M3	Complete design, supply and construction of all civil items and facilities required for the 400kV & 230kV panel building.
3M4	One (01) Testing of pile Foundation, Compression & uplift on random basis
3M5	One (1) lot of complete design, supply and construction of fire alarm & fire fighting system for Control Room. Fire extinguishers shall be supplied as per section 12.7 of Volume 2 of 3, for main control building.
3M6	One (1) lot of complete design and construction of fire fighting system for auto transformers including pipe network, panel, alarm etc.
3N	**Lighting, Small Power, Air Conditioning and Ventilation**
3N1	One (1) lot of complete design, supply, installation and commissioning of equipment to provide indoor lighting (LED type) , LV power supply, air conditioning system, ventilation system and emergency DC lighting for extension work
3N2	One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) for security, roadway, switchyard and emergency DC lighting at strategic locations for equipment operation and inspection for extension work .
3N3	Complete solar system (1kW solar panel) including 12V VRLA type maintenance free battery and other accessories for Substation emergency DC Lighting.
3O	**Extension of Fibre Optic Multiplexer Equipment for Communication and Protection**
	Multiplexer at Loacl end
3O1	The equipment to be supplied, installed and commissioned shall be as shown on bid drawing. One (1) lot of extension of complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment at local end substation with necessary works to interface with connecting substations is to be provided with the following minimum services: - 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC) - 21 or 87 (built in 21) relay carrier signal (main and back-up)

	- SCADA data from switchgear and control system through SAS - Hot-line telephone system - Substation LAN system
3O2	Othe Indoor equipment:
	One lot of other indoor equipment like New digital PABX card with subscriber telephone sets, IP phones, MDF etc for the complete substation including necessary works to interface with the system.
3O3	Outdoor equipment:
	outdoor terminal box at gantry, Armoured Underground optical fibre cables (48 cores) from gantry of 400kV and 230kV double circuit transmission line termination point to MDF (Main distribution structure at each Frame) to be installed in control room , pigtail cables with adequate length.
3O4	Supply/Extension of Indoor Fibre Optic Multipexer Equipment at remote end sunstations each comprising
	Deleted
3O5	PLC Equipment:
	Deleted
3P	SCADA system for Telecontrol and Telemetering
3P1	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 station at Biddyut Bhaban for integration of complete new 400kV Bogura, 400kV Rahanpur, 230KV Gopalganj and extension of 132kV Chapainawabganj substation. All required electrical signals shall be transmitted to the NLDC through the Industrial Gateway of the substation automation system. All HV breakers, motorized disconnectors, tap changer, etc. shall be controlled from NLDC through the Gateway of the substation automation system using IEC 60870-5-104 protocol. All necessary modification works in the software of master station of NLDC at Rampura & Biddyut Bhaban are to be carried out. Scope of supply work shall include of required redundant Ethernet switches for existing gateway, one hardware firewall, cables, separate panel with wiring & all other accessories . The panel of SCADA system shall be separate than SAS panels & shall be located in Main Control Room building. The Engineering PC & software of SAS shall be useable for engineering of SCADA system also. Therefore, necessary hardware & software shall be installed here.

Section-II **Mandatory Spares, Erection & Test Equipment**

Supply of complete spares and spare parts of transformer, switchgear, control equipment, protection relays, meters, erection & test equipment as per quantity mentioned in Schedule B. Test equipment is to be supplied from Europe, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.The materials shall have to be handed over to the designated store as per instruction of the Engineer.

Section-III **Shunt Reactor & Associated works**

Deleted

÷

1.3.4 Technical requirement forextension of AIS 132kV bays at Chapainawabganj 132/33kV Substation

Section-I **132 kV AIS Substation**

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

Bus scheme is main and transfer bus.

4ADeleted

4B Deleted

4C **145 kV Outdoor Type Air Insulated Switchgear (AIS), equipment connection and steel structures**

4C1 Two (2) sets of 145 kV, 1600A, 40kA/1s, 50Hz, 650/275 kV BIL, live tank type, SF6 gas circuit breakers with three spring-stored energy operating mechanism.

4C2 Two (2) sest of 145kV, 1600A, 40kA/1s, 50Hz, 650/275 kV BIL, three pole, double break, post type, motor operated disconnectors with motor-operated earthing switches.

4C3 Six (6) sets of 145kV, 1600A, 40kA/1s, 50Hz, 650/275 kV BIL, three pole, double break, post type, motor operated disconnectors without earthing switch.

4C4 Six (6) single-phase, 5-core, multi ratio, 145kV, 40kA/1s, 50Hz, 650/275 kV BIL, post type current transformer with cores as follows:

- 800-1600/1A, Class 0.2S,10VA for Metering 1
- 800-1600/1A, Class 0.2S,10VA for Metering 2 , BCU
- 1600-24001A, Class 5P20, 30VA for Main 1 Protection
- 1600-2400/1A, Class 5P20, 30VA for Backup Protection,
- 2400/1, 5P20, 30VA for Busbar differential and Breaker failure

4C5 Six (6) single-phase, 3-secondary winding, 145kV, 132/V3 / 110/V3 / 110/V3 / 10/V3 kV/V/V/V, 40kA, 50Hz, 650/275 kV BIL, capacitor type voltage transformers.

4C6 Six (6) nos. 145kV, 120kV continuous operating voltage, 102kV MCOV, 10kA nominal discharge current, 50Hz, Heavy duty station class, gapless metal oxide type, single phase surge arresters.

4C7 One (1) lot of flexible conductors (2000 Amp bus),Jumper conductors, insulators and fittings including all necessary clamps and connectors required for completing 132 kV switchgear.

4C8 One (1) lot of Gantry steel structures, for each double circuit of 145kV Transmission Line, equipment supports and Extension of cable tray including all necessary acces-sories required for extension of 132kV switchyard.

4C9 All other necessary material and equipment to complete the 132 kV switchard

4D 36kV Switchgears and Connections with Auto Transformer & Earthing / Auxiliary Deleted

4E Power Transformers & Earthing/Auxiliary Transformers

Deleted

4F Control, Protection, Substation Automation & Metering

230 kV Circuits

Deleted

132 kV Circuits

The existing Substation does not have busbar protection.The new lines (Rahanpur-1&2) willbe hooked to existing Rajshahi & Amnura bay and newly built bay will be

named as Rajshahi & Amnura line. Hence, the new Control & relay panels will be named for Rajshahi & Amnuraline and existing panels will be named for .

One (1) lot of complete equipment for control, protection, alarm and metering panels for 132 system shall be designed, calculated, supplied, delivered, installed, tested and commissioned, under this contract.

The sequence of the control panels and protection panels shall mirror the actual switchyard layout. Space shall be provided adjacent to the control and relay suites for each voltage level to accommodate sufficient panels for the future circuits indicated in the substation layout drawings.

A control panel shall accommodate complete switchgear mimic.132 kV transmission line protection relay panels of Main &backup protection shall be supplied and installed.

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

4F1 Two (02) sets of Control, Monitoring, Protection (Main &Backup) & Substation Automation Functionality including event recording function for overhead line circuit bays.

4F2 Deleted

4F3 Deleted

4F4 Deleted

4F4 One (01) lot of Tariff metering panel (if required) to accommodate programmable & recordable digital 3-phase,4wire import and export MWh and MVArhmeters (accuracy class 0.2) for each 132 kV line and transformer feeders. For each feeder minimum two meters (main & check). Substation Automation System shall include the metering for all the bays. Tariff Metering is to be supplied from Europe, Canada, USA or Japan origin. Printed catalogue, operation and service manual are to be provided.

~~Note: Only on/off monitoring of ES and measuring of bus PT shall be integrated with SAS within the contract price.~~

33kV Station Power System

Deleted

4G DFDR

Deleted

4HPower Cable

Deleted

4I Multicore Cables

4I1 One(1) lot complete set of multicore low voltage 06/1.1kV, XLPE insulated power and

control cables (IEC 60502) shall be supplied, installed, glanded, terminated and have individual cores identified to be used for connection of all equipment supplied under this bay extension work. The overall substation cable routing and core schedules shall also be provided.

4J Earthing and Lightning Protection

4J1 One (1) lot of extension of Design, supply and installation of earthing system, connectors and clamps, with design to suit the substation extension work under this contract arrangement. SAoil resistivity is different for different layer, calculation and GPR shall have to shown using software like Auto Grid pro.

4J2 One (1) lot of extension of design, supply and installation of lightning protection screen including connections, connectors and clamps, with design to suit the substation extension work under this contract arrangement. Supporting calculation shall have to be shown in Rolling sphere mathod.

Required number of Lightning Mast (for switchyard & Building) shall be provided as per DSLP calation during detail design stage.

4K Batteries, Chargers and DC Distribution

4K1 One (01) lot of Extension of existing 110V DC distribution board to provide DC connections to all equipment required for bay extension work under this contract.

The DC distribution board shall be with 50% overall spare switches for future use. The MCBs shall be from USA/Europe/Japan origin

4K2 One (01) lot of Extension of existing 48V DC distribution board to provide DC connection to fiber optic multiplexer equipment for communication, protection to all equipment required for bay extension work under this contract.

The DC distribution board shall be suitable to connect the new fibre optic multiplexer equipment for communication and protection with 50% overall spare switches for future use. The MCBs shall be from USA/Europe/Japan origin

4L LVAC Distribution

4L1 One (1) lot of Extension of LVAC switchboard for 132/33kV substations services to be supplied, installed and commissioned, to provide the 415/240V supplies to all equipment being supplied under this extension work.

All AC status excluding control & protection (AC voltage status for each bus including coupling breaker on/off status, fail with alarm) shall be incorporated in substation automation system. The MCBs shall be from USA/Europe/Japan origin

4L2 Deleted

4M **Civil Works, Building and Foundation**

4M1 Design, supply and construction of Complete Land development with carried/dredged earth filling required for civil construction of bay extension.

4M2 Complete design, supply and construction of all civil items required for extension of bays at 132kV level. The outdoor works shall include filling/cutting of soil and leveling up to finished level and within the property line suitable for switchyard gantry & equipment foundations, Extension of internal roads, cable trenches including soak pit, septic tank, switchyard drainage system including outfall, fences, sentry post, PVC pipes etc., switchyard surface finishing and gravel surfacing etc. shall be included.

4M3 One Lot of design, supply and construction of Horizontal Extension of Control Romm Building (CRB). The size of Existing CRB size is 19.5mx13.5m. 3 meter extension of CRB shall be required parallel to 19.5 meter. Required dismantling work shall have to be performed.

4M4 Deleted

4N **Lighting, Small Power, Air Conditioning and Ventilation**

4N1 Deleted

4N2 One (1) lot of complete set of design, supply, installation and commissioning of equipment to provide lighting (flood light LED type) for security, roadway, switchyard and emergency DC lighting at strategic locations for equipment operation and inspection required only for the bay extension work.

Minimum3 Nos of 5 ton & 2 No.s of 2 ton Air Conditioner with complete system for existing Control Room including the extension part shall be provided. Hoever, if after calculation during execution-stage, the no. of Air Con increases, the contractor shall have to provide the same within the contract price. Lighting & small power fot Control Room shall include LED light & small power outlet for Extented part of Control Room only.

4O **Fibre Optic Multiplexer Equipment for Communication and Protection**

4O1 Multiplexer:

One (1) lot of complete set of design, supply, installation and commissioning of fibre optic multiplexer equipment required for this extension work covering related substation optical interfaces with necessary works to interface with existing system is to be provided for:

- 21(or 87 with built-in 21) relay for each transmission line protection (through fibercores or backup PLC)
- 21 or 87 (built in 21) relay carrier signal (main and back-up)
- SCADA data from switchgear and control system through SAS
- Hot-line telephone system
- Substation LAN system

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

4O2 PABX:

Deleted

4O3 Optical Fiber :

Underground optical fibre cables (48 cores for 230kV, 24 cores for 132kV) from terminal box gantry 132kV double circuit transmission line termination point to MDF (Main distribution structure at each Frame) required for this extension work to be installed in control room. The Contract includes supply and installation of MDF and pigtail cables with adequate length.

4O4 PDH, SDH and ODF:

One (1) set of Extension of PDH / SDH and 24 Core ODF with necessary connection work and testing shall be installed.

4O5 PLC Equipment:

Deleted.

4PSCADA system for Tele-control and Telemetering

One (1) lot of hardware and software to provide telecontrol & telemetering facilities required both at the existing National Load Despatch Centre (NLDC) at Aftabnagar and the back-up station at Biddut Bhaban for integration of **new** 132 kV bays.All required electrical signals shall be transmitted to the NLDC and Back up station through the RTU. All HV circuit 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 and the back-up station are to be carried out

Extension of the existing equipment, necessary adjustment, adaptation, modification, inte gration and configuration of new and existing equipment in **NLDC.**

Scope of work shall include extension of SCADA system in existing Substation with necessary hardwire & software modification in existing RTU/gateway. Supply of IED/transducer, sub-rack with I/O card, CPU, necessary wiring required for MiCOM264 RTU required for the extension work are also included.

Mandatory Spares, Erection & Test Equipment

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

A sample tool list to be submitted for each of the substations is as follows:

Tools List		

Serial No	Name	Quantity
107.	Socket Wrench Set	1 Set
108.	Adjustable Wrench Set wiith Grip (6”,8”,12”,15”)	1 Set
109.	Ratchet Wrench Set	1 Set
110.	Open-endWrench Set	1 Set
111.	Ring/Ball Wrench Set	1 Set
112.	Pipe Wrench (12”,18”,24”,	1 Set
113.	Allen Key Set	1 Set
114.	Hammer (1lb & 2lb)	1 Set
115.	Plier, 8 inch	1 No.
116.	Cutting Plier, 8 inch	1 No.
117.	Nose Plier, 8 inch	1 No.
118.	Screw Driver Set	1 Set
119.	Screw Driver (Star and Flat Big)	1 Set
120.	File (Flat)	1 No.
121.	File (Round)	1 No.
122.	Hakso Frame with blade	1 No.
123.	Safety Belt	4 Nos
124.	Ladder (Aluminium)	2 Nos.
125.	Helmet	6 Nos.
126.	Gas Cylinder Pipe Set	1 Set
127.	Multimeter (Fluke/Megger)	2 Nos
128.	Bucket	2 Nos.
129.	Shabol	2 Nos.
130.	Coppa	2 Nos
131.	Rope	200 m
132.	Duur Metal Box	1 No.
133.	Grinding Machine	1 No.
134.	Blower Machine	1 No.
135.	Mechanical Jug	1 No.
136.	Compressor Jug	1 No.
137.	Wire Cutter	1 No.
138.	Steel Cutter	1 No.
139.	Chain Pulley (2 Ton)	1 No.
140.	Vice Set	1 No.
141.	Drill Machine	1 No.
142.	Crimping Tools	1 No.
143.	Lug Puncher	1 No.
144.	Steel Wire Brush	2 No.
145.	Blade type Knife	2 Nos.
146.	Wire Stripper	1 No.
147.	Grass Trimmer	1 No.
148.	Drill Bits	1 Set
149.	Tool Box	1 No.
150.	Hand Gloves (Leather)	1 No.
151.	Vacuum Cleaner	1 No.
152.	Chisel	1 No.

153.	Tester	1 No.
154.	Rivet Gun	1 No.
155.	PIB Tape, 1”	3 Nos.
156.	PVC Tape	4 Nos
157.	Steel Wire Brush	3 Nos.
158.	Chisel	2 Nos.
159.	Measuring Tape	1 No.

Refer to the BOQ for detail of other spares, testing kit, tools etc.
For Tools set, STANLEY, USA is preferable.

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

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

- New 400/230 kV Gas Insulated Substation **at Bogura (West)**
- New 400/132 kV Gas Insulateds Substation at **Rahanpur (Chapainawabganj)**
- Upgradation of 400/132 kV Substation **at Gopalganj to 400/230kV Substation**
- Extension of existing 132kV bays at 132/33 kV Substation at **Chapainawabganj**

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

- SCADA for data exchange between the substations and the National Load Despatch Centre (NLDC) by two communication technologies i.e. LAN&WAN
- Tele-protection to enable the communication between line differential protection relays and between distance protection relays,
- Telephone to enable telephone communication between the substations and NLDC,
- Metering: Data transfer between meters and the entity in charge of collecting and processing metering data,
- Any other telecommunication channels.

1.4.1 Recommendation of Communication System

Telecom equipment (Optical Transmission and ADD/DROP MUX)

- STM-1/4/16/64 / 10G or 100G / DWDM
  - MPLS (Layer-3)
- ADD/DROP Multiplexer (PDH)

Services:

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

NMS:

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

- DCN Channel management

Existing equipment and facilities in PGCB Telecommunication Network

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

Services:

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

NMS :

- FOXMAN-UN/U-2000
  - End-to-End Trail management
  - Protection management (I+I MPS, MSSP RING, SNCP, SNCPM)
  - Clock management
  - DCN Channel management

1.4.2 Architecture of the Overall Telecommunication System

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

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

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

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

- **SDH Telecommunication System**

1.4.3 Scope of Work and Supply

The scope of work and supply of the telecommunication system:

- One (1) optical fibre cable from the gantry of each of 400kV, 230 kV and/or 132 kV OHL to the substation communication room, including 48 cores and non-metallic (underground) but with the same optical characteristics with the OPGW (compliant to ITU-T-G 655 recommendation), shall be provided, for each of 400kV, 230 kV and/or 132 kV OHL at every involved Substation

- One (1) Optical Distribution Frames (ODF), of 48 cores capacity each, shall be provided, for each of 400kV, 230 kV and/or 132 kV OHL at every involved Substation. ODF shall be installed in the telecommunication / control room to facilitate the termination of fibres, testing and isolating of both the optical fibre cable and fibre optic terminal equipment.

- Optical SDH & PDH multiplexers shall be provided for each involved Substation, including:
  - Duplicate CPU
  - Duplicate power supply
  - Oneoptical STM-16 ports for each 400 kV transmission line
  - Oneoptical STM-4/16 ports for each 230 kV transmission line
  - Oneoptical STM-1/4 ports for each 132 kV transmission line
  - One 16x2 Mbps (E1) drop card
  - One 8x2 Mbps (E1) elect. Card
  - One card with four ports 10/100 Base T LAN
  - One card with four ports 10/100 Base T Router
  - One card with 20x2-w voice for FXS
  - Required no. of cards with 4x4 commands for distance protection after detail design

- The optical SDH & PDH multiplexer shall be preferably of ABB FOX 515/FOX 615 type to ensure fully integration with existing FOX 515/FOX 615 and MSE 5001/MSE 5010 (DXC 500) to existing MSE 5001/MSE 5010 (DXC 500).
- Depending of the length of each 400kV, 230 kV and/or 132 kV one or two optical boosters may be required.

1.4.4 Engineering Services

General

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

Design Services

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

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

- design of all works required for the implementation and extension of the telecommunication system, general layouts of the telecommunication system, engineering of telecommunication system, all necessary calculations.

These engineering services shall also include:

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

1.5 Terminal Points

1.5.1 Transmission Line Circuit Connections

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

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

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

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

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

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

1.5.2 Communication and SCADA Equipment

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

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

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

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

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

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

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

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

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

Schedule B: Bid Prices & Schedules

General

1. The Price Schedules are divided as follows:

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

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

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

Pricing

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

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

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

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

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

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

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

Notes

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

Schedule B: Schedules of Rates and Prices

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

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

Schedule No. B3: Design Services

Schedule No. B4: Installation and Other Services

Schedule No. B5: Grand Summary

Schedule No. B6: Recommended Spare Parts

Please see the separate Excel file for the above.

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

Please use the attached excel file

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

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

3.1 Times for Delivery and Completion

The individual dates are all contractually binding.

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

Construction Schedule exceeding 24 months shall be rejected.

The following dates shall be from the commencement date of the Contract.

Key dates to be provided as follows.

E - Target completion dates planned by the Contractor

D - Construction (delivery, erection and commissioning) date guaranteed by the Contractor.

C - Shipping completion dates guaranteed by the Contractor.

B - Date of arrival of first shipment guaranteed by the Contractor.

A - Earliest date by which access is required by the Contractor.

Site/Descriptions	A Earliest Access Permitted Months	B Months	C Months	D Months	E Months
400/230kV Bagura GIS SS (1) Civil works (2) 400kV GIS (3) 230kV GIS (4) 400/235/34.5kV AutoTransformer (5) 33kV Switchgear (6) 400kV BUS Reactor (7) SAS (8) Protection (9) AC/DC					

Site/Descriptions	A Earliest Access Permitted Months	B Months	C Months	D Months	E Months
(10) Tel/SCADA					
<u>400/132kV Rahanpur GIS SS</u> (1) Civil works (2) 400kV GIS (3) 132kV GIS (4) 400/135/34.5kV AutoTransformer (5) 33kV Switchgear (6) 400kV BUS Reactor (7) SAS 8) Protection (9) AC/DC (10) Tel/SCADA					
<u>400/230kV Gopalganj AIS SS</u> (1) Civil works (2) 400kV AIS Equipment (3) 230kV AIS Equipment (4) 400/235/34.5kV AutoTransformer (5) 33kV Switchgear (6) SAS 8) Protection (9) AC/DC (10) Tel/SCADA					
<u>132/33kV Chapainawabganj AIS SS</u> (1) Civil works (2) 132kV AIS Equipment (6) Automation 8) Protection (9) AC/DC (10) Tel/SCADA					

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

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

Manufacturers

The following Manufacturers are proposed for carrying out the facilities:

Item	Equipment	Type of Equipment	Manufacturer's Name and Address	Place of Manufacture and Testing	Nationality
1.Power Transformer					
1.1.	Auto transformer 400/235/34.5 kV				
i.	Complete				
ii.	Tap Changer				
iii.	Bushing: HV/LV/TV/NV				
iv.	Silicon Core				
v.	Copper Winding				
vi.	Winding Insulation Material				

vii.	Oil				
viii.	Tank				
ix.	Radiator				
x.	Fan				
xi.	Motor				
xii.	Temperature Indicator				
xiii.	PRD				
xiv.	Oil Valve				
xv.	Silica Gel				
xvi.	Gas/Oil actuated relay				
xvii.	AVR				
xviii.	Indicating Instruments				
xix.	Cooler control Equipment				
xx.	Remote control panel				
xxi.	Magnetic Shunt				
xxii.	Clamp				
1.2.	Auto transformer 400/135/34.5 kV				
i.	Complete				
ii.	Tap Changer				

iii.	Bushing: HV/LV/TV/NV				
iv.	Silicon Core				
v.	Copper Winding				
vi.	Winding Insulation Material				
vii.	Oil				
viii.	Tank				
ix.	Radiator				
x.	Fan				
xi.	Motor				
xii.	Temperature Indicator				
xiii.	PRD				
xiv.	Oil Valve				
xv.	Silica Gel				
xvi.	Gas/Oil actuated relay				
xvii.	AVR				
xviii.	Indicating Instruments				
xix.	Cooler control Equipment				
xx.	Remote control panel				
xxi.	Magnetic Shunt				

xxii.	Clamp				
2.Shunt/Bus Reactor					
i.	Complete				
ii.	Bushing HV/NV				
iii.	Copper Winding				
iv.	Winding Insulation Material				
v.	Porcelain for insulators				
vi.	Core plates				
vii.	Radiators				
viii.	Reactor Oil				
ix.	Oil valves				
x.	Tank				
xi.	Temperature Indicator				
xii.	PRD				
xiii.	Oil Valve				
xiv.	Gas/Oil actuated relay				
xv.	Remote control panel				
xvi.	Indicating Instruments				

Auxiliary Power Transformer					
2	Auxiliary power transformer 33/0.4 kV				
420 kV Equipment					
3.1.	400kV GIS				
	GIS 400 kV Complete				
	Enclosure				
	SF_6				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnector				
	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
3.2.	400kV AIS				
3.2.1	Circuit breakers 400 kV				
	Drive Mechanism				
	Interrupter Chamber				
	Insulator				
3..2.2	Disconnectors 400 kV				
	Drive Mechanism				

	Male-Female Contact				
	Insulator				
3..2.3	Current transformers 400 kV				
	Core				
	Winding				
	Insulator				
3.2.4.	Voltage transformers 400 kV				
	Core				
	Winding				
	Insulator				
3.2.5	Surge arresters 400 kV				
	ZnO Resistor Block				
	Housing				
	Surge Counter				
4. 245 kV Equipment					
4..1.	230kV GIS				
	GIS 230 kV Complete				
	Enclosure				
	SF_6				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnector				

	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
4.2	230kV AIS				
4.2.1	Circuit breakers 230 kV				
	Drive Mechanism				
	Interrupter Chamber				
	Insulator				
4..2.2	Disconnectors 230 kV				
	Drive Mechanism				
	Male-Female Contact				
	Insulator				
4..2.3	Current transformers 230 kV				
	Core				
	Winding				
	Insulator				
4.2.4.	Voltage transformers 230 kV				
	Core				
	Winding				
	Insulator				
4.2.5	Surge arresters 230 kV				
	ZnO Resistor Block				

	Housing				
	Surge Counter				
5. 145 kV Equipment					
5..1.	132kV GIS				
	GIS 132 kV Complete				
	Enclosure				
	SF_6				
	Support Insulator				
	Barrier Insulator				
	Pressure Monitor				
	Circuit breaker				
	Disconnector				
	Earth Switch				
	High Speed Earth Switch				
	Current Transformer				
	Voltage transformer				
	Surge Arrester				
5.2	132kV AIS				
5.2.1	Circuit breakers 132 kV				
	Drive Mechanism				
	Interrupter Chamber				
	Insulator				
5..2.2	Disconnectors 132 kV				

	Drive Mechanism				
	Male-Female Contact				
	Insulator				
5..2.3	Current transformers 132 kV				
	Core				
	Winding				
	Insulator				
5.2.4.	Voltage transformers 132 kV				
	Core				
	Winding				
	Insulator				
5.2.5	Surge arresters 132 kV				
	ZnO Resistor Block				
	Housing				
	Surge Counter				
6. 33 kV Equipment					
6.1.	Circuit breakers 33 kV				
6.2.	Disconnectors 33 kV				
6.3.	Current transformers 33 kV				
6.4.	Voltage transformers 33 kV				
6.5.	Surge arresters 33 kV				
10. Control, Protection, and Metering Equipment					
7.1	Control & monitoring equipment				

7.2	Relay protection equipment				
7.3.	Control & protection panels				
7.4.	Metering equipment				
7.5.	Metering panels				
7.6	Auxiliary Switches				
7.7.	Auxiliary Relays				
7.8.	Trip Relays				
7.9.	TCS Relays				
7.10.	Relay Test Block				
7.12	Humidity Sensor				
8.Substation Automation System					
8.1	Bay Control Unit				
8.2	Industrial Server				
8.3	Server Processor				
8.4	Firewall				
8.5	Gateway Server				
8.6	GPS system				
8.7	Ethernet Switch				
8.8	Modem				
8.9	LCD Monitor				
8.10	Monitor & Keyboard				
8.11	Printer				
8.12	55” LCD Monitor				

8.13	Cables (FO, EC,CC)				
9.Digital Fault & Disturbance Recorder					
9.1	Control Card				
9.2	Data Acquisition material				
9.3	Panel				
9.4	Processor				
9.5	Copper cable				
9.6	Fiber optic Cable				
9.7	Laptop				
10.Telecommunication Equipment					
10.1	Communication equipment				
10.2	Multiplexer				
10.3	Fiber Optic cable				
10.4	PLC Communication				
10.5	Complete				
10.6	Panel				
10.7	Line matching Unit				
10.8	Surge arrester				
10.9	Wave Trap				
11.XLPE Cable & Cable Termination Kit					
11.1	400kV	NA			
11.2	230kV	NA			
11.3	132kV	N/A			

11.4	33kV				
11.5	Cable Sealing End				
12.Auxiliary Power Supply Equipment					
12.1	ACU battery				
12.2	Charger				
12.3	DC distribution Panel & Switch-board				
12.4	AC distribution Panel & Switch-board				
12.5	Inverter				
13.Conductors, Insulators & Fittings					
13.1.	Conductors				
	Tubular Conductor				
	Flexible Conductor				
	Fittings & Clamps				
13.2.	Insulators				
	Post Insulator				
	Disk Insulator				
13.3.	Fittings& Clamps				
14. Earthing & Lightning					
14.1	Copper Conductor				
14.2	Earthing Wire				
15. Multicore LV Auxiliary Power and Control Cables					
15.1	LV Cables				
15.2	Cable Trays				

Name of Bidder:
Signature of Bidder:

5. Schedule E

TECHNICAL PARTICULARS AND GUARANTEES

5.1 PART 1 – SWITCHGEAR

5.1.1 HV OUTDOOR TYPE GAS INSULATED SWITCHGEAR (GIS)

Sl. No.	Description	Unit		Bidder's Data	
			420kV	245kV	145kV
1.	**Type of designation** **Manufacturer's name & address** **Enclosure:** **Busbar** **Bay** **Enclosure Material** **Standard**				
2.	**Electrical data** **Rated Voltage** **Rated power frequency withstand voltage (rms value 1 min.)** - **phase to earth** - **phase to phase** - **across open isolator** - **across open gap c.b.** **Rated lightning impulse withstand voltage** - **phase to earth** - **phase to phase** - **across open isolator** - **across open gap c.b.** **Rated frequency** **Rated continuous current at 40 °C ambient temperature** - **Busbar and bus coupler** - **Line bay** - **Transformer bay** **Rated short time withstand current for 3 sec.** **Rated peak withstand current**	 **kV** **kV** **kV** **kV** **kV** **kV** **kV** **kV** **Hz** **A** **A** **kA** **kA**			
3.	**Secondary circuits** **Auxiliary voltages:** - **for controlling and signalling** - **for remote control** - **for heating** - **tolerance**	 **V** **d.c.** **V** **d.c.**			

		V **a.c.** **%**			
4.	**Solid insulator** **Type of solid insulators** **Material of solid insulator** **Discharge level at 110% of the rated voltage** **Gas tight disc type insulator** - **Bursting pressure** - **Routine test pressure**	 **pcs.** **bar** **bar**			
5.	**Insulation medium** **Insulation medium** **Max. permissible moisture content** **Max. permissible air content**	 **ppm** **Vol %**			
6.	**Gas compartments** **No. of gas compartment per feeder** **(line feeder without busbars, standard configuration)** **Max. gas losses per gas compartment and year** **Min. operating period to 1 recharge of SF6 gas** **Material of filter employed for moisture absorption** **SF6 filling pressure at 20 °C ambient temp.** **Min. SF6 service pressure at 40 °C ambient temp.** **Min. SF6 service pressure at -25 °C ambient temp.** **Type of gas monitoring** **Signal: "Loss of SF6 Gas" at 20 °C ambient temp.** **Signal: "Min. SF6 Density" at 20 °C ambient temp.** **Type of pressure relief device** **Material of pressure relief device** **Setting of pressure relief device**	 **pcs.** **%** **year** **bar** **bar** **bar** **bar** **bar** **bar**			
7.	**Enclosure** **Mechanical strength of enclosure** - **Design pressure** - **Min. bursting pressure** **Temperature rise of enclosure at rated current** - **which have to be touched during normal operation** - **which need not be touched during normal operation** - **which are not accessible to the operator**	 **bar** **bar** **K** **K** **K**			
8.	**Circuit Breaker**				

	Enclosure **Enclosure material** **Material of Contracts** **No. of breaks per phase** **Rated continuous current at 40 °C ambient temp. (bus coupler feeder)** **Rated short time breaking current** **Rated peak withstand current** **Percentage d.c. component** **First-pole-to-clear-factor** **Rated breaking current, small capacitive currents** - **line charging** - **cable charging** - **capacitor bank** **Rated breaking current, small inductive currents** - **unloaded transformers** - **transformer loaded with reactor** - **shunt reactors** **Switching overvoltage**	**pcs.** **A** **kA** **kA** **%** **A** **A** **A** **A** **A** **A** **p.u.**			
	Operating mechanism **Autoenclosure** **Operating mechanism** - **for closing** - **for opening** **Making coil** - **number per operating mechanism** - **rated power each** **Tripping coil** - **number per operating mechanism** - **rated power each** - **voltage tolerances** **Rated motor voltage** **Rated motor power** **Auxiliary contacts** - **number (NC/NO/wiping)** **Rated operating sequence (O-t-CO-t'-CO)** - **t** - **t'** **Max. closing time** **Max. dead time** **Max. break time** **Max. arcing time** **Pre insertion resistor** - **Closing resistor** - **Pre insertion time**	**pcs.** **W** **pcs.** **W** **%** **V** **d.c.** **W** **pcs.** **sec** **min** **ms** **ms** **ms** **ms** **ohm** **ms**			

9.	**Disconnector** **Enclosure** **Enclosure materials** **No. of breaks i series (per phase)** **Gas quantity (3-phase) for isolator** **Rated continuous current at 40 °C ambient temp. (bus coupler / feeder)** **Rated breaking current (capacitive)** **Operating mechanism** - **for closing** - **for opening** **Max. operating time** - **for closing** - **for opening** **Auxiliary contacts** - **number (NC/NO/wiping)** **Rated motor voltage** **Rated motor power** **Hand operating facilities**	**pcs.** **kg** **A** **A** **sec** **sec** **pcs.** **V** **d.c.** **W**			
10.	**Maintenance Earthing Switch** **Enclosure** **Enclosure materials** **Gas quantity (3 phase) for isolator** **Operating mechanism** - **for closing** - **for opening** **Max. operating time** - **for closing** - **for opening** **Auxiliary contacts** - **number (NC/NO/wiping)** **Rated motor voltage** **Rated motor power** **Hand operating facilities**	**kg** **sec** **sec** **pcs.** **V** **d.c.** **W**			
11.	**High speed earthing switch** **Enclosure** **Enclosure materials** **Gas quantity (3 phase) for isolator** **<u>Electrical data:</u>** **Rated current** **Rated capacitive breaking current (at 6 kV eff.)** **Rated inductive breaking current (at 10 kV eff.)** **<u>Operating mechanism</u>** - **for closing**	**kA** **A** **A**			

	- for opening max. charging time max. operating time - for closing - for opening Auxiliary contacts - number (NC/NO/wiping) Rated motor voltage Rated motor power Hand operating facilities	 sec ms ms pcs. V d.c. W			
12.	SF6 to Air Bushing Manufacturer Enclosure Enclosure materials Flashover distance Creepage distance	 mm mm			
13.	Gas Insulated Current Transformers (a) Transformer bay CT ratio Accuracy class Output (b) Overhead transmission line bay CT ratio Accuracy class Output (c) Bus coupler bay CT ratio Accuracy class Output	 Amp. VA Amp. VA Amp. VA			
14.	Gas Insulated Voltage Transformers Ratio Burden Accuracy Class	 kV VA			
15.	Circuit Breaker Control Cubicle Material Material thickness Dimensions - Depth - Width - Height	 mm mm mm mm			

16.	**Separate Local Control Cubicle** **Material (Steel)** **Material thickness (1.5)** **Dimensions** - **Depth** - **Width** - **Height (2,200)** **Total weight**	 **mm** **mm** **mm** **mm** **kg**			

5.1.2 HV OUTDOOR AIR INSULATED SWITCHGEARS (AIS)

1.2.1 CIRCUIT BREAKERS

Sl. No.	**Description**	**Unit**	**Bidders Data**			
			420kV	245kV	145kV	36kV
1	Manufacturer					
2	Type Reference (Manufacturer's designation)					
3	Number of Poles					
4	Rated Voltage					
5	Rated frequency					
6	Rated normal current at 40℃Ambient Temperature -Main busbar/ Diameter /transformer/line/shunt reactor	A				
7	Rated breaking currents: Line charging Cable charging Small inductive	kA rms				
8	Rated short-circuit breaking current	kArms				
9	First pole to clear factor					
10	Rated transient recovery voltage for terminal faults if other than standard	kV				
11	Rated characteristics for short-line faults					
12	Rated short-circuit making current	kA				
13	Rated duty cycle					
14	Rated duration of short-circuit	s				
15	Rated out of phase breaking current	kA				
16	Rated opening time	ms				
17	Rated break time	ms				

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
18	Rated closing time	ms				
19	Maximum arcing time of any duty cycle to IEC 62271-100	ms				
20	Is circuit-breaker re-strike free	Yes/No				
21	Test Authority					
22	Test Certificate ref.					
23	Rated short time withstand current	kA				
24	Rated duration of short-circuit	s				
25	Rated peak withstand current	kA				
26	Rated insulation levels:-					
26.1	Lightning impulse withstand to earth	kV pk				
	(wave shape 1.2/50µs)					
26.2	Lightning impulse withstand across open	kV pk				
	contacts (wave shape 1.2/50µs)					
26.3	Power frequency voltage withstand to earth	kV rms				
26.4	Power frequency voltage withstand across open contacts	kV rms				
27	Rated supply pressure of gas for interruption	MPa (g)				
28	Limits for correct operation max min	 MPa (g) MPa (g)				
29	Frequency of operation	yr^{-1}				
30	Operating mechanism Manufacturer					
31	Mechanism Type:					
32	Trip free/or fixed trip					
33	Is lockout facility fitted?					
34	Closing supply Volts max/min Amps	 V A				
35	Rated supply voltage of shunt opening release	V				
36	Current required at rated supply voltage to open circuit-breaker	A				
37	Spring charging/ Hydraulic motor - Current - Voltage AC/DC	 A V				

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
38	Number of auxiliary switch contacts - normally open - normally closed - adjustable					
39	Other auxiliary loads: Voltage: Current:					
40	Degree of Protection for (a) auxiliary circuits (b) moving parts					
41	Minimum clearances in air: (a) between phases (b) phases to earth (c) across interrupters (d) live parts to ground level	 mm mm mm mm				
42	Minimum creepage (a) to earth (b) across interrupter terminals	 mm mm				
43	Radio interference voltage	µV				
44	Guaranteed maximum gas leakage	% per annum				
45	Number of interrupters per pole					
46	Material of interrupter chamber					
47	Wall thickness of interrupter chamber	mm				
48	Material of contact surfaces primary arcing					
49	Length of each break	mm				
50	Length of stroke	mm				
51	Operating rod for moving contact(s) material-dimensions, etc.					
52	Weight of circuit-breaker unit complete	kg				
53	Maximum shock load imposed on floor or foundations when opening under fault conditions (state whether tension or compression)	kg				
54	Quantity of gas in complete three-phase circuit breaker					
55	Maximum pressure rise in circuit breakers due to the making or breaking of rated current					
56	Routine pressure test on circuit-breaker tanks or containers					

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
57	Pressure type test on circuit-breaker tanks or containers					
58	Interrupting gas pressure at 20°C Normal					
59	Limits of gas pressure at 20°C Maximum Minimum					
60	Period of time equipment has been in commercial operation					
61	Number of the same type of circuit breakers supplied to date					
62	Pre insertion Resistor(PIR) for 400kV	OHM				
63	In case of CSD (Control Switching Device)					
63.1	Manufacturer's name and address					
63.2	Country of origin					
63.3	Type					
63.4	Model No.					
63.5	Standard					
63.6	Operation voltage	V				

1.2.2 DISCONNECTORS AND EARTHING SWITCHES

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
1	Manufacturer					
2	Type Number					
3	Operating type					
	(a) horizontal/vertical break					
	(b) Number of support insulation for pole					
	(c) Number of breaks per pole					
	(d) Material of contact surfaces					
	(e) Type of Contacts					
4	Rated normal currentat 40℃Ambient Temperature for Disconnectors ; -Main busbar/ Diameter /transformer/line/shunt reactor	A				
5	Rated short time withstand current	kA, rms				

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
6	Rated duration of short time current	s				
7	Rated peak withstand current	kA pk				
8	Rated insulation levels:					
8.1	Lightning impulse withstand to earth (wave shape: 1.2/50µs)	kV pk				
8.2	Lightning impulse withstand across open contacts (wave shape: 1.2/50µs)	kV pk				
8.3	Power frequency voltage withstand to earth	kV rms				
8.4	Power frequency voltage withstand across open contacts	kV rms				
9	Method of operation					
10	Type of operating mechanism manual/power					
11	Operating power					
12	Voltage rated max min	V V V				
13	Consumption electric	A				
14	Operating time: open max min	ms ms				
15	Operating time: close max min	ms ms				
16	Manual operating torque	kNm				
17	Load switching capability	A				
18	Mechanical Terminal Load	N				
19	Insulator Creepage	mm				
20	Radio interference voltage	mV				
21	Number of auxiliary switches - normally open - normally closed - adjustable					
22	Other auxiliary loads - voltage - current					
23	Mechanical endurance:					
	Number of operations carried out for mechanical operation test					

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
24	Degree of protection for 1) auxiliary circuits 2) moving parts					
25	Total weight of three pole disconnector complete	kg				
26	Type test certificate date/reference					
27	Period of time equipment has been in commercial operation					
28	Number of the same type of disconnectors supplied to date					

1.2.3 CURRENT TRANSFORMERS

Sl. No.	Description	Unit	Bidders Data			
			420kV	245kV	145kV	36kV
1	Manufacturer/type					
2	Rated primary current	A rms				
3	Rated secondary current	A rms				
4	Rated frequency	Hz				
5	Highest voltage for equipment	kV				
6	Rated insulation level - primary winding	kV				
7	Lightning impulse withstand	kV pk				
8	(a) Power frequency withstand (dry) (b) Power frequency withstand (wet)	kV rms kV rms				
9	Insulator creepage (phase to earth)	mm				
10	Electrical dissipation factor at power frequency test voltage					
11	Radio influence voltage measured at U/√3 1 MHz	µV				
12 13	Rated short term thermal current for 1s Rated short term thermal current for 3s	A rms A rms				
14	Rated dynamic current	kA pk				
15	Insulation class					
16	Number of secondary windings					
	Location of core					
	Core 1 Rated output Accuracy class * Accuracy limit factor					
	Core 2 Rated output Accuracy class * Accuracy limit factor					
	Core 3 Rated output Accuracy class * Accuracy limit factor					
	Core 4 Rated output Accuracy class * Accuracy limit factor					
	Core 5 Rated output Accuracy class * Accuracy limit factor					
	Class x winding: - Rated knee point emf - Exciting current *including instrument security factor where applicable	 V A				
17	Is earth screen fitted between primary and secondary windings					
18	Type test certificate ref/date					

1.2.4 VOLTAGE TRANSFORMERS

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
1	Manufacturer	-				
2	Type No.	-				
3	Transformer type	-				
4	Rated primary voltage	kV rms				
5	Rated secondary voltage for each secondary winding	kV rms				
6	Accuracy class for each winding Rated output for each winding Rated volt-ampere rating for each winding	 VA VA				
7	Rated voltage factor					
8	Type of Insulation					
9	Maximum temperature rise	°C				
10	Short-circuit withstand capability	kA rms				
11	Primary insulation					
11.1	Lightning impulse withstand dry	kV pk				
11.2	(a) Power frequency withstand wet (b) Power frequency withstand dry	kV rms kV rms				
12	Partial discharge magnitude	pC				

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
13	Total external creepage distance	mm				
14	Radio influence voltage measured at 11 Um/√3 at 1 MHz	µV				
15	Total installed weight	kg				
16	Capacitor					
16.1	High voltage capacitor (C1)	pF				
16.2	Intermediate - voltage capacitor (C2)	pF				
16.3	Total Capacitor (C_n)	pF				
17	Open circuit intermediate voltage	kV				
18	Rated open-circuit intermediate voltage	kV				
19	Reference range of frequency	+/- Hz				
20	Reference range of temperature	^oC				
21	Protective device to limit overvoltage					

1.2.5 CAPACITOR VOLTAGE TRANSFORMERS

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
1	Manufacturer	-				
2	Type No.	-				

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
3	Transformer type	-				
4	Rated primary voltage	kV rms				
5	Rated secondary voltage for each secondary winding	kV rms				
6	Accuracy class for each winding Rated output for each winding Rated volt-ampere rating for each winding	 VA VA				
7	Rated voltage factor					
8	Type of Insulation					
9	Maximum temperature rise	°C				
10	Short-circuit withstand capability	kA rms				
11	Primary insulation					
11.1	Lightning impulse withstand dry	kV pk				
11.2	(a) Power frequency withstand wet (b) Power frequency withstand dry	kV rms kV rms				
12	Partial discharge magnitude	pC				
13	Total external creepage distance	mm				

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
14	Radio influence voltage measured at 11 Um/√3 at 1 MHz	µV				
15	Total installed weight	kg				
16	Capacitor					
16.1	High voltage capacitor (C1)	pF				
16.2	Intermediate - voltage capacitor (C2)	pF				
16.3	Total Capacitor (C_n)	pF				
17	Open circuit intermediate voltage	kV				
18	Rated open-circuit intermediate voltage	kV				
19	Reference range of frequency	+/- Hz				
20	Reference range of temperature	^oC				
21	Protective device to limit overvoltage					

1.2.6 SURGE ARRESTERS

Sl. No.	Description	Unit	Bidder's Data			
			420kV	245kV	145kV	36kV
1	Manufacturer					
2	Model Number					
3	Type:					
4	Continuous operating voltage	kV rms				

5	Rated voltage	kV rms				
6	Standard nominal discharge current	kA				
7	Reference current at ambient temperature	mA				
8	Reference voltage for above	kV rms				
9	Steep current impulse residual voltage	kV pk				
10 11	Lightning impulse residual voltage at 5kA 10kA 20kA Duty Class	 kV pk kV pk kV pk				
12	Discharge class					
13	Pressure relief class					
14	Nominal diameter of resistor blocks	mm				
15	Number of resistor blocks connected electrically in parallel					
16	Number of separately housed units per phase					
17	Overall height of arrester (without supporting structure)	m				
18	Overall height of arrester including grading ring if applicable	mm				
19	Clearances: phase to earth (from centre line) phase to phase (centre line to centre line)	 mm mm				
20	Overall Weight of arrester (without supporting structure)	kg				

21	Maximum cantilever strength	Nm				
22	Maximum force due to wind (at maximum specified gust speed)	Nm				
23	Minimum creepage distance over insulator housing	mm				
24	Insulator shed profile - Reference Document					
25	Terminal palm details - Drawing No.					
26	Earthing terminal - Drawing No.					
27	Type & Description of surge monitoring device					
28	Type test certificate ref/date					
29	Number of the same type of surge arresters supplied to date					

5.2 PART 2 – TRANSFORMERS&BUS REACTOR

5.2.1 400/235/34.5 KV, 525/750 MVA, THREE PHASE AUTOTRANSFORMER:

Sl. No.	Description	Unit	Bidder's data
1.1	Name of the Manufacturer		
1.2	Type/Model		
2.1	Continuous Rating - ONAN ONAF		
2.2	Voltage ratio at no-load HV/LV	kV	
3	Tap Changer		
3.1	HV Tap Changer (On load type) TappingRange		
3.2	Size of tapping step		
3.3	No. of Steps		
4	Vector Group		
5	On-load voltage control equipment:		
	(A) Type. (B) Manufacturer (C) Range (D) Size of steps	 % %	

Sl. No.	Description	Unit	Bidder's data
	(E) Power frequencywithstand test voltage (BS.4571) - between first and last contactsof the selectorswitch - between any two adjacentcontacts of the selector - between open diverterswitch contacts (F) Type test certificatereference		
6	Type of cooling		
7	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	°C	
8	Top oil temperature under service conditions stated in Schedule of Technical Requirement (A) CMR (B) ONAN rating	 °C °C	
9	Maximum hot spot temperature rise in core at rated power	°C	
10	Maximum hot spot temperature rise in copper at rated power	°C	
11	Temperature gradient at rating specified	°C	
12	Flux density in iron at normal voltage and		

Sl. No.	Description	Unit	Bidder's data
	frequency and at normal ratio - (no load) (A) Cores (B) Yokes (C) Volts/turn	 Tesla Tesla V	
13	Magnetising current (approx) at nominal ratio and at 0.9 x nominal voltage at 1.0 x nominal voltage at 1.1 x nominal voltage at 1.2 x nominal voltage	 % % % %	
14	Harmonic component of magnetising current at rated voltage as percentage of fundamental (A) Fifth harmonic (B) Seven harmonic	 % %	
15.1*	No-load loss (excluding cooling plant losses) at rated voltage, ratio and frequency	 kW	
15.2*	Grain Oriented Electrical Steel used: Steel Manufacturer Steel Grade Core Loss at W17/50 Irradiation method	 Name Grade Wats/kg	 (should be less than or equal to 0.85) (Laser beam or Plasma jet)
16*		kW	

Sl. No.	Description	Unit	Bidder's data
	Copper loss (excluding cooling plant losses) at 75°C and at rated voltage, ratio (nominal tap),frequency		
17*	Auxiliary loss (Total power input to fans for operation of total installed cooling capacity)	kW	
18	Total loss at 75°C and normal ratio(Sl. No.15+16+17)	kW	
19	Regulation at 75°C and normal ratio - (A) At unity power factor % (B) At 0.8 lagging power factor	% %	
20	Short circuit impedance corrected to reference temperature of 75°C at rated frequency and rated power i) HV - LV, on the basis of CMR with onload tapchanger at - highest tap nominal tap lowest tap ii) HV - TV, on the basis of CMR with onload tapchanger at nominal tap iii) LV - TV, on the basis of CMR with onload tapchanger at nominal tap	 % % % % %	
21	Equivalent circuit zero		

Sl. No.	Description	Unit	Bidder's data
	sequence impedance: HV-LV	 %	
22	Maximum current density in windings at C.M.R. (A) HV winding (B) LV winding (C) TV winding	 A/mm^2 A/mm^2 A/mm^2	
24	Noise level	dB	
25	Types of transformers (shell or core)		
26	Core steel (a) Type (b) Grade		
27	Types of winding - (A) HV (B) LV (C) TV		
28	Insulation of (a) HV windings (b) LV windings (c) TV winding		
29	Insulation of - (A) Yoke bolts (B) Side plates		
31	Safe working temperature of core plate insulation	 °C	
32	Winding connections brazed or crimped		
33			

Sl. No.	Description	Unit	Bidder's data
	For fault with zero impedance external to the transformer and infinite system (a) Maximum axial force (b) Maximum tensile stress in winding	 kN N/m^2	
34	Is facility provided for adjustment of axial pressure on windings	Yes/No	
35	Thickness of transformer tank (A) Sides (B) Bottom	 mm mm	
36	Material used for gaskets for oil tight joints		
	Radiators, Valves, Fans		
37	Thickness of radiator plates	mm	
38	Valve type/material: (A) 100mm and below (B) Above 100mm		
39	Equipment for ONAF + cooling state (A) - (A) Radiators on main tank		
40	Number of coolers/radiators or cooler banks per transformer		
41	Number of air blowers per transformer		
42	Speed of air blowers	rpm	

Sl. No.	Description	Unit	Bidder's data
43	Rating of each air blower motor	kW	
44	Starting current of each air blower motor	A	
	Oil Volumes and Weights		
45	Total oil required including cooler system	litres	
46	Volume of oil to fill transformer to above the top yoke	litres	
47	Total volume of conservator	litres	
48**	Weight of active copper	tonnes	
49**	Weight of active iron in core	tonnes	
50**	Weight of core and winding assembly	tonnes	
51**	Weight of each coolerbank complete with oil ifmounted separately fromtransformer	tonnes	
52**	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tonnes	
53	Weight of transformer arranged for transport	tonnes	
54	Manufacture, type and class of oil to IEC 60296		

Sl. No.	Description	Unit	Bidder's data		
	Transformer Parts Subject To Short-Circuit Test				
55	Brief description of transformer or parts thereof subjected to short-circuit test				
	Transformer Bushing Insulators (ABB, SWEDEN; TRENCH, FRANCE/USA; HSP, GERMANY; JAPAN)		420kV	245kV	36kV
56	Maker				
57	Insulator material (solid,oil-paper etc)				
58	Maker's type reference and rated voltage				52kV
59	Rated current				
60	BCT particulars				
	i) HV Side: Core 1, Core2 ii) LV Side: Core 1, 2 & 3: iii) Tertiary Side: Core 1, 2 & 3: iv) Neutral Core 1, Core 2				
61	Manufacturer of porcelain				
62	Length of insulator (overall)	mm			
63	Weight of insulator	kg			
64	Electrostatic capacity of	pF			

Sl. No.	Description	Unit	Bidder's data		
	complete bushings				
65	Dry lightning impulse voltage withstand (1.2/50 wave)	kV			
66	50Hz wet withstand voltage without arcing horns	kV			
67	Total creepage distance of outdoor shedding	mm			
68	Protected creepage distance of shedding	mm			
69	Buchhlolz Relay Make		MESSKO,MR; Qualitrol; Electromo-torenpreferable		
70	Oil Surge Relay make		MR, Germany; ABB, Sweden		
71	PRD Make		MESSKO, MR; Qualitrol preferable		
72	Through fault withstand data for 3 sec		Insert		
73	Over excitation curve for Transformer				
74	Minimum Installation Winding Resistance curve				
75	Stray capacitance value of winding to wind-ing and between tank (Not mandatory at bidding time)				

6.2.1(1)

No.	Description	Minmum 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	
1.6	Quality control		ISO 9001	
1.7	Number of phases		3	
1.8	Number of windings		Auto plus stabilizing	
1.9	Tertiary winding function		Stabilizing winding & auxiliary power supply	

1.10	Thermal insulation class		A	
1.11	Installation requirement		Outdoor	
2	**Ratings and properties**			
2.1	Voltage ratio at no load and at principle tap HV/MV/LV	kV/kV/kV	400/235/33kV	
2.2	Rated voltage of windings: a) HV winding b) MV winding c) LV - stabilizing winding	 kV kV kV	 420 245 36	
2.3	Rated power: a) Primary / secondary winding b) Tertiary - minimum	 MVA MVA	 520/750 104	
2.4	Rated power by cooling ONAN / ONAF (OFAF) a) Primary & secondary winding b) Tertiary - minimum	 MVA MVA	 520/750 104/150	
2.5	Rated current on HV/ LV windings at CMR a) HV at Highest Voltage T ap b) HV at Nominal Voltage Tap c) HV at Lowest Voltage T ap d) LV	 **A** **A** **A** **A**		
2.6	Tap changer:			
	a) Manufacturer		Insert	
	b) Country of origin		Insert	
	c) Model designation		insert	
	d) Type of tap changing		On-load Local, remote, supervisory electrical and hand operation	

	e) DS Type and Number		Vacuum Tap Insert	
	f) Tap changer location		At High voltage side	
	g) Type of voltage regulation		C.F.V.V.	
	h) Tapping range	%	±10	
	i) Tapping step size	%	1.25	
	j) Number of tapping steps	Nos.	Insert	
	k) Rating		Rated power 750 MVA, all taps	
	l) Power frequency withstand test voltage (BS.4571) - between first and last contacts of the selector switch - between any two adjacent contacts of the selector - between open diverter switch contacts		Insert	
	m) Type test certificate reference		Insert	
	n) Motor Drive Unit Make /Type Number		Insert	
2.7	AVR relay			
	a) Manufacturer's Name		Insert	
	b) Country Of Origin		Insert	
	c) Hardware / Software Version		Insert	
2.8	Frequency	Hz	50	
2.9	Corresponding lowest system frequency	Hz	Insert	

2.10	Connection of three-phase windings (group of vector IEC 60076)		YNa0d1	
2.11	Neutral point insulation		Si245	
2.12	Low voltage winding connection (LV)		Open delta, with four terminals brought out outside of the tank	
2.13	Type of cooling		ONAN/ONAF/OFAF	
2.14	Line drop compensation	Yes/No	Yes	
2.15	Whether automatic control required and referenced voltage		Yes, 110V, 50Hz	
2.16	Whether separate remote control panel required	Yes/No	Yes	
2.17	Whether provision for supervisory control required, including AVR setting	Yes/No	Yes	
2.18	Whether 3agnetizin kiosk required	Yes/No	Yes (Tank Side, Cubicle)	
2.19	Number of transformers for which automatic control is to be suitable			
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 in extreme plus position in extreme minus 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' MWA with on-load tap changer in middle position	%	Insert	
3.1.4	Maximum Impedance between HV - MV over tapping range Corresponding tap	% 	Insert Insert	
3.1.5	Minimum Impedance between HV - MV over tapping range Corresponding tap	%	Insert Insert	
3.2	Zero-sequence impedance, with tap changer in middle position: a) HV/MV b) HV/LV c) MV/LV	 % % %	 Insert Insert Insert	
3.3	**Autotransformer capacity to withstand external short circuits**			
3.3.1	Short-circuit duration	s	3	
3.3.2	Symmetrical short-circuit with-stand capacity during indicated period: a) HV winding b) MV winding c) LV winding d) Pre-fault voltage	 kA kA kA p.u.	 63 50 31.5 1.05	
3.3.3	Asymmetrical short-circuit withstand capacity during indicated period: a) HV winding b) MV winding c) LV winding	 kA kA kA		

	d) Pre-fault voltage	p.u.		
3.4	**Guaranteed losses**			
3.4.1	No-load losses with tap changer in nominal position: ***a)*** at rated voltage and rated frequency ***(this value will be evaluated)***	kW	**Insert**	
	b) at 110 % rated voltage, at rated frequency	kW	Insert	
	No-load losses with tap changer in plus (+) extreme position: a) at 110 % rated voltage, at rated frequency	kW	Insert	
	No-load losses with tap changer in minus (-) extreme position: a) at 110 % rated voltage, at rated frequency	kW	Insert	
3.4.2	No-load losses capitalized value	BDT/kW	**600,000**	
3.4.3	Tolerance to be applied to no-load losses in % of the guaranteed value	%	10	
3.4.4	On-load losses at 75°C, at rated voltage and frequency, with tap changer in normal position ***(this value will be evaluated)***	kW	**Insert**	
3.4.5	On-load losses capitalized value	BDT/kW	**300,000**	
3.4.6	Tolerance to be applied to on-load losses in % on the guaranteed value	%	10	
3.4.7	Ancillary equipment (fans, pumps, heaters, etc.)			
3.4.8	Load of ancillary equipment ***(this value will be evaluated)***	kW	**Insert**	

3.4.9	Capitalized valued of ancillary equipment load	BDT/kW	**300,000**	
3.4.10	Tolerance to be applied to ancillary equipment load in % of the guaranteed value	%	10	

3.5	**Total loss at 75°C and normal ratio**	kW		
3.6	**Insulation level**			
3.6.1	High voltage (HV)		LI 1425, SI 1050, AC 630	
3.6.2	Medium voltage (MV)		LI 1050, AC 460	
3.6.3	Low voltage (LV)		LI 170, AC 70	
3.6.4	Neutral		LI 1050, AC 460	
3.6.5	Induced voltage (ACSD, ACLD)	kV	In acc. To IEC 60076-3	
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	245	
3.7.4	Low voltage (LV)	kV	52	
3.8	**Regulation at 75°C and normal ratio -** (A) At unity power factor (B) At 0.8 lagging power factor	% %		
3.9	**Efficiencies**			

3.9.1	If cosϕ = 1.0 and: a) 25 % load of the rated value b) 50 % load of the rated value c) 75 % load of the rated value d) 100 % load of the rated value		 Insert Insert Insert Insert	
3.9.2	If cosϕ = 0.8 (inductive) and: a) 25 % load of the rated value b) 50 % load of the rated value c) 75 % load of the rated value d) 100 % load of the rated value		 Insert Insert Insert Insert	
3.10	**Voltage drop at the terminals of second-winding at rated temperature and at the middle tap changer position**			
3.10.1	a) cosϕ = 1.00		Insert	
3.10.2	b) cosϕ = 0.95 (inductive)		Insert	
3.10.3	c) cosϕ = 0.90 (inductive)		Insert	
3.10.4	d) cosϕ = 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 voltage tap			
3.12.1	Top oil	K	< 50	

3.12.2	Winding	K	< 55	
3.12.3	Hottest spot in core, metallic parts and adjacent Parts in contact with oil	K	Insert	
3.12.4	Hottest spot in copper (winding)	K	Insert	
3.12.5	Winding hot spot temperature on emergency overload not exceeding	K		
3.13	At the emergency cases it is allowed: a) Continuous overload at the highest winding temperature which exceeds by 2.5°C the guaranteed limit value b) Continuous voltage increase when the top oil temperature exceeds the guaranteed limit by 2.5°C at rated power (in % of the rated voltage)	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 a) full rated power b) % rated power c) [1]% rated power		 Insert Insert Insert	
3.14.1.2	After operation under 20 min a) full rated power b) **%** rated power c) [1]% rated power		 Insert Insert Insert	
3.14.1.3	After operation under 120 min a) full rated power b) % rated power		 Insert Insert	

	c) [1]% rated power		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 a) full rated power b) % rated power c) % rated power		 Insert Insert Insert	
3.14.2.2	After operation under 20 min a) full rated power b) % rated power c) % rated power		 Insert Insert Insert	
3.14.2.	After operation under 120 min a) full rated power b) % rated power c) % rated power		 Insert Insert Insert	
3.15	Guaranteed values of loads at ambient temperature of 40°C, without danger of exceeding the oil and winding temperature limits: a) with all cooling groups in operation (excluding stand-by cooling group) b) with one cooling group out of operation c) with two cooling groups out of operation		Insert Insert Insert	t
4	**Oil**			
4.1	New		Insert	
4.2	Manufacturer		Insert	
4.3	Type Class		Insert 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		**No**	
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		ABB,SWEDEN; TRENCHE, FRANCE/USA; HSP, GERMANY	
5.1.4	Type: RIP		Insert	
5.1.4.1	Single Flange or Double Flange		Insert	
5.1.4.2	Draw lead type or Solid Type		Insert	
5.1.4.3	Type: Oil to Oil or Oil to Air or Oil to SF6		Insert	
5.1.5	Rated current	A	> 1600	
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	Not applicable	
5.1.10	Connectors			
5.1.10.1	Shape	mm	0 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	Total Creepage distance of outdoor shedding	mm	Insert	
5.1.13	Protective Creepage distance of shedding	mm	Insert	
5.1.14	Full vacuum withstand of complete bushing		YES	
5.1.15	Total length of insulator	mm	Insert	
5.1.16	Weight of insulator	kg	Insert	
5.1.17	Electrostatic capacity of complete bushings	pF	Insert	
5.1.18	Manufacturer of porcelain		Insert	
5.1.19	De-rating Factor		Insert	
5.2	**Neutral bushing (identical as MV bushing)**			
5.2.1	Quantity		1	
5.2.2	Class	kV	245	
5.2.3	Manufacturer		ABB,SWEDEN; TRENCHE, FRANCE/USA; HSP, GERMANY	

5.2.4	Type: RIP or OIP or Solid		Insert	
5.2.4.1	Single Flange or Double Flange		Insert	
5.2.4.2	Draw lead type or Solid Type		Insert	
5.2.4.3	Type: Oil to Oil or Oil to Air or Oil to SF6		Insert	
5.2.5	Rated current	A	> 2500	
5.2.6	Rated short-circuit current (2 s)	kA rms	50	
5.2.7	Rated lightning impulse withstand voltage	kV peak	1050	
5.2.8	Rated switching impulse withstand voltage	kV peak	-	
5.2.9	Rated power frequency withstand voltage	kV rms	630	
5.2.10	Connectors			
5.2.10.1	Shape	mm	Flat	
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	Total Creepage distance of outdoor shedding	mm	Insert	
5.2.13	Protective Creepage distance of shedding	mm	Insert	
5.2.14	Full vacuum withstand of complete bushing		YES	
5.2.15	Total length of insulator	mm	Insert	
5.2.16	Weight of insulator	kg	Insert	
5.2.17	Electrostatic capacity of complete bushings	pF	Insert	

5.2.18	Manufacturer of porcelain		Insert	
5.2.19	De-rating Factor		Insert	
5.3	**MV bushings**			
5.3.1	Quantity		3 or 4	
5.3.2	Class	kV	245	
5.3.3	Manufacturer		ABB,SWEDEN; TRENCHE, FRANCE/USA; HSP, GERMANY	
5.3.4	Type: RIP		Insert	
5.3.4.1	Single Flange or Double Flange		Insert	
5.3.4.2	Draw lead type or Solid Type		Insert	
5.3.4.3	Type: Oil to Oil or Oil to Air or Oil to SF6		Insert	
5.3.5	Rated current	A	> 2500	
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	0 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	Total Creepage distance of outdoor shedding	mm	Insert	
5.3.13	Protective Creepage distance of shedding	mm	Insert	
5.3.14	Full vacuum withstand of complete bushing		YES	
5.3.15	Total length of insulator	mm	Insert	
5.3.16	Weight of insulator	kg	Insert	
5.3.17	Electrostatic capacity of complete bushings	pF	Insert	
5.3.18	Manufacturer of porcelain		Insert	
5.3.19	De-rating Factor		Insert	
5.4	**LV bushings**			
5.4.1	Quantity		4	
5.4.2	Class	kV	52	
5.4.3	Manufacturer		TRENCH,ABB, CE-DASPE, ELMEK	
5.4.4	Type: RIP or OIP or Solid		Insert	
5.4.4.1	Single Flange or Double Flange		Insert	
5.4.4.2	Draw lead type or Solid Type		Insert	
5.4.4.3	Type: Oil to Oil or Oil to Air or Oil to SF6		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	150	
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	Total Creepage distance of outdoor shedding	mm	Insert	
5.4.13	Protective Creepage distance of shedding	mm	Insert	
5.4.14	Full vacuum withstand of complete bushing		YES	
5.4.15	Total length of insulator	mm	Insert	
5.4.16	Weight of insulator	kg	Insert	
5.4.17	Electrostatic capacity of complete bushings	pF	Insert	
5.4.18	Manufacturer of porcelain			
5.4.19	De-rating Factor			
6	**Design Data**			
6.1	Maximum flux density in the legs a) At rated voltage, frequency & normal ratio b) At 105 % of the rated voltage c) Volts/turn	 T T V	 Insert Insert Insert	

6.2	Maximum flux density in the yokes: a) At rated voltage, frequency & normal ratio b) At 105 % of the rated voltage c) Volts/turn	 T T V	 Insert Insert Insert	
6.3	Maximum current density in windings at rated power and normal tap changer position: a) HV winding b) MV winding c) LV - stabilizing winding	 A/mm^2 A/mm^2 A/mm^2	 Insert Insert Insert	
6.3.1	Magnetising current (13agneti) at nominal ratio and at 0.9 x nominal voltage at 1.0 x nominal voltage at 1.1 x nominal voltage at 1.2 x nominal voltage	% % % %		
6.3.2	Harmonic component of 13agnetizing current at rated voltage as percentage of fundamental (A) Fifth harmonic (B) Seven harmonic	 % %		
6.4	Winding resistance at 75°C and middle tap changer position: a) HV winding b) MV winding c) LV - stabilizing winding		 Insert Insert Insert	
6.5	**Core construction**			
6.5.1	Type of transformer		Core	
6.5.2	Method of joining of legs		Insert	
6.5.3	Method of joining of yokes		Insert	
6.5.4	Joining material		Insert	
6.5.5	Number of legs		Insert	
6.5.6	Type of core steel		Insert	

6.5.7	Steel Manufacturer			
6.5.8	Steel Grade	Grade		
6.5.9	Core Loss at W17/50 Specific loss of core steel at 1.7 T inductance	Watts/kg W/kg	< 0.85 < 1.11	
6.5.10	Irradiation method			
6.5.11	Insulation of (A) Yoke bolts (B) Side plates			
6.5.12	Safe working temperature of core plate insulation			
6.6	**Winding & Winding conductor**			
6.6.1	Types of winding (A) HV (B) LV			
6.6.2	Insulation of (a) HV windings (b) LV windings			
6.6.3	Type of Winding connections (brazed or crimped)			
6.6.4	HV winding		Cu - 'Interleaved'	
6.6.5	MV winding		Cu - Interleaved / disc - transposed, cured in epoxy coating	
6.6.6	LV - stabilizing winding		Cu - transposed, cured in epoxy coating	
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	^V	2500 max	

6.9	For fault with zero impedance external to the transformer and infinite svstem (a) Maximum axial force (b) Maximum tensile stress in winding	 kN N/m^2	 Insert Insert	
6.10	Type of Insulation of Tapping Connections			
6.11	Is facility provided for adjustment of axial pressure on windings	Yes/No		
7	**Weights and dimensions**			
7.1	Core and winding assembly	kg	Insert*	
7.2	Tank, conservator , cooler banks & cooling assembly & other accessories	kg	Insert*	
7.3	Total mass excluding oil	kg	Insert*	
7.4	Oil mass in tank & conservator	kg	Insert*	
7.5	Oil mass in coolers	kg	Insert*	
7.6	Total mass of Oil	kg	Insert*	
7.7	Total weight of autotransformer, with oil, equipped for service	kg	Insert*	
7.8	Maximum shipping weight (the heaviest item)	kg	Insert*	
7.9	Height from foundation to: a) Highest point of HV bushing b) Highest point of tank c) Highest point of conservator d) Highest point of lifting hook for removal of and oil assembly	mm mm mm mm	Insert* Insert* Insert* Insert*	
	Outer dimensions:			

7.10	a) Length b) Width	mm mm	Insert* Insert*	
7.11	Informative dimensional sketch		To be enclosed with bid	
7.12	Maximum shipping dimensions of tank: a) Outside height b) Outside width c) Outside length	 mm mm mm	 Insert Insert Insert	
7.13	Transportation drawing		To be enclosed with bid	
8	**Tap changer**			
8.1	Manufacturer		Insert	
8.2	Type		Insert	
8.3	Insulation level	kV	Si 420	
8.4	Rated current	A	> 2500	
8.5	Number of steps		17	
8.6	Regulating coil		At HV Winding	
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	
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)	
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 fan groups, Radiator banks & Valves**			
12.1	Number of cooling fan groups (total)	Qty.	4	
12.2	Number of cooling fan groups (for rated power)	Qty.	3	
12.3	Number of stand-by cooling fan groups	Qty.	1	
12.4	Number of coolers (fans) in a cooling group	Qty.	Insert	
12.5	Number of spare fans	Qty.	Insert	
12.6	Rating of each cooler (fan)	kW	Insert	
12.7	Starting current of each fan motor	A	Insert	
12.8	Speed of air blowers/fans	rpm	Insert	
12.9	IP Class of Fan Motor		Insert	
12.10	Full vacuum withstand of complete cooler	mbar	Yes	
12.11	Number of cooler (radiator) banks per trans-former		Insert	
12.12	Number of coolers/radiators per cooler bank		Insert	
12.13	Thickness of radiator plates	mm	Insert	
12.14	Valve type/material: (A) 100mm and below (B) Above 100mm		 Insert Insert	
12.15	Gate /Ball Valve		Insert	
12.16	Radiator Valve		Insert	
12.17	Bucholz relay bypass valve		Insert	
13	**Oil Preservation system & Dehydrating breather**			
13.1	Main Tank and HV cable Box		Air Bag with dehydrat-breather	

13.2	On-load Tap Changer		Dehydrating breather	
13.3	Type of dehydrating breather		Insert	
13.4	Dehumidifying agent	kg	Insert	
13.5	Type of Dehumidifying agent		Environment friendly	
14	**Autotransformer tank**			
14.1	Type of design			
14.2	Thickness of transformer tank: a) Sides b) Bottom c) 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	4520	
14.4.3	Transversal distance between wheels in pair	mm	1435	
14.4.4	Distance between wheels in longitudinal direction	mm	1435	
14.5	Corrosion protection of the tank		YES	
14.6	Vacuum withstand of the complete tank with cooler	mbar	1	
14.7	Over-pressure withstand of the complete autotransformer	bar	0.3	
14.8	Oil Sealing System (Type)			

	a) Main Tank b) Other parts		Gasket/Welded Gasket	
14.9	Oil Sealing System (Gasket Material: Material used for gaskets for oil tight joints) a) Main Tank b) Bushings c) Other Parts d) Temperature Class / Grade		Insert	
14.10	Maximum Operating Pressure a) At Top of Tank b) At Bottom of Tank	kN/m2 kN/m2	Insert Insert	
14.11	Permanent Deflection of Tank plates or Stiffeners: a) At Maximum Operating Pressure b) At Design Hydraulic Pressure for which Tank is Designed c) At Full Vacuum	mm mm mm	< IEC < IEC < IEC	
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 and lowest levels as percentage of total cold oil at 0°C of the volume of autotransformer	%	Insert	
15.5	Pressure rise inside the tank due to oil expansion		Insert	
15.6	Diagraph design parameters: a) Maximum diagraph stress at highest working pressure b) Diagraph construction details c) 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	**Marshaling Kiosk**			
16.1	Type of Mounting		Tank mounted	
16.2	IP Class		Insert	
16.3	Mounted on tank with/ without anti-vibration packing		Insert	
17	**Operating Pressure of Pressure Relief Device**			
17.1	Main Tank	kN/m2	Insert	
17.2	OLTC	kN/m2	Insert	
17.3	HV Cable Box	kN/m2	Insert	
18	**Operating conditions**			
18.1	At the altitude (above sea level)	m	< 1000	
18.2	Maximum ambient temperature	°C	+ 45	
18.3	Average daily temperature	°C	+ 35	
18.4	Average annual temperature	°C	+ 30	
18.5	Minimum ambient temperature	°C	- 5	
18.6	Tertiary winding		Will be used	
18.7	Parallel operation		Yes	
18.8	External cooling medium		Air	
18.9	Average air temperature in any one year not exceeding: - In any one day - Average in one year			
18.10	Consideration for Exposure to Sunshine		Required	

18.11	Consideration for Restricted Air Circulation		Required	
19	**Short Circuit Withstand Requirement**			
19.1	Brief description of transformer subjected to short- circuit test		Test Reference	
20	**Make of major accessories with country of origin**			
	Below Items shall be offered from Approved Vendor List. New Makes are Acceptable Subject to Approval Separately. Note: The Country Of Origin including sub-assembly items shall be from Western Europe or Japan Origin.			
	Name of Accessories	**Make**	**Country of Origin**	**Guaranteed make & Country of Origin**
20.1	Buchholz Relay			
20.2	Oil Surge Relay for OLTC		MR, Germany; ABB, Sweden	
20.3	Air Bag Rupture Relay			
20.4	Pressure Relief Device		MESSKO, MR; Quali-trol preferable	
20.5	Air Bag for Conservator			
20.6	Magnetic Oil Level Gauge			
20.7	Oil Temperature Indicator			
20.8	Winding Temperature Indicator			
20.9	Radiator			
20.10	Cooling Fan			
20.11	Bushing Current Transformer			

20.12	Neutral Current T ransformer			
20.13	Anti-Vibration Pad			
20.14	AVR Panel			
	Name of Raw Material	**Make**	**Country of Origin**	**Guaranteed make & Country of Origin**
20.15	Copper Conductor			
20.16	CRGO			
20.17	Insulating Paper			
20.18	Press Boards			
20.19	Steel Plate			

5.2.2 (400/√3)/(235/√3)/34.5 KV, 175/250 MVA, SINGLE PHASE AUTO TRANSFORMER:

Sl. No.	Description	Unit	Bidder's data
1.1	Name of the Manufacturer		
1.2	Type/Model		
2.1	Continuous Rating - ONAN ONAF		

Sl. No.	Description	Unit	Bidder's data
2.2	Voltage ratio at no-load HV/LV	kV	
3	Tap Changer		
3.1	HV Tap Changer (On load type) TappingRange		
3.2	Size of tapping step		
3.3	No. of Steps		
4	Vector Group		
5	On-load voltage control equipment:		
	(A) Type. (B) Manufacturer (C) Range (D) Size of steps (E) Power frequencywithstand test voltage (BS.4571) - between first and last contactsof the selectorswitch - between any two adjacentcontacts of the selector - between open diverterswitch contacts (F) Type test certificatereference	 % % 	
6	Type of cooling		
7	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	°C	

Sl. No.	Description	Unit	Bidder's data
8	Top oil temperature under service conditions stated in Schedule of Technical Requirement (A) CMR (B) ONAN rating	 °C °C	
9	Maximum hot spot temperature rise in core at rated power	°C	
10	Maximum hot spot temperature rise in copper at rated power	°C	
11	Temperature gradient at rating specified	°C	
12	Flux density in iron at normal voltage and frequency and at normal ratio - (no load) (A) Cores (B) Yokes (C) Volts/turn	 Tesla Tesla V	
13	Magnetising current (approx) at nominal ratio and at 0.9 x nominal voltage at 1.0 x nominal voltage at 1.1 x nominal voltage at 1.2 x nominal voltage	 % % % %	
14	Harmonic component of magnetising current at rated voltage as percentage of fundamental		

Sl. No.	Description	Unit	Bidder's data
	(A) Fifth harmonic (B) Seven harmonic	% %	
15.1*	No-load loss (excluding cooling plant losses) at rated voltage, ratio and frequency	kW	
15.2*	Grain Oriented Electrical Steel used: Steel Manufacturer Steel Grade Core Loss at W17/50 Irradiation method	 Name Grade Wats/kg	 (should be less than or equal to 0.85) (Laser beam or Plasma jet)
16*	Copper loss (excluding cooling plant losses) at 75°C and at rated voltage, ratio (nominal tap),frequency	kW	
17*	Auxiliary loss (Total power input to fans for operation of total installed cooling capacity)	kW	
18	Total loss at 75°C and normal ratio(Sl. No.15+16+17)	kW	
19	Regulation at 75°C and normal ratio - (A) At unity power factor % (B) At 0.8 lagging power factor	 % %	
20	Short circuit impedance corrected to reference temperature of 75°C at rated frequency and rated power		

Sl. No.	Description	Unit	Bidder's data
	i) HV - LV, on the basis of CMR with onload tapchanger at – highest tap nominal tap lowest tap ii) HV - TV, on the basis of CMR with onload tapchanger at nominal tap` iii) LV - TV, on the basis of CMR with onload tapchanger at nominal tap	 % % % % %	
21	Equivalent circuit zero sequence impedance: HV-LV	 %	
22	Maximum current density in windings at C.M.R. (A) HV winding (B) LV winding (C) SV winding	 A/mm^2 A/mm^2 A/mm^2	
24	Noise level	dB	
25	Types of transformers (shell or core)		
26	Core steel (a) Type (b) Grade		
27	Types of winding - (A) HV		

Sl. No.	Description	Unit	Bidder's data
	(B) LV		
28	Insulation of (a) HV windings (b) LV windings		
29	Insulation of - (A) Yoke bolts (B) Side plates		
31	Safe working temperature of core plate insulation	°C	
32	Winding connections brazed or crimped		
33	For fault with zero impedance external to the transformer and infinite system (a) Maximum axial force (b) Maximum tensile stress in winding	kN N/m^2	
34	Is facility provided for adjustment of axial pressure on windings	Yes/No	
35	Thickness of transformer tank (A) Sides (B) Bottom	mm mm	
36	Material used for gaskets for oil tight joints		
	Radiators, Valves, Fans		
37	Thickness of radiator plates	mm	
38	Valve type/material:		

Sl. No.	Description	Unit	Bidder's data
	(A) 100mm and below (B) Above 100mm		
39	Equipment for ONAF + cooling state (A) - (A) Radiators on main tank		
40	Number of coolers/radiators or cooler banks per transformer		
41	Number of air blowers per transformer		
42	Speed of air blowers	rpm	
43	Rating of each air blower motor	kW	
44	Starting current of each air blower motor	A	
	Oil Volumes and Weights		
45	Total oil required including cooler system	litres	
46	Volume of oil to fill transformer to above the top yoke	litres	
47	Total volume of conservator	litres	
48**	Weight of active copper	tonnes	
49**	Weight of active iron in core	tonnes	
50**	Weight of core and winding assembly	tonnes	

Sl. No.	Description	Unit	Bidder's data		
51**	Weight of each coolerbank complete with oil ifmounted separately fromtransformer	tonnes			
52**	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tonnes			
53	Weight of transformer arranged for transport	tonnes			
54	Manufacture, type and class of oil to IEC 60296				
	Transformer Parts Subject To Short-Circuit Test				
55	Brief description of transformer or parts thereof subjected to short-circuit test				
	Transformer Bushing Insulators (ABB, SWEDEN; TRENCH, FRANCE; HSP, GERMANY)		420kV	245kV	36kV
56	Maker				
57	Insulator material (solid,oil-paper etc)				
58	Maker's type reference and rated voltage				52kV
59	Rated current				
60	BCT particulars				
	v) HV Side: Core 1, Core2				

Sl. No.	Description	Unit	Bidder's data		
	vi) LV Side: Core 1, 2 & 3: vii) Tertiary Side: Core 1, 2 & 3: viii) Neutral Core 1, Core 2				
61	Manufacturer of porcelain				
62	Length of insulator (overall)	mm			
63	Weight of insulator	kg			
64	Electrostatic capacity of complete bushings	pF			
65	Dry lightning impulse voltage withstand (1.2/50 wave)	kV			
66	50Hz wet withstand voltage without arcing horns	kV			
67	Total creepage distance of outdoor shedding	mm			
68	Protected creepage distance of shedding	mm			
69	Buchhlolz Relay Make		MESSKO,MR; Qualitrol; Electromo-toren preferable		
70	Oil Surge Relay make		MR, Germany; ABB, Sweden		
71	PRD Make		MESSKO, MR; Qualitrol preferable		
72	Through fault withstand data for 3 sec		Insert		

Sl. No.	Description	Unit	Bidder's data
73	Over excitation curve for Transformer		
74	Minimum Installation Winding Resistance curve		
75	Stray capacitance value of winding to winding and between tank (Not mandatory at bidding time)		

*; Subject to Loss Evaluation during the tender stage and guaranteed values subject to deduction from Contract Price
**: Estimated weight. Actual weight shall be measured during execution of the contract and included on thename plate.

5.2.3 400/135/34.5 KV, 400/520 MVA, 3-PHASE AUTO/POWER TRANSFORMER:

Sl. No.	Description	Unit	Bidder's data
1.1	Name of the Manufacturer		
1.2	Type/Model		
2.1	Continuous Rating - ONAN ONAF		
2.2	Voltage ratio at no-load HV/LV	kV	
3	Tap Changer		
3.1	HV Tap Changer (On load type) TappingRange		
3.2	Size of tapping step		
3.3	No. of Steps		
4	Vector Group		
5	On-load voltage control equipment:		
	(A) Type. (B) Manufacturer (C) Range (D) Size of steps (E) Power frequencywithstand test voltage (BS.4571) - between first and last contactsof the selectorswitch	 % % 	

	- between any two adjacentcontacts of the selector - between open diverterswitch contacts (F) Type test certificatereference		
6	Type of cooling		
7	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	°C	
8	Top oil temperature under service conditions stated in Schedule of Technical Requirement (A) CMR (B) ONAN rating	 °C °C	
9	Maximum hot spot temperature rise in core at rated power	°C	
10	Maximum hot spot temperature rise in copper at rated power	°C	
11	Temperature gradient at rating specified	°C	
12	Flux density in iron at normal voltage and frequency and at normal ratio - (no load) (A) Cores (B) Yokes (C) Volts/turn	 Tesla Tesla V	
13	Magnetising current (approx) at nominal ratio and		

	at 0.9 x nominal voltage at 1.0 x nominal voltage at 1.1 x nominal voltage at 1.2 x nominal voltage	% % % %	
14	Harmonic component of magnetising current at rated voltage as percentage of fundamental (A) Fifth harmonic (B) Seven harmonic	 % %	
15.1*	No-load loss (excluding cooling plant losses) at rated voltage, ratio and frequency	kW	
15.2*	Grain Oriented Electrical Steel used: Steel Manufacturer Steel Grade Core Loss at W17/50 Irradiation method	 Name Grade Wats/kg	 (should be less than or equal to 0.85) (Laser beam or Plasma jet)
16*	Copper loss (excluding cooling plant losses) at 75°C and at rated voltage, ratio (nominal tap),frequency	kW	
17*	Auxiliary loss (Total power input to fans for operation of total installed cooling capacity)	kW	
18	Total loss at 75°C and normal ratio(Sl. No.15+16+17)	kW	
19	Regulation at 75°C and normal ratio -		

	(A) At unity power factor % (B) At 0.8 lagging power factor	% %	
20	Short circuit impedance corrected to reference temperature of 75°C at rated frequency and rated power i) HV - LV, on the basis of CMR with onload tapchanger at – highest tap nominal tap lowest tap ii) HV - TV, on the basis of CMR with onload tapchanger at nominal tap` (ii) LV - TV, on the basis of CMR with onload tapchanger at nominal tap	 % % % % %	
21	Equivalent circuit zero sequence impedance: HV-LV	 %	
22	Maximum current density in windings at C.M.R. (A) HV winding (B) LV winding (C) TV winding	 A/mm^2 A/mm^2 A/mm^2	
24	Noise level	dB	
25	Types of transformers (shell or core)		
26	Core steel (a) Type (b) Grade		
27	Types of winding - (A) HV		

	(B) LV (C) TV		
28	Insulation of (a) HV windings (b) LV windings (c) TV winding		
29	Insulation of - (A) Yoke bolts (B) Side plates		
31	Safe working temperature of core plate insulation	°C	
32	Winding connections brazed or crimped		
33	For fault with zero impedance external to the transformer and infinite system (a) Maximum axial force (b) Maximum tensile stress in winding	kN N/m^2	
34	Is facility provided for adjustment of axial pressure on windings	Yes/No	
35	Thickness of transformer tank (A) Sides (B) Bottom	mm mm	
36	Material used for gaskets for oil tight joints		
	Radiators, Valves, Fans		
37	Thickness of radiator plates	mm	
38	Valve type/material: (A) 100mm and below		

	(B) Above 100mm		
39	Equipment for ONAF + cooling state (A) - (A) Radiators on main tank		
40	Number of coolers/radiators or cooler banks per transformer		
41	Number of air blowers per transformer		
42	Speed of air blowers	rpm	
43	Rating of each air blower motor	kW	
44	Starting current of each air blower motor	A	
	Oil Volumes and Weights		
45	Total oil required including cooler system	litres	
46	Volume of oil to fill transformer to above the top yoke	litres	
47	Total volume of conservator	litres	
48**	Weight of active copper	tonnes	
49**	Weight of active iron in core	tonnes	
50**	Weight of core and winding assembly	tonnes	
51**	Weight of each coolerbank complete with oil ifmounted separately fromtransformer	tonnes	

52**	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tonnes				
53	Weight of transformer arranged for transport	tonnes				
54	Manufacture, type and class of oil to IEC 60296					
	Transformer Parts Subject To Short-Circuit Test					
55	Brief description of transformer or parts thereof subjected to short-circuit test					
	Transformer Bushing Insulators (ABB, SWEDEN; TRENCHE, FRANCE; HSP, GERMANY)		420kV	245kV	52kV	Neutral
56	Maker					
57	Insulator material (solid,oil-paper etc)					
58	Maker's type reference and rated voltage		420	245	52	145kV
59	Rated current					
60	BCT particulars					
	i) HV Side: Core 1, Core2 ii) LV Side: Core 1, 2 & 3: iii) Tertiary Side: Core 1, 2 & 3:					

	iv) HV Neutral Core 1, Core2 v) LV Neutral Core 1, Core2				
61	Manufacturer of porcelain				
62	Length of insulator (overall)	mm			
63	Weight of insulator	kg			
64	Electrostatic capacity of complete bushings	pF			
65	Dry lightning impulse voltage withstand (1.2/50 wave)	kV			
66	50Hz wet withstand voltage without arcing horns	kV			
67	Total creepage distance of outdoor shedding	mm			
68	Protected creepage distance of shedding	mm			
69	Buchhlolz Relay Manufacturer		MESSKO,MR; Qualitrol; Electromo-toren (EMB) preferable		
70	Oil Surge Relay Manufacturer		MR, Germany; ABB, Sweden		
71	PRD Manufacturer		MESSKO, MR; Qualitrol preferable		
72	Through fault withstand data for 3 sec		Insert		
73	Over excitation curve for Transformer				
74	Minimum Installation Winding Resistance curve				

75	Stray capacitance value of winding to winding and between tank (Not mandatory at bidding time)		

*; Subject to Loss Evaluation during the tender stage and guaranteed values subject to deduction from Contract Price
**: Estimated weight. Actual weight shall be measured during execution of the contract and included on the name plate.

5.2.4 33/0.415 kV, 500kVA EARTHING/AUXILIARY TRANSFORMERS

Sl. No.	Description	Unit	Bidder's Data
1.1	Name of the Manufacturer		
1.2	Type/Model		
2.1	Continuous Rating - ONAN		
3	Vector Group		
4	Type of cooling		
5	Winding temperature riseat CMR under serviceconditions stated in Schedule of Technical Requirement	°C	
6	Top oil temperature under serviceconditions stated in Schedule of Technical Requirement (A) CMR (B) ONAN rating	 °C °C	
7	Rated short time (10 second) current neutral	A	
8	Current density in the interconnected star winding at rated short time current	A/mm^2	
	Current density in theinterconnected star winding		

9	-at CMR and -5 second fault rating simultaneously	A/mm^2 A/mm^2	
10	Maximum flux density incore iron at normalvoltage and frequency	Tesla	
11	CMR of lower voltage star winding	kVA	
12*	No load losses	kW	
13*	Load losses at 75°C at CMRof lower voltage winding	kW	
14	Impedance voltage at CMRof lower voltage winding between HVand LV winding	%	
15	Total range of variation of off load ratio ..... ratio ..... Size of step	plus % minus %	
16	Resistance of higher voltagewinding at 75°C	Ω / phase	
17	Zero phase sequence impedance at 75°C with LV windings open circuited	Ω / phase	
18	Total oil required	litres	
19**	Weight of complete transformer(including oil)	tonnes	
20	Height from base to bottom of neutral bushing insulator	mm	

*; Subject to Loss Evaluation during the tender stage and guaranteed values subject to deduction from Contract Price

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

5.2.5 400KV, 125MVAr, 3-PHASE BUS REACTOR:

Sl. No.	Description	Unit	Bidder's data
1.1	Name of the Manufacturer		
1.2	Type/Model		
2.1	Continuous Rating - ONAN		
2.2	Voltage of winding	kV	
2.3	Lightning Impulse test Voltage	kV	
3	Vector Group Symbol		
4	Type of cooling		
5	Winding temperature rise at CMR under service conditions stated in Schedule of Technical Requirement	°C	
6	Top oil temperature under service conditions stated in Schedule of Technical Requirement (A) CMR (B) ONAN rating	 °C °C	
7	Maximum hot spot temperature rise in core at rated power	°C	
8	Maximum hot spot temperature rise in copper at rated power	°C	

Sl. No.	Description	Unit	Bidder's data
9	Type of core		
10	Flux density in iron at normal voltage and frequency and at normal ratio - (no load) (A) Cores (B) Yokes (C) Volts/turn	 Tesla Tesla V	
11	Magnetising current (approx) at nominal ratio and at 0.9 x nominal voltage at 1.0 x nominal voltage at 1.1 x nominal voltage at 1.2 x nominal voltage	 % % % %	
12	Harmonic component of magnetising current at rated voltage as percentage of fundamental (A) Fifth harmonic (B) Seven harmonic	 % %	
13.1*	Total lossat 75°C, rated voltage and frequency	kW	
13.2*	Grain Oriented Electrical Steel used: Steel Manufacturer Steel Grade Core loss at W 17/50	 Name Grade Wats/kg	 (should be less than or equal to 0.85)

Sl. No.	Description	Unit	Bidder's data
	Irradiation method		(Laser beam or Plasma jet)
14	Impedance at 75°C and CMR	Ω/phase	
15	Maximum current density inwinding at C.M.R.	A/mm^2	
16	Noise level	dB	
17	Types of winding -		
18	Insulation ofwindings		
19	Insulation of - (A) Yoke bolts (B) Side plates		
20	Safe working temperature of core plate insulation	°C	
21	Winding connections brazed or crimped		
22	Is facility provided for adjustment of axial pressure on windings	Yes/No	
23	Thickness of Reactor tank (A) Sides (B) Bottom	 mm mm	
24	Material used for gaskets for oil tight joints		
	Radiators, Valves		

Sl. No.	Description	Unit	Bidder's data
25	Thickness of radiator plates	mm	
26	Valve type/material: (A) 100mm and below (B) Above 100mm		
27	Equipment for cooling state - (A) Radiators on main tank		
28	Number of coolers/radiators or cooler banks per transformer		
	Oil Volumes and Weights		
29	Total oil required including cooler system	litres	
30	Volume of oil to fill transformer to above the top yoke	litres	
31	Total volume of conservator	litres	
32	Weight of active copper	tonnes	
33	Weight of active iron in core	tonnes	
34	Weight of core and winding assembly	tonnes	
35**	Weight of each cooler bank complete with oil if mounted separately from reactor	tonnes	
36**	Total weights of complete reactor, including		

Sl. No.	Description	Unit	Bidder's data
	attached coolers, voltage regulating equipment, all fittings and oil	tonnes	
37**	Weight of reactor arranged for transport	tonnes	
38	Manufacture, type and class of oil to IEC 60296		
	Shunt Reactor Bushing Insulators		420kV
39	Maker		
40	Insulator material (solid, oil-paper etc.)		
41	Maker's type reference and rated voltage		
42	Rated current		
43	BCT particulars		
	i) HV Side: Core 1, 2 & 3: ii) Neutral: Core 1& 2:		
44	Manufacturer of porcelain		
45	Length of insulator (overall)	mm	
46	Weight of insulator	kg	
47	Electrostatic capacity of complete bushings	pF	

Sl. No.	Description	Unit	Bidder's data
48	Dry lightning impulse voltage withstand (1.2/50 wave)	kV	
49	50Hz wet withstand voltage without arcing horns	kV	
50	Total creepage distance of outdoor shedding	mm	

*; Subject to Loss Evaluation during the tender stage and guaranteed values subject to deduction from Contract Price
**: Estimated weight. Actual weight shall be measured during execution of the contract and included on the name plate.

PART-3

5.3 XLPE POWER CABLES

5.3.1 33kV Power Cable

(Schedule to be completed if manufacture not to BS.6346)

Sl. No.	Description	Unit	Bidder's Data
			36 kV
1	Manufacturer		
2	Type		
3	Rated system voltage	kV	
4	Max. permissible system voltage	kV	
5	Rated frequency	Hz	
6	Max. operating current	A	
7	No. of cable		
8	Nominal cross sectional area	mm^2	
9	Impulse withstand voltage	kV	
10	Power frequency withstand voltage	kV	
11	Shape of conductor		
12	Nominal cross section of Cu-screen	mm^2	
13	Thickness of outer sheath	mm	
14	Insulation thickness	mm	
15	Min. bending radius	D	
16	Max. pulling force		
17	Max. DC resistance at 20℃	ohm/km	
18	Max. AC resistance at 20℃	ohm/km	

Sl. No.	Description	Unit	Bidder's Data
			36 kV
19	Max. reactance in single configure	mH/km	
20	Operating capacitance	µF/km	
21	Charging current (phase)		
22	Charging load (phase)		
23	Earth fault current	kA	
24	Short circuit rating for 1 sec	kA	
25	Three phase symmetrical fault current for 1 sec	kA	
26	Current rating	kA	
	- in soil	A	
	- in air	A	
27	standard		

5.3.2 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															

5.4 BATTERIES AND CHARGERS

5.4.1 110V BATTERIES AND CHARGERS

Sl.No.	Description	Unit	Bidder's Data
	Battery		
1	Manufacturer		
2	Type		
3	Electrolyte		
4	Nominal voltage	V	
5	Capacity at 5 hour rate	Ah	
6	Number of cells		
7	Float voltage per cell	V	
8	Battery voltage at end of the duty cycle	V	
9	Normal charging rate	A	
10	Maximum charging rate	A	
11	Ampere-hour efficiency at ten hour rate	%	
12	Ampere-hour efficiency at one hour rate	%	
13	Dimensions of cells	mm	
14	Dimensions of battery complete	mm	
15	Weight of cell complete with electrolyte	kg	
16	Internal resistance per cell when fully charged	ohms	
17	Material of battery case		
	Charger		
18	Manufacturer		
19	Type		
20	AC input voltage and range	kVA	
21	DC output of charger	kW	
22	Type of DC voltage control		
23	Range of DC voltage	V	
24	Output current sharing facility (for parallel operation of chargers)		
25	Regulation	%	
	Charger Cubicle Complete		
26	Manufacturer		
27	Overall dimensions	mm	
28	Total weight	kg	
	DC Switchboard		
29	Manufacturer		
30	Type		
31	Busbars:		

Sl.No.	Description	Unit	Bidder's Data
	- maximum current rating	A	
	- dimensions	mm	
32	Boost charge contactors:		
	- manufacturer		
	- maximum current rating		
	- coil rating		
	- method of interlocking		
33	Alarm relays:		
	- manufacturer		
	- type and reference		
	- power consumption: a) quiescent b) operated	 A mA	
34	Number and rating of distribution circuits		
35	Overall dimensions	mm	
36	Total weight	kg	

5.4.2 48 V BATTERIES AND CHARGERS

Sl.No.	Description	Unit	Bidder's Data
	Battery		
1	Manufacturer		
2	Type		
3	Electrolyte		
4	Nominal voltage	V	
5	Capacity at 5 hour rate	Ah	
6	Number of cells		
7	Float voltage per cell	V	
8	Battery voltage at end of the duty cycle	V	
9	Normal charging rate	A	
10	Maximum charging rate	A	
11	Ampere-hour efficiency at ten hour rate	%	
12	Ampere-hour efficiency at one hour rate	%	
13	Dimensions of cells	mm	
14	Dimensions of battery complete	mm	
15	Weight of cell complete with electrolyte	kg	
16	Internal resistance per cell when fully charged	ohms	
17	Material of battery case		
	Charger		
18	Manufacturer		

Sl.No.	Description	Unit	Bidder's Data
19	Type		
20	AC input voltage and range	kVA	
21	DC output of charger	kW	
22	Type of DC voltage control		
23	Range of DC voltage	V	
24	Output current sharing facility (for parallel operation of chargers)		
25	Regulation	%	
	Charger Cubicle Complete		
26	Manufacturer		
27	Overall dimensions	mm	
28	Total weight	kg	
	DC Switchboard		
29	Manufacturer		
30	Type		
31	Busbars:		
	- maximum current rating	A	
	- dimensions	mm	
32	Boost charge contactors:		
	- manufacturer		
	- maximum current rating		
	- coil rating		
	- method of interlocking		
33	Alarm relays:		
	- manufacturer		
	- type and reference		
	- power consumption: c) quiescent d) operated	 A mA	
34	Number and rating of distribution circuits		
35	Overall dimensions	mm	
36	Total weight	kg	

PART 5 - LVAC EQUIPMENT

5.5 LV AC EQUIPMENT

Sl.No.	Description		Bidder's Data
5.1	**Distribution Board**		
1	Manufacturer		
2	Manufacturer's type designation		
3	Rating	Amps	
4	Fault Rating for 1 sec	kA	
5	Voltage	Volts	
5.2 1	**Miniature Circuit Breakers** Manufacturer		
2	Type		
3	Rating	Amps	
4	Fault Rating for 1 sec	kA	

PART 6 - Digital Fault and Disturbance Recorder [DFDR]

5.6 Digital Fault and Disturbance Recorder [DFDR]

SL. No.	Description	UNITS	BIDDER'S DATA
(A)	**GENERAL**		
1	Manufacturer's name & address		
2	Type		
3	Power Supply -power Supply for printer	VDC VAC	
(B)	**ANALOGUE INPUTS**		
1	Number of Channel For Niamatpur : Noagaon : -Expandability		
2	Nominal Current	Amp	
3	Nominal voltage	Vac/Vdc	

SL. No.	Description	UNITS	BIDDER'S DATA
	- Current	mA/Amp	
4	Frequency response		
5	Cut-off frequency		
	(a) Bandwidth	dB	
	(b) Attenuation at	dB	
	(c) Auto adjusted anti-aliasing filters for chosen sampling rate	Yes/No	
	(d) Simultaneously programmable sam-pling rate for all feeders/inputs -Locally Changeable -Remotely Changeable	 Yes/No Yes/No	
	(e) Possible sampling rates	Samples/sec Samples/sec Samples/sec	
6	DC coupled inputs	Yes/No	
7	Resolution	bits	
8	Accuracy	%	
9	Burden 1. Current Circuit at IN 2. Voltage Circuit	 VA VA	
10	Over load 1. Current 2. Voltage circuit	 % In % Vn	
(C)	**DIGITAL INPUTS**		
1	Number of Channel -Expandability (Without and time skew)		
2	Selectable input level	Vdc	
3	Type		
4	Resolution	ms	
(D)	**MEMORY**		
1	Size	MB	
2	Type		
3	Pre-fault time (fast scanning rate)	sec	
4	Post-fault (fast scanning rate	sec	
5	Pre and Post-fault time (slow scanning rate)	sec	
6	In-Built hard disk (auto-maintained	GB	
(E)	**SENSORS/ TRIGERRING CRITERIA**		
	All sensors/trigerrs are preferable Programmable and Virtually recordable	Yes/No	
1.	Logical combination sensor	Yes/No	
2.	Three phase over or under Voltage / Current	Yes/No	
3.	Mono phase over or under Voltage / Current	Yes/No	
4.	*du/dt, dp/dt, dq/dt, [Single/3 Phases], df/dt. etc.	Yes/No	
5.	RMS [Voltage / Current]	Yes/No	

SL. No.	Description	UNITS	BIDDER'S DATA
6.	Zero Sequence	Yes/No	
7.	Negative, Positive Sequence	Yes/No	
8.	Frequency	Yes/No	
9.	DC Step	Yes/No	
10.	Pendling / Swing	Yes/No	
11.	Digital level and edge	Yes/No	
12.	Sensor trigger	Yes/No	
13.	Event Trigger	Yes/No	
14.	Manual Trigger	Yes/No	
15.	Remote Trigger	Yes/No	
(F)	**CLOCK SYSTEM**		
1.	Internal Clock	Yes/No	
2.	Accuracy		
3.	External Synchronization	Yes/No	
4.	Time resolution between 2 synchro-nized pulses		
(G)	**OUTPUT ALARM RELAY CON-TACT**		
1.	Max. operation Voltage DC/AC	Vac / Vdc	
2.	Make and carry for 0.5 sec	A	
3.	Carry Continuously	A	
4.	Break (DC) – resistive	W	
(H)	**INTERFACE FOR DATA COMMUNICA-TION**		
1.	Full definition compression	Yes/No	
2.	Maximum transmission rate	bits / Sec	
3.	Standard serial port (EIA-232-D)	Yes / No	
4.	PrinterPort	Yes/No	
5.	Dedicated serial port for modem	Yes/No	
(I)	**PRINTER DATA**		
1.	Printer amplitude (scaling peak to peak)		
2.	Time Scal (mm / s)		
3.	Printer resolution	mm	
4.	Auto printing	Yes/No	
(J)	Fault Priority transmission	Yes/No	
(K)	Fault location (distance calculation)	Yes/No	
(L)	Test certificates from internationally recognized Laboratories	Yes/No	
(M)	**COMMUNICATION AND REMOTE ANA-LYZING UNIT**		
	1. Processor Pentium	(MHz) Yes/No	
	2. Co-Processor pentium	Yes/No	
	3. Main memory capacity	(Mb) Yes/No	
	4. Color graphics board S-VGA	Yes/No	
	5. Screen S-VGA	Yes/No	
	6. Hard disk unit	Yes/No	
	7. Printer	Yes/No	
	8. Modem	Yes/No	

SL. No.	Description	UNITS	BIDDER'S DATA
*Note: du/dt=Change of voltage, dp/dt=Change of active power, dq/dt=change of reactive power, df/dt=Change of frequency.			

PART 7 - SUBSTATION AUTOMATION SYSTEM

5.7 SUBSTATION AUTOMATION SYSTEM

Sl. No.	Description	Unit	Bidder's Data
1	**General Requirement:**		
	Standards to be complied with Substation Automation system		
	Test Ca. Damp heat steady state		
	Test Db and guidance; Damp heat cyclic		
	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		
	Temperature range (min/max)	^{o}C	
	Relative humidity	%	
	Intelligent Electronic Devices (IED's)		
	- serial communication interface included?		
	- Protection & Control IED's connected same bus?		
	- self monitoring		
	- display of measured values		
	- remote parameterization		
	- disturbance record upload and analysis		
	Availability Calculation shall be furnished for eachequipment as well as for the entire system		
	Main system, HMI, Gateway, IEC have dual communication port		
	SNTP server provide GPS time synchronization to HMI, Gate-way, IED		
	System topology		
2	**Detailed Requirements:**		
	Manufacturer of Substation Automation System		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		

Sl. No.	Description	Unit	Bidder's Data
	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)	Yrs.	
	Design life of substation Automation System	Yrs.	
	Manufacturers quality assurance system		
	Dimensions of cubicle: - Width - Depth - Height - Floor load	 mm mm mm N/m^2	
3	**Station Level Equipment:**		
	Station Controller		
	MTBF (Mean time between Failures)		
	MTTR (Mean time to repair)		
	Station computer dual connection to Ethernet		
	Dual wide screen monitor	inch	
	Dual Station Computers Provided in redundant hot Standby		
	Hot standby take over time		
	Annunciator for Station PC system software		
	Number of years of proven field experience of offeredsoftware	Yrs.	
	Operating System		
	All standard picture as per spec included in HMI		
	Process Status Display & Command Procedures		
	Event processing as per spec		
	Alarm processing as per spec		
	Reports as per spec		
	Trend Display as per spec		
	Graphical Fault l information receiving function		
	Disturbance & Fault recording and analysis with graphical for-mat		
	User Authority levels as per spec		
	System supervision & monitoring as per spec		
	Automatic sequence control as per spec		
4	**Gateway to National Load dispatch Center**		
	Manufacturer		
	Name & type of Product in supplier's catalogue		
	Origin of manufacturer		
	Number of years of proven filed experience of offered unit	Yrs.	
	Insulation tests		

Sl. No.	Description	Unit	Bidder's Data
	Fast disturbance tests		
	Industrial environment		
	Industrial grade hardware with no moving parts		
	Design life of offered equipment	Yrs.	
	MTBF (Mean Time Between Failures)		
	MTTR (Mean Time to Repair)		
	OS (Windows 7 or above)		
	CPU (Intel Xeon or similar)		
	Hard Disk (SSD with more than 50% free space)		
	Memory (Min. 8GB DDR3)		
	Redundant communication channel		
	Dual Connection to Ethernet		
	Communication Protocol (Both IEC 61850 & IEC 60870-5-104 supported)		
	I/O Interface: LAN Port: 8 (min) x FE & GbE with RJ-45 Socket (Teaming function supported) Serial Port: 4 (min) x RS-232 USB Port: 4 (min) x USB 2.0		
	Redundant DC/DC supply (Dual Power Supply)		
	Firewall between Gateway & NLDC		
	Stateful Inspection: Firewall Rules (Incoming/Outgoing, Management), IP masquer-ading, Port Forwarding, DoS Protection, ACL		
	I/O Interface: LAN Port: 4 (min.) x FE & GbE RJ-45 Socket Serial Port: 4 (min) x RS-232 USB Port: 4 (min) x USB 2.0		
	VPN (SSL and IPSec protected)		
	Protocols: Serial, HTTPS, SSH, SNMP		
	Routing Functionality: L3 (Static & OSPF)		
	VLAN Support		
	Cyber Security (IEEE 1686 Standard)		
	Network Interface Firewall must be capable of communicating with at least 3 dif-ferent networks i.e. one with substation's internal network, sec-ond one with NLDC main station and third one with NLDC backup station. OR, Two nos. of firewall must be provided to meet the purpose.		
5	**Station Bus:**		

Sl. No.	Description	Unit	Bidder's Data
	Type of bus/protocol		
	Physical Medium		
	Dual connection		
	Transfer rate/bus speed		
6	**Interbay Bus**		
	Type of bus/protocol		
	Physical Medium		
	Transfer rate/bus speed		
7	**Printer server**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	MTBF		
8	**Event Printer**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Print speed		
	Paper feed/width		
	Character set		
	MTBF		
9	**Hard Copy colour Printer**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Print speed		
	Colours		
	Resolution		
	Character set		
	MTBF		
10	**Master Clock GPS (Global Positioning System) Receiver:**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Stability		
	MTBF		
11	**Bay control Unit - HV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		

Sl. No.	Description	Unit	Bidder's Data
	Number of years of proven field experience of offered unit	Yrs.	
	SeparateBay controller unit provided for each bay & feeder		
	Type of bay controller offered HV/MV		
	Select Before Operate with Open Execute & Close Execute		
	Single bit dependence		
	Interlocking, bay & Station wide		
	Dual connection to Ethernet sw		
	Synchrocheck function: - Maximum Voltage difference - Maximum Frequency difference - Maximum Phase difference		
	Double command blocking		
	Independent settable parameter groups		
	Local Display Unit		
	Sequence of event recorder: - Events - Time resolution		
	Disturbance recorder function		
	Disturbance record transfer function		
	Comtrde file generation		
	Comprehensive self-supervision		
	Battery free backup of events and disturbance records Insulation tests		
	Fast disturbance tests		
	MTBF		
	MTTR		
	Temperature range: IED's - Operation - Transport and storage	 ^{o}C ^{o}C	
	Relative humidity: - Operating max./min. - Transport and storage	 % %	
12	**Back up control mimic -HV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Control functionality: Control of breaker as well as all isolators/earthing switch (Control functionality should not be affected if bay controller fails)		

Sl. No.	Description	Unit	Bidder's Data
	Key-Locked		
	Interlock override function		
	Separate backup control mimic provided for each bay & feeder		
13	**Bay Control Unit - MV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Number of years of proven field experience of offered unit	Yrs.	
	SeparateBay controller unit provided for each bay & feeder		
	Control functionality implementation in software:		
	Select before Operate with Open Execute & Close Execute		
	Interlocking, Bay & Station Wide		
	Dual connection to Ethernet sw		
	Synchrocheck function - Maximum Voltage difference - Maximum Frequency difference - Maximum Phase difference		
	Local Display Unit		
	Sequence of event recorder - Events - Time resolution	 ms	
	Disturbance recorder function		
	Disturbance record transfer function		
	Comtrde file generation		
	Comprehensive self-supervision		
	Insulation tests		
	Fast disturbance tests		
	MTBF		
	MTTR		
	Temperature range: IED's - Operation - Transport and storage	 ^{o}C ^{o}C	
	Relative humidity: - Operating max./min. - Transport and storage	 % %	
14	**Back up control mimic – MV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		

Sl. No.	Description	Unit	Bidder's Data
	Control functionality: Control of breaker as well as all isolators/earthing switches Separate backup control mimic provided for each bay & feeder		
15	**Bay Control Unit - LV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		
	Number of years of proven field experience of offered unit	Yrs.	
	SeparateBay controller unit provided for each bay & feeder		
	Control functionality implementation in software:		
	Select before Operate with Open Execute & Close Execute		
	Interlocking, Bay & Station Wide		
	Dual connection to Ethernet sw		
	Synchrocheck function - Maximum Voltage difference - Maximum Frequency difference - Maximum Phase difference		
	Local Display Unit		
	Sequence of event recorder - Events - Time resolution	 ms	
	Disturbance recorder function		
	Disturbance record transfer function		
	Comtrde file generation		
	Comprehensive self-supervision		
	Insulation tests		
	Fast disturbance tests		
	MTBF		
	MTTR		
	Temperature range: IED's - Operation - Transport and storage	 ^{o}C ^{o}C	
	Relative humidity: - Operating max./min. - Transport and storage	 % %	
16	**Back up control mimic - LV**		
	Manufacturer		
	Name and type of product in supplier's catalogue		
	Origin of manufacturer		

Sl. No.	Description	Unit	Bidder's Data
	Control functionality: Control of breaker as well as all isolators/earthing switches Separate backup control mimic provided for each bay & feeder		
17	**System Performance:**		
	Exchange of display (First reaction)	s	
	Presentation of a binary change in the process display	s	
	Presentation of an analogue change in the process display	s	
	From order to process output	s	
	From order to updated of display	s	
18	**Deviations**		
	Please state all deviations from specification		

PART 8 - FIBRE OPTIC MULTIPLEXER EQUIPMENT

5.8 FIBRE OPTIC MULTIPLEXER EQUIPMENT

SL. No.	Description	Unit	Bidder's Data
1	**GENERAL:**		
	Manufacturer		
	Model No.		
	Type		
	Type of multiplexer		
	Complying to ITU-T rec.		
	Transmission Capacity	Mbit/s	
	Access capacity on 64 kbit/s	channels	
	Access capacity on 2 Mbit/s	channels	
	Redundant central processor		
	Digital cross connect function		
2	**Available AGGREGATES:**		
	Optical aggregates (ITU-T G.957)		
3	**Available TRUNK INTERFACES:**		
	HDB3, 2 Mbit/s interfaces per module	No.	
	Complying to ITU-T rec.		
	HDSL, 2Mbit/s interface: no of copper wires - Capacity on 2Mbit/s or on 1Mbit/s - Capacity selectable	No. ch ch / pair of wire	
4	**Available USER INTERFACES**		
4.1	**Voice interfaces for trunk lines:**		
	1 + 1 com path protection, available for all		

SL. No.	Description	Unit	Bidder's Data
	~~Analogue, 4wire with E&M:Input level~~ ~~Output level~~	dBr dBr	
	Analogue, 2wire with E&M:Input level Output level	dBr dBr	
	Digital, 2Mbit/s CAS or PRI		
4.2	**Voice interfaces for remote Subscriber:**		
	2wire, subscriber side	dBr	
	2wire, PABX side	dBr	
4.3	**Integrated teleprotection**		
4.3.1	**Interface for Commands:**		
	Number of independent commands	No.	
	Transmission time max.	ms	
	Signal voltage	Vpeak	
	1 + 1 com path protection		
4.3.2	**Interface(s) for Differential Protection:**		
	Electrical interface: G.703	kbit/s	
	Optical Interface	kbit/s	
4.4	**Data: channels per module**		
	1 + 1 com path protection, available for all		
	V.24/V.28 (RS-232) data interface	No.	
	V.11/X.24 (RS-422) data interface	No.	
	V.35/ V.36 (RS-485) data interface	No.	
	G.703: 64kbit/s	No.	
	Ethernet: 10/100 BaseT WAN capacity Protocols	No. Mbit/s Mbit/s	
4.5	**Integrated alarm gathering module:**		
	Number of external alarms per module	No.	
	Auxiliary power supply for ext. contacts		
4.6	**Network Management System**		
	Type/Name of configuration tool		
	For fault / configuration management		
	For local / remote operation		
	Data communication network (DCN)		
4.7	**Ambient Conditions:**		
	Storage: ETS 300 019-1-1, class 1.2	°C / % hum	
	Transport: ETS 300 019-1-2, class 2.2	°C / % hum	
	Operation: ETS 300 019-1-3, class 3.1E	°C / % hum	
4.8	**Power Supply**		
	Operation	VDC	
	Fully redundant power supply		

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

PART 9– DIGITAL PABX EQUIPMENT

5.9 DIGITAL PABX EQUIPMENT

SL. No.	Description	Unit	Bidder's Data
1.0	**GENERAL:**		
1.1	Manufacturer		
1.2	Type		
1.3	Complying to ITU-T rec.		
1.4	Analogue Trunk Connectivity		
1.5	Digital Trunk Connectivity(E1/T1)		
1.6	10/100 BaseT Ethernet Connection		
1.7	No of Subscribers	No.	
2.0	**Trunk Connectivity**		
2.1	Analogue Trunk		
2.1.1	- Loop Start/Ground Start(Via peripheral)		
2.1.2	- E&M		
2.1.3	- DID(Direct Inward Dial)		
2.2	Digital Trunk		
2.2.1	- T1		
2.2.2	- E1		
2.2.3	- ISDN Connectivity using BRI/PRI		
2.3	IP Trunk		
2.3.1	- 10/100 Mbps Ethernet(IEEE 802.3)		
2.3.2	- TCP/IP, H.323, T.38(Switching)		
2.3.3	- Voice Compressor : G.711, G729		
2.3.4	- QoS(Quality of Signal) : 802.1		
2.3.5	- SIP(Session Initiation Protocol): RFC 3261		
3.0	**Main Features**		
3.1	- Ring Back		
3.2	- Call Forwarding, park, waiting, pick-up		
3.3	- Call/Message waiting lamp		
3.4	- Hands Free operation		
3.5	- Speed Calling, Stored number redial		
3.6	- Account Code		
3.7	- Automatic Attendant, Auto Answer		
3.8	- Automatic Route Selection		
3.9	- Call-by-call Service, Call Duration Display		
3.10	- Call Transfer, Direct Outward Dialing		
3.11	- Hunt Group, Music on Hold		
3.12	- Night Service, Off-hook Alarm, Redial		
4.0	**Network Management System**		
4.1	Type/Name of configuration tool		
4.2	For fault / configuration management		

SL. No.	Description	Unit	Bidder's Data
4.3	For local / remote operation		
4.4	Data communication network (DCN)		
5.0	**Ambient Conditions:**		
5.1	Storage: ETS 300 019-1-1, class 1.2	°C / % hum	
5.2	Transport: ETS 300 019-1-2, class 2.2	°C / % hum	
5.3	Operation: ETS 300 019-1-3, class 3.1E	°C / % hum	

PART 10– PROTECTION

5.10 PROTECTION RELAYS & ASSOCIOTED EQUIPMENT

5.10.1 Line Distance Protection:

SL. No.	Description	Unit	Guaranteed
1	Manufacturer		
2	Country of Origin (Place of Manufactur-ing)		
3	**Relay Identification**		
3.1	Relay Type & model		
3.2	Relay Software version		
3.3	Relay Hardware version		
4	Language		
5	Housing & mounting		
6	Relay auxiliary voltage	V	
7	Operating frequency	Hz	
8	**Current transformer requirement**		
8.1	No of Inputs	Nos.	
8.2	Nominal current	A	
8.3	Minimum continuous current capacity	A	
8.4	Thermal withstand capacity	A	
9	**Voltage transformer requirement**		
9.1	No of Inputs	Nos.	
9.2	Nominal voltage	V	
9.3	Minimum continuous withstand voltage	V	
10	**Binary input module**		
10.1	Minimum number of inputs	Nos.	
10.2	Minimum operating range	V	
11	**Binary output module**		
11.1	Minimum number of outputs	Nos.	
11.2	Minimum operating range	V	
11.3	Minimum continuous current capacity	A	
11.4	Short time withstand capacity	A	
11.5	Maximum operating time	ms	
12	Number of LEDs	Nos.	
13	HMI		
14	Software requirement		
14	GPS Time synchronization		
16	**Communication interface**		
16.1	Standard protocol		
16.2	Ethernet speed and connector		
17	**Main protection function**		
17.1	Tripping options		
17.2	Number of parameter setting groups	Nos.	

SL. No.	Description	Unit	Guaranteed
17.3	Pre-configuration		
17.4	Number of impedance protection zones	Nos.	
17.5	Shape of impedance zone		
17.6	Reverse looking element		
17.7	Can resistance and reactance reaches be set independent of each other	Yes/No	
17.8	Arc forward and reverse reach setting independent of each other?	Yes/No	
17.9	Switch on to fault	Yes/No	
17.10	Power swing block	Yes/No	
17.11	Communication aided impedance pro-tection		
17.12	Communication aided Directional Earth Fault	Yes/No	
17.13	Impedance zone operating time	Sec	
17.14	Impedance setting range	Ohm	
18	Back up protection function		
19	Control functions		
20	**Monitoring functions**		
20.1	Fuse failure supervision, current circuit supervision	Yes/No	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	
20.3	Fault locator	Yes/No	
20.4	Event records and oscillographic dis-turbance records		
21	Tripping and indication logics		
22	Standards		
23	Type test certificate		

5.10.2 Line Differential Protection:

SL. No.	Description	Unit	Guaranteed
1	Manufacturer		
2	Country of Origin (Place of Manufacturing)		
3	**Relay Identification**		
3.1	Relay Type & model		
3.2	Relay Software version		
3.3	Relay Hardware version		
4	Language		
5	Housing & mounting		
6	Relay auxiliary voltage	V	
7	Operating frequency	Hz	
8	**Current transformer requirement**		
8.1	No of Inputs	Nos.	
8.2	Nominal current	A	
8.3	Minimum continuous current capacity	A	
8.4	Thermal withstand capacity	A	
9	**Voltage transformer requirement**	Nos.	
9.1	No of Inputs		
9.2	Nominal voltage	V AC	
9.3	Minimum continuous withstand voltage	V AC	
10	**Binary input module**		
10.1	Minimum number of inputs	Nos.	
10.2	Minimum operating range	V	
11	**Binary output module**		
11.1	Minimum number of outputs	Nos.	
11.2	Minimum operating range	V	
11.3	Minimum continuous current capacity	A	
11.4	Short time withstand capacity	A	
11.5	Maximum operating time	ms	
12	Number of LEDs	Nos.	
13	HMI		
14	Software requirement		
15	GPS Time synchronization		
16	**Communication interface**		
16.1	Standard protocol		
16.2	Ethernet speed and connector		
16.3	Protection communication		
16.4	Binary input transfer		
17	**Main protection function**		
17.1	Tripping options		
17.2	Number of parameter setting groups	Nos	
17.3	Pre-configuration		
17.4	Differential characteristics		
17.5	Harmonics blocking		
17.6	CT summation		

SL. No.	Description	Unit	Guaranteed
17.7	Emergency protection (Should be enabled in case of differential communication failure)		
17.8	Display options		
17.9	Tripping time		
17.10	Protected distance		
18	Back up protection function		
19	Control functions		
20	**Monitoring functions**		
20.1	Fuse failure supervision, current circuit supervision	Yes/No	
20.2	U, I, P, Q, S, f, PF monitoring	Yes/No	
20.3	Event records and oscillographic disturbance records		
21	Tripping and indication logics		
22	Standards		
23	Type test certificate		

5.10.3 Transformer Differential Protection (3 Winding):

SL. No.	Description	Unit	Bidder's Data
1	Manufacturer		
2	Country of Origin (Place of Manufacturing)		
3	**Relay Identification**		
3.1	Relay Type & model		
3.2	Relay Software version		
3.3	Relay Hardware version		
4	Language		
5	Housing & mounting		
6	Relay auxiliary voltage	V	
7	Operating frequency	Hz	
8	**Current transformer requirement**		
8.1	No of Inputs	Nos.	
8.2	Nominal current	A	
8.3	Minimum continuous current capacity	A	
8.4	Thermal withstand capacity	A	
9	**Voltage transformer requirement**		
9.1	No of Inputs		
9.2	Nominal voltage	V AC	
9.3	Minimum continuous withstand voltage	V AC	
10	**Binary input module**		
10.1	Minimum number of inputs	Nos.	
10.2	Minimum operating range	V	
11	**Binary output module**		
11.1	Minimum number of outputs	Nos.	
11.2	Minimum operating range	V	
11.3	Minimum continuous current capacity	A	
11.4	Short time withstand capacity	A	
11.5	Maximum operating time	ms	
12	Number of LEDs	Nos.	
13	HMI		
14	Software requirement		
15	GPS Time synchronization		
16	**Communication interface**		
16.1	Standard protocol		
16.2	Ethernet speed and connector		
17	**Main protection function**		
17.1	Application		
17.2	Number of parameter setting groups	Nos.	
17.3	Pre-configuration		
17.4	Differential characteristics		
17.5	Harmonics blocking		
17.6	CT ratio matching and vector group compensation		
17.7	CT connection		
17.8	Display options		

SL. No.	Description	Unit	Bidder's Data
17.9	Tripping time		
17.10	Restricted Earth Fault		
18	Back up protection function		
19	Control functions		
20	**Monitoring functions**		
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	
20.2	Event records and oscillographic disturbance records		
21	Tripping and indication logics		
22	Standards		
23	Type test certificate		

5.10.4 Over current and Earth fault protection:

SL. No.	Description	Unit	Bidder's Data
1	Manufacturer		
2	Country of Origin (Place of Manufacturing)		
3	**Relay Identification**		
3.1	Relay Type & model		
3.2	Relay Software version		
3.3	Relay Hardware version		
4	Language		
5	Housing & mounting		
6	Relay auxiliary voltage	V	
7	Operating frequency	Hz	
8	**Current transformer requirement**		
8.1	No of Inputs	Nos.	
8.2	Nominal current	A	
8.3	Minimum continuous current capacity	A	
8.4	Thermal withstand capacity	A	
9	**Voltage transformer requirement**		
9.1	No of Inputs	Nos	
9.2	Nominal voltage	V	
9.3	Minimum continuous withstand voltage	V	
10	**Binary input module**		
10.1	Minimum number of inputs	Nos.	
10.2	Minimum operating range	V	
11	**Binary output module**		
11.1	Minimum number of outputs	Nos.	
11.2	Minimum operating range	V	
11.3	Minimum continuous current capacity	A	
11.4	Short time withstand capacity	A	
11.5	Maximum operating time	ms	

SL. No.	Description	Unit	Bidder's Data
12	Number of LEDs	Nos.	
13	HMI		
14	Software requirement		
15	GPS Time synchronization		
16	**Communication interface**		
16.1	Standard protocol		
16.2	Ethernet speed and connector		
17	Main protection function		
17.1	Number of parameter setting groups	Nos.	
17.2	Minimum stages in each setting groups for Over-current	Nos	
17.3	Minimum stages in each setting groups for Earth fault	Nos	
17.4	Pre-configuration		
17.5	Tripping time		
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	
17.10	TMS setting range for IDMT		
18	Other protection functions		
19	**Monitoring functions**		
19.1	U, I, P, Q, S, f, PF monitoring	Yes/No	
19.2	Event records and oscillographic disturbance records		
20	Tripping and indication logics		
21	Standards		
22	Type test certificate		

5.10.5 Bay Control & Protection Unit (BCPU):

SL. No.	Description	Unit	Bidder's Data
1	Manufacturer		
2	Country of Origin (Place of Manufacturing)		
3	**Relay Identification**		
3.1	Relay Type & model		
3.2	Relay Software version		
3.3	Relay Hardware version		
4	Language		
5	Housing & mounting		
6	Relay auxiliary voltage	V	
7	Operating frequency	Hz	
8	**Current transformer requirement**		

SL. No.	Description	Unit	Bidder's Data
8.1	No of Inputs	Nos	
8.2	Nominal current	A	
8.3	Minimum continuous current capacity	A	
8.4	Thermal withstand capacity	A	
9	**Voltage transformer requirement**		
9.1	No of Inputs	Nos	
9.2	Nominal voltage	V	
9.3	Minimum continuous withstand voltage	V	
10	**Binary input module**		
10.1	Minimum number of inputs	Nos	
10.2	Minimum operating range	V	
11	**Binary output module**		
11.1	Minimum number of outputs	Nos	
11.2	Minimum operating range	V	
11.3	Minimum continuous current capacity	A	
11.4	Short time withstand capacity	A	
11.5	Maximum operating time	ms	
12	Number of LEDs	Nos	
13	HMI		
14	Software requirement		
15	GPS Time synchronization		
16	**Communication interface**		
16.1	Standard protocol		
16.2	Ethernet speed and connector		
17	**Main protection function**		
17.1	Number of parameter setting groups	Nos	
17.2	Minimum stages in each setting groups for Over-current	Nos	
17.3	Minimum stages in each setting groups for Earth fault	Nos	
17.4	Pre-configuration		
17.5	Tripping time		
17.6	Pick up setting range for Time delayed Directional/Non-directional OC	A	
17.7	Pick up setting range for High set Directional/Non-directional OC	A	
17.8	Pick up setting range for Time delayed Directional/Non-directional EF	A	
17.9	Pick up setting range for High set Directional/Non-directional EF	A	
17.10	TMS setting range for IDMT		
18	Other protection functions		
19	Control functions		
20	**Monitoring functions**		
20.1	U, I, P, Q, S, f, PF monitoring	Yes/No	
20.2	Event records and oscillographic disturbance records		
21	Tripping and indication logics		
22	Standards		

SL. No.	Description	Unit	Bidder's Data
23	Type test certificate		

5.10.6 Busbar and Breaker Failure Protection

SI No.	Description	Unit	Guaranteed
1.1	Manufacturer		
1.2	Country of origin		
1.3	Type of installation		
1.4	Standards		
1.5	Central Unit (CU)		
1.5.1	Terminal type		
1.5.2	Terminal version (software version)		
1.5.3	Central unit for busbar protection must be supported for min. 16 bays		
1.6	Bay Unit (BU)		
1.6.1	Terminal type		
1.6.2	Terminal version (software version)		
2			
2.1	Auxiliary supply voltage		
2.1.1	CU, BU Rated auxiliary supply voltage	V d.c.	
2.1.2	CU auxiliary supply redundant		
2.1.3	Interruption in auxiliary d.c. voltage: • Without resetting • Restart time	 ms s	
2.2	a.c. current inputs BU		
2.2.1	Number of inputs		
2.2.2	Rated current Ir	A	
2.2.3	Permissive overload, continuous		
2.2.4	Permissive overload, 1 s		
2.2.5	Burden at Ir	VA	
2.3	Binary inputs CU, BU		
2.3.1	Number of modules		

SI No.	Description	Unit	Guaranteed
2.3.2	Number of inputs per module		
2.3.3	Rated voltage	V d.c.	
2.4	Binary outputs CU, BU		
2.4.1	Number of modules		
2.4.2	Number of outputs per module		
2.4.3	Rated voltage	V d.c.	
2.4.4	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	
2.4.5	Current carrying capacity at rated voltage for signalling contacts, continuous	A	
2.4.6	Number of tripping contacts (high-speed out-put)	pcs.	
2.4.7	Current carrying capacity at rated voltage for tripping contacts, continuous	A	
2.5	LED indications CU, BU		
2.5.1	Number of LED's		
2.5.2	Multi-colour LED's	Yes/No	
2.6	Communication ports CU, BU		
2.6.1	Port for front-connected PC		
2.6.1.1	Protocols supported		
2.6.1.2	Communication speed	Kbit/s	
2.6.1.3	PC connector type		
2.6.2	CU, BU communication media		
2.6.3	CU rear station (system) communication ports		
2.6.3.1	Number of rear ports		
2.6.3.2	Protocols supported		
2.6.3.3	Communication speed	Mbit/s	
2.6.3.4	Connector type		
2.6.4	Time synchronisation		
2.7	Busbar differential protection		
2.7.1	Operating time	ms	
2.7.2	Internal CT radio adaptability		
2.7.3	Multiple tripping criteria, check and bus zone		
2.7.4	Current transformer supervision		
2.7.5	External signal of load transfer starting		

SI No.	Description	Unit	Guaranteed
2.7.6	Busbar protection system should be suitable/adaptable for future switchgear extension or modification		
2.7.7	Bay-selective intertripping		
2.7.8	Phase-segregated measurement system		
2.8	Breaker failure protection		
2.8.1	Setting range	% Ir	
2.8.2	Re-trip time delay range	s	
2.8.3	Re-trip operation mode 1/3ph		
2.8.4	Back-up time delay range	s	
2.8.5	Trip operating time setting resolution	ms	
2.8.6	Trip delay range	s	
2.8.7	Single-phase with/without current		
2.8.8	2-stage operation bay trip repeat/trip busbar		
2.8.9	Selectable operation mode (current, unbalance, low current)		
2.8.10	Independent settable delay times for all operation modes		
2.8.11	Low current mode using the circuit breaker auxiliary contact		
2.8.12	End fault protection		
2.8.13	Independent breaker failure protection per bay unit		
2.9	Disturbance recorder CU, BU		
2.9.1	Number of digital signals		
2.9.2	Number of analogue signals		
2.9.3	External/manual initiation of recording		
2.9.4	Sampling rate	kHz	
2.9.5	Pre-fault time	ms	
2.9.6	Recording time	ms	
2.9.7	Number of recorded disturbances		
2.9.8	Total recording time with max. analogue and binary signals	s	
2.9.9	Output file comtrade format		
2.10	Event recorder CU, BU		
2.10.1	Max. number of events		

SI No.	Description	Unit	Guaranteed
2.10.2	Time tagging resolution	ms	
2.11	Self-supervision CU, BU		
3			
3.1	Test socket BU		
3.2	Setting and configuration approved by Engineer		
3.4	**Centralised, user-friendly configuration and all necessary software tools for full parameterization, and (re)configuration in case of extensions should be delivered**		

5.10.7 Trip Circuit Supervision Relay:

SI No.	Description	Unit	Guaranteed
1.1	Manufacturer		
1.2	Country of origin		
1.3	Type		
1.4	Standards		
2			
2.1	Auxiliary supply voltage		
2.1.1	Rated auxiliary supply voltage	V d.c.	
2.2	Binary outputs		
2.2.1	Number of outputs	NO/NC	
2.2.2	Rated voltage	V d.c.	
2.2.3	Breaking capacity at inductive load with L/R<40 ms, at rated voltage	A	
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous	A	
2.3	Supervised circuits		
2.3.1	Voltage range of supervised circuits	V d.c.	
2.3.2	Injected current of supervised circuits	mA	
2.3.3	Operating time range	s	
2.3.4	Resetting time range	s	

5.10.8 Tripping Relays (High Speed High Impedance Type)

No.	Description	Unit	Guaranteed

1			
1.1	Manufacturer		
1.2	Country of origin		
1.3	Type		
1.4	Standards		
2			
2.1	Auxiliary supply voltage		
2.1.1	Rated auxiliary supply voltage		
2.2	Binary outputs		
2.2.1	Number of outputs		
2.2.2	Rated voltage		
2.2.3	Breaking capacity at inductive load with L/R < 40 ms, at rated voltage		
2.2.4	Current carrying capacity at rated voltage for signalling contacts, continuous		
2.2.5	Make and carry continuously		
2.2.6	Make and carry for 3 sec.		
2.2.7	Break: resistive inductive		
2.3	Supervised circuits		
2.3.1	Voltage range of supervised circuits		
2.3.2	Injected current of supervised circuits		
2.3.3	Operating time range		
2.3.4	Resetting time range		

5.10.9 Test Socket

No.	Description	Unit	Guaranteed
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		
1.4	Standards		
1.5	Each protection device must have its own test socket		
1.6	Test socket must obtain safe online protection testing and maintaining, and performing whole tripping test with following AR		
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		
1.8	Socket should be designed for 4 mm banana plugs access		

5.10.10 Front Panel Annunciation for OHL & Power Transformers

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

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

5.10.11 Front Panel Annunciation for Control Room

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

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

5.10.12 Overall Fault Clearance Times

SL. No.	Description	Unit	Bidder's Data
1	400 kV Busbar Faults:		
	Main protection relay operating time	ms	
	Auxiliary and tripping relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
2	230 kV Busbar Faults:		
	Main protection relay operating time	ms	
	Auxiliary and tripping relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
3	400/230/33 kV Transformer Faults:		
	Main protection relay operating time	ms	
	Auxiliary and tripping relay time	ms	
	Circuit breaker time	ms	
	Total	ms	
4	400/132/33 kV Transformer Faults:		
	Main protection relay operating time	ms	
	Auxiliary and tripping relay time	ms	
	Circuit breaker time	ms	
	Total	ms	
5	400 kV Line Faults:		
5.1	Fault Clearance at Rahanpur:		

SL. No.	Description	Unit	Bidder's Data
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
5.3	Fault Clearance at Bogura		
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
5.6	Fault Clearance at Future Transmission Line		
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
6	230 kV Line Faults:		
6.1	Fault Clearance at Bogura:		
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
6.2	Fault Clearance at : Barapukuria		
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	
6.3	Fault Clearance at Future Transmission Line:		
	Distance protection maximum operating time	ms	
	Permissive scheme time delay	ms	
	Auxiliary relay time (where used)	ms	
	Circuit breaker time	ms	
	Total	ms	

5.10.13 Multi-Phase Auto reclose

SL. No.	Description	Bidder's Data
1.	Manufacturer's name and address	
2.	Country of origin	
3.	Type	
4.	Model No.	
5.	Standard	
6.	Single phase auto reclose	
7.	Three phase auto reclose	

SL. No.	Description	Bidder's Data
8.	Multi-phase auto reclose	
9.	Main -1 Protection	
10.	Main -2 Protection	

5.11 PART 11–OTHERS

Sl. No.	Description	Unit	420kV	245kV	36kV
1	**Structural Steel**				
	Type and standard specification				
	Manufacturer and country				
	Minimum yield strength	kg/mm^2			
	Ultimate tensile strength	kg/mm^2			
2	**Copper Conductors for Earthing system**				
	Type and standard specification				
	Manufacturer and country				
	Conductor material				
	Size of conductors (Solid copper rods)	mm^2			
	Size of conductors (Flat copper bars) (Width×Thickness×Bundles)	mm			
	Rated current	A			
	Short time withstand current	kA rms			
	Peak withstand current	kA pk			
3	**High Voltage Bus Work**				
3.1	**Switchyard Conductor**				
3.1.1	**Cupper Tubular Conductors for Busbar**				
	Type and standard specification				
	Manufacturer and country				
	Inner diameter	mm			
	Outer diameter	mm			
	Rated continuous current (site rating)	A rms			
	Temperature rise at rated current	^{o}C			
	Rated short time current	kA rms			
	Peak withstand current	kA pk			
	Weight	kg/m			
	Moment of inertia	kg-m2			
3.1.2	**AluminiumTubular Conductors for Busbar**				
	Type and standard specification				
	Manufacturer and country				

Sl. No.	Description	Unit	420kV	245kV	36kV
	Inner diameter	mm			
	Outer diameter	mm			
	Rated continuous current (site rating)	A rms			
	Temperature rise at rated current	^{o}C			
	- Rated short time current	kA rms			
	Peak withstand current	kA pk			
	Weight	kg/m			
	Moment of inertia	kg-m2			
	Temperature rise at rated current	^{o}C			
	Rated short time current	kA rms			
	Peak withstand current	kA pk			
	Rated ultimate tensile strength	kN			
	Mass, nominal	kg/m			
	No. of conductors per bundle				
	Bundle configuration				
	Bundle spacing				
3.1.3	**Flexible Bus Conductor**				
	Type and standard specification				
	Manufacturer and country				
	Conductor type				
	Conductor size				
	Standing - No. of Al wires - Dia. Of each wire	mm			
	Overall conductor dia.	mm			
	Cross-sectional area	mm2			
	Rated continuous current (site rating)	A rms			
	Temperature rise at rated current	^{o}C			
	Rated short time current	kA rms			
	Peak withstand current	kA pk			
	Rated ultimate tensile strength	kN			
	Mass, nominal	kg/m			
	No. of conductors per bundle				
	Bundle configuration				
	Bundle spacing				
3.1.4	**Shield Wire**				
	Type and standard specification				

Sl. No.	Description	Unit	420kV	245kV	36kV
	Manufacturer and country				
	Dia. of galvanized steel wire	mm			
	Stranding - No. of Al wires - Dia. Of each wire	 mm			
	Grade of wire				
	Weight of wire	kg/km			
	Minimum breaking strength of wire	kN			
3.2	**Insulators**				
3.2.1	**Station Post Type (for rigid Busbar)**				
	Type and standard specification				
	Manufacturer and country				
	Insulator unit, length/height	mm			
	No. of units in each insulator				
	Power frequency flashover voltage - Dry - Wet	 kV kV			
	Impulse flashover voltage - Positive - Negative	 kV kV			
	Power frequency withstand voltage - 1 min. dry - 10 sec. wet	 kV kV			
	Power frequency puncture voltage	kV			
	Switching impulse withstand voltage, wet	kV pk			
	Lightning impulse withstand voltage	kV pk			
	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			
	Leakage distance	mm			
	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			
3.2.2	**String Type**				

Sl. No.	Description	Unit	420kV	245kV	36kV
	Type and standard specification				
	Manufacturer and country				
	Insulator unit, length	mm			
	No. of units in each insulator				
	No. of insulator strings per conductor (at each end)				
	Dia. of disc	mm			
	Disc spacing	mm			
	Power frequency flashover voltage - Dry - Wet	 kV kV			
	Impulse flashover voltage - Positive - Negative	 kV kV			
	Power frequency withstand voltage - 1 min. dry - 10 sec. wet	 kV kV			
	Power frequency puncture voltage	kV			
	Switching impulse withstand voltage, wet	kV pk			
	Lightning impulse withstand voltage	kV pk			
	Dry arcing distance	mm			
	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			
	Leakage distance	mm			
	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			
3.3	**Clamps and Fittings**				
	Type and standard specification				
	Manufacturer and country				
	Maximum working stresses				
	All accessories for installation (bolts, nuts, etc.)				

PART -12

5.12 POWER LINE CARRIER EQUIPMENT

12.1	**Wave Trap**	Bidder's Data
1.	Manufacturer/model	
2.	Type	
3.	Rated continuous current	
4.	Coil inductance	
5.	Air temperature operating range	
6.	Weight of trap	
7.	Type of protective device	
8.	Temperature rise at normal rating	
9.	Dynamic short circuit rating	
10.	Temperature rise at short circuit rating	
11.	Working tension of strain (mounted units)	
12.	Bandwidth blocked band	
13.	Minimum impedance in working bandwidth	
14.	Compatibility with IEC Recommendation 353	
15.	Mounting details	
16.	MTBF	
17.	Design Life	
18.	Equipment technical description	
12.2	**HF Coupling Unit**	
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**	
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 IEC62488-1	
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 paralleling 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	
12.5	**Digital PLC Terminal (Terminal)**	
27.	Maximum transmitting level for parasitic signals: • 0-4 kHz from the band limits • 4-8 kHz from the band limits • >8 kHz from the band limits	
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	
12.6	**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	
30.	Information to be submitted with the Tender (a) Technical description (b) MTBF calculations (c) Performance graphs/details	
12.7	**PAX Telephone Equipment and Subscriber Equipment**	
(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	
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	

6. Drawings and Other Technical Information to be provided

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

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

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

7. Schedule F: Subcontractors

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

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

Subcontractors

The following Subcontractors are proposed for carrying out the facilities:

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

8. Schedule G : PROPOSED ALTERNATIVE STANDARDS TO WHICH EQUIPMENT SHALL BE PROVIDED

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

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

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

Specified Standard	Alternative Standard	
	Number	Title

9. Schedule H: PROPOSED CONTRACT & SITE ORGANISATION

Personnel

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

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

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

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

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

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

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

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

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

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

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

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

10. From	**11. To**	**12. Company / Project / Position / Relevant technical and management experience**

10. Schedule I: DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH BID AND AFTER CONTRACT

10.1 Drawing and Documets to be Submitted with BID

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

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

2. Outline drawings of all switchgear equipment:-

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

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

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

4. Typical drawing of transformer remote control panel.

5. Following type test certificates of the equipment of similar or higher specifications (higher voltage &higher capacity) required by the bid shall be submitted as per relevant IEC.

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

Type test certificates of Power Transformer, Shunt Reactor, GIS, Circuit breaker and Lightning Arrester shall be issued by any independent STL member testing laboratories or from manufacturer's own testing laboratory. Test carried out at manufacturer's own testing laboratory must have been witnessed and certified by a representative from STL member laboratories.

Power Transformer

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

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

Shnt Reactor:

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

GIS Switchgear: (For **400 kV / 63 kA / 4000 A or higher capacity)**

(a) On one Complete Switchgear

Sl No	IEC 62271-203 Clause	Test Name
i.	6.2	Dielectric tests:
		- Lightning impulse voltage tests
		- Power-frequency voltage tests
ii.	6.4	Measurement of the resistance of circuits
iii.	6.5	Temperature-rise tests
iv.	6.6	Short-time and peak withstand current tests
v.	6.104	Pressure test on partitions
vi.	6.105	Test under conditions of arcing due to an inter-nal fault
vii.	6.106	Insulator tests

(b) Circuit Breaker

Sl No	IEC 62271-203 Clause	Test Name
ii.	6.101	Mechanical and environment al tests
iii.	6.103	Test circuits for short circuit making and breaking tests
iv.	6.108	Single-phase and double-earth fault tests
v.	6.109	Short-line fault tests
vi.	6.110	Out-of-phase making and breaking tests

(c) Disconnector & Earthing Switch

Sl No	IEC 62271-203 Clause	Test Name
ii.	6.101	Tests to prove the short-circuit making perfor-mance of earthing switches
iii.	6.102	Operating and mechanical endurance tests
iv.	6.106	Bus-transfer current switching tests
v.	6.107	Induced current switching tests

(d) Current Transformer

i. Short-time current tests

ii. Temperature-rise test

iii. Impulse tests on primary winding

(e) Voltage Transformer

i. Temperature-rise test

ii. Lightning Impulse test

(f) Gas leakage rate (Per year)

Circuit Breaker (AIS)

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

Disconnector (AIS)

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

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

Current Transformer (AIS)

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

f. Partial Discharge Measurement test

Voltage Transformer (AIS)

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

Lightning Arrester (AIS)

a. Power frequency voltage withstands and lightning impulse voltage withstand tests on complete arrester housing.
b. Operating duty test.
c. Long duration current impulse withstand test.
d. Residual voltage test.
e. Pressure relief test.
f. Artificial pollution test.

Wavetrap

a. Impulsevoltagetest
b. Power frequencyvoltagetest
c. Temperaturerise test
d. Radio interferancetest
e. Short time current withstand test
f. Measurement of tapping loss&tappinglos basedon the blocking resistance

Insulator Units

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

a. Dry lightning impulse voltage withstand test;
b. Wet power frequency voltage withstand test;
c. Electro-mechanical failing load test;
d. Thermal mechanical performance test;
e. Impulse voltage puncture test;
f. Power arc test.

Substation Automation System and Protection Relays

- Type test certificates from independent reputed testing laboratory for protective relays as per IEC 61850.

DC System

1) Battery

(i) Test for capacity.
(ii) Test for retention of charge.
(iii) Ampere-hour (at 5 hour rate) and watt-hour efficiency test.
(iv) Test for voltage during discharge.

2) Battery Charger

(i) Short circuit Performance
(ii) Efficiency and power factor measurement test
(iii) Temperature rises test so as to determine the temperature rise of SCR, Transformer primary, Secondary and core, Diode, capacitor, choke and cabinet etc.
(iv) Measurement of insulation resistance.
(v) High Voltage Tests.
(vi) Measurement of ripple voltage test at No, half & full Load

XLPE Power Cable

g. Bending test on Cable
h. Ten Delta measurement test
i. Heating cycle voltage test
j. Partial discharge tests:At ambient temperature, andAt high temperature.
k. Switching impulse voltage test
l. Lightning impulse voltage test followed by a power frequency voltage test
m. Short Circuit Test

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

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

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

(i) Power transformer
(ii) Switchgears (CB, DS/ES) &
(iii) Instrument Transformer
(iv) Relays& substation Automation System
(v) Fibre Optic Multiplexer Equipment for protection and communication
(vi) GIL / Under ground power cables
(vii) Surge arrester
(viii) Wave trap
(ix) Bus Reactor
(x) DFDR
(xi) Battery & charger
(xii) Insulator

10.2 Drawings and Documents to be Submitted after Contract

Technical Drawings/Documents

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

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

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

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

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

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

The Technical documents shall have the followings features:
a) Units:
International System of Units (SI) shall be applied to all works.
b) Language:
English shall be the formal language, hence all documents, correspondences, drawings, reports, schedules, instructions, name plates, rating plates, caution plates and notices shall be written in English.
c) Symbols, Marks and Abbreviations:

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

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

d) Sizes and Identifications of Documents:

The size of the drawings shall be standardized as follows:

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

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

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

Typical Technical Documents Required to be Submitted to the Employer:

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

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

The following drawings shall be submitted with the Bid:

a) General arrangement of substation.

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

b) General arrangement and overall dimension drawings of the switchgear.

c) Single line diagram of the main connections with secondary circuit of protection and metering etc.

d) General arrangement for transformers.

e) General arrangement of control and indicating panels.

f) General arrangement of relay panels

g) Drawings for MV switchgear & auxiliary buildings and guard house including floor plan, section, elevation and dimensions.

h) Catalogues, literature and reference list of proposed Switchgear equipment, protection relays and SAS.

i) Quality Management System Manual and ISO Certificate of the equipment manufacturer for 400kV & 230kV GIS, Auto Transformer, Shunt Reactor, 33kV Switchgear, Protection relays, Battery and Battery charger, Communication equipment and SAS.

j) Type testing certificates and procedures for similar switchgear, transformer, shunt reactor, circuit breaker, cable, etc.

k) Routine testing certificates and procedures for all equipment.

B) After Contract Award Stage:

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

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

After contract signing, the Contractor shall create and submit a master list of drawings and documents to the Employer for approval, for the purpose of monitoring and smooth processing of document

approval, which shall contain document title and number, date to be submitted, re-submission date, approval date etc. underneath each column of relevant document classification or category.

i) Single Line diagram (SLD) for main circuits and secondary circuits.

ii) Layout drawings of the substation showing buildings/rooms, equipment arrangement, over-all dimensions of equipment bays, cable routes or connections between equipment, internal/access roads and phase-phase and phase-earth clearances where applicable.

iii) Outline drawings of switchgear bays, circuit breakers, disconnecting switches, earthing switches and other main plant showing overall dimensions and weights, including details for shipping.

iv) General arrangement for transformers and shunt reactors.

v) Bushings or cable termination details for switchgears and transformers/reactors.

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

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

viii) SAS system configuration and related drawings

ix) AC/DC system and panels arrangement drawing

x) Telecommunication equipment system diagram & panel arrangement

xi) Detailed schematic diagram for all equipment

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

xiii) Civil Engineering/design drawings

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

xv) Others, when required

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

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

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

b) Subcontractors & manufacturers:

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

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

c) Specifications:

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

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

d) Calculation sheets:

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

i) 230/33kV/LV cable sizing calculation

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

iii) Batteries and Battery Charger capacity

iv) Auxiliary Transformer capacity calculation
v) Earthing system, conductor sizing and safety of personnel and equipment calculations
vi) Detailed civil structural design calculations.
vii) Protective Relay settings calculations and recommendations
viii) Insulation coordination study

e) Lists:

The following lists shall be submitted for approval:

- Cable Lists
- List of site installation equipment
- List of Test Equipment and Special Tools.
- List of Spare Parts

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

Required Numbers of Drawings/Documents:

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

a) During the Design/ Manufacturing stage:

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

.

b) Before energizing stage:

- Red mark corrected drawings : 4 copies.

c) After commissioning test:

- Complete sets of bound prints of As-built drawings : 4 copies.

d) After Final Acceptance:

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

Corresponding Letters:

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

11. Schedule J: DEPARTURES FROM THE SPECIFICATION

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

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

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

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

Item	Volume	Clause	Detail of Departure from Specification
			NOT APPLICABLE

12. Schedule K: COEFFICIENT AND INDICES FOR PRICE ADJUSTMENT

Price Adjustment Formula

Prices payable to the Contractor, in accordance with the Contract, shall be subjected to adjustment during performance of the Contract to reflect changes in the cost of labor and material components, in accordance with the following formula. Each percentage of the formula (except the fixed element) shall be changed by the Contractor.

(1) Transformer and Shunt Reactor

$$P_1 = P_0 \times (a + b\frac{L_1}{L_0} + c\frac{M_{11}}{M_{01}} + d\frac{M_{12}}{M_{02}} + e\frac{M_{13}}{M_{03}} + f\frac{M_{14}}{M_{04}}) - P_0$$

Where,

P_1 = Price Adjustment amount of power transformer and shunt reactor, payable to the Contractor

P_0 = Contract Price (base price)

a= percentage of fixed element in Contract Price (a = 15%)

b= percentage of labour component in Contract Price (b = 20%)

c= percentage of material Core (Si steel) component in Contract Price (c = 22%)

d = percentage of material (Copper) component in Contract Price (d = 25%)

e = percentage of material (Steel) component in Contract Price (e = 15%)

f = percentage of material (Zinc) component in Contract Price (f = 3%)

L_0, L_1= labour indices applicable to the appropriate industry in the country of origin of the base date and the date for adjustment, respectively

M_{01}, M_{11}= material (Core, Si steel) indices applicable to the appropriate industry in the country of origin of the base date and the date for adjustment, respectively

M_{02}, M_{12}= material (Copper) indices applicable to the appropriate industry in the country of origin of the base date and the date for adjustment, respectively

M_{03}, M_{13}= material (Steel) indices applicable to the appropriate industry in the country of origin of the base date and the date for adjustment, respectively

M_{04}, M_{14}= material (Zinc) indices applicable to the appropriate industry in the country of origin of the base date and the date for adjustment, respectively

Conditions Applicable To Price Adjustment

The Bidder shall indicate the source of labor and materials indices and the base date indices in its Bid.

Item	Country of Origin;	Source of Indices Used	Base Date Indices

	Currency of index	Title / definition	ValueDate
L_0, L_1 (Labour)			
M_{01}, M_{11} (Si Steel)			
M_{02}, M_{12} (Cop-per)			
M_{03}, M_{13} (Steel)			
M_{04}, M_{14} (Zinc)			

The following conditions shall apply:

a. The base date shall be the date 28 days prior to the deadline for submission of the Bid.

b. The date of adjustment shall be the mid-point of the period of manufacture of the component or Plant. The mid-point shall be determined by considering the start date of manufacture to be 30 days after Contract Effective Date. The end date of manufacture is considered to be 30 days prior to the shipping date.

c. No price increase will be allowed beyond the original delivery date unless covered by an extension of time awarded by the Employer under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Employer will, however, be entitled to any price decrease occurring during such periods of delay.

d. If the currency in which the Contract price, P_0, is expressed is different from the currency of the country of origin of the labour and/or materials indexes, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall correspond to the ratio of exchange rates between the two currencies on the base date and the date for adjustment as defined above.

e. No price adjustment shall be payable on the portion of the Contract price paid to the Contractor as an advance payment.

f. If no data is entered for one item in the above table, the price adjustment does not apply to this item.

g. Any payments resulting from price adjustments will be settled at the end of contract.

Coefficient Scope of Index	**Country of Origin; Currency of Index**	**Source of Index; Title/Definition**	**Value on Stated Dates**	
			Value	**Date**
For Transformer& Reactor: a= b= c= d= e= f=				