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SECTION 7.1

TECHNICAL SPECIFICATIONS FOR 33 KV GIS SWITCHING STATION SWITCHGEAR

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7.1 TECHNICAL SPECIFICATIONS FOR 33 KV GIS SWITCHING STATION SWITCHGEAR

7.1.1 Scope

This clause describe the General Technical Requirements for the new 33 KV indoor gas insulated Switchgear and general switchyard equipment, and shall be read in conjunction with the Project Requirements, Schedules and Drawings in the specification.

The Contractor shall demonstrate that the switchgear has been designed, built and installed in accordance with the relevant international standards and the specification. It shall also operate and perform on a site in accordance with the requirements of the specification and in the environment defined herein.

The design shall be proven by the submission at the time of Tender of test certificates covering all specified tests deemed to be pertinent to the plant and to the conditions in which it will operate or, if such test certificates cannot be supplied or are deemed unacceptable by the Engineer, type tests which will be subject to the conditions of this Contract shall be carried out at no extra cost to the Employer.

The requirement for switchgear spares, tools and appliances, including test, maintenance and handling equipment shall be as stated in the Bid document. All devices necessary for operation and earthing shall be provided within the Contract Price.

7.1.2 References

British Standards

BS 159 Specifications for HV bus bars and bus bar connections
BS 1977 Specifications for high conductivity copper tubes for electrical
BS 2898 Specifications for wrought aluminum for electrical purposes. Strip with drawn or rolled edges.
BS 3938
BS 5253 Specifications for AC disconnectors and earthing switches.
BS 6651 Lightning Protection
BS 7354 Code of practice for design of HV open terminal stations.

IEC Standards

1.	IEC 62271	HV Switchgear and Controlgear.
2.	IEC 60376	Specification and acceptance of new sulphur hexafluoride
3.	IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment.
4.	IEC 60060	High Voltage test techniques.
5.	IEC 60071	Insulation Co-ordination
6.	IEC 60099-5	Surge arresters Part 5: Selection and application reccommandation
7.	IEC 60129	AC disconnectors (isolators) and earthing switches
8.	IEC 61689	Current transformers.
9.	IEC 61689	Voltage transformers.
10.	IEC 60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
11.	IEC 61850	Communication network and system in switching station

12.	IEC 60529	Degrees of protection provided by Enclosure (IP code)
13.	IEC 60255	Electrical relays
14.	IEC 62271-1	High voltage switchgear and control gear: common specification
15.	IEC 62271-100	High voltage switchgear and control gear: Part 100: Alternating current circuit breakers
16.	IEC 62271-102	High voltage switchgear and control gear: Part 102: Alternating current disconnector and earthing switch
17.	IEC 61850	Communication Protocol

7.1.3 33KV Gas Insulated Switchgear (GIS) Cubicle

7.1.3.1 Switch gear–Design and Performance:

33 KV gas insulated switchgear shall be suitable for indoor location and capable of continuous operation under the climatic conditions existing on site. It shall be designed to comply with this Specification and relevant IEC Standards.

In all cases the ancillary plant necessary to complete installation of the equipment shall be included in the Contract.

The disposition of plant in any switching station is to be such that the operation of any item of plant under the specified service conditions shall in no way create a condition that could adversely affect the performance of adjacent circuit breakers or any associated equipment.

The Contractor is to ensure that the complete switching station installation will satisfy the requirements of this Specification and the appropriate Standards in respect of insulation, fault levels, mechanical stress etc. and any additional equipment found to be necessary to meet these requirements shall be deemed to have been included in the Contract Price.

The layout and design of plant and equipment on switching station sites shall make provision for the future extensions of same capacity switching station shown on the layout drawings and shall provide for ready access for operation, maintenance and extension whilst the remaining sections of equipment are alive. Working clearances provided between isolated equipment and nearest live metal work shall not be less than the British Standard section clearances.

Insulation creepage distances shall not be less than 25mm per KV rated voltage between phases.

The Contractor shall be responsible for ensuring that insulation co-ordination in accordance with recommendation of IEC-71 is achieved. Dynamic and temporary over voltages shall be assumed to be in accordance with normally accepted IEC levels.

The 33 KV Gas Insulated switchgear with circuit breakers having vacuum interruption facility shall be Indoor, Metal clad, dust & vermin proof, factory assembled, type tested, protected against condensation and aggressive gases, single busbar and single phase encapsulated or three phase encapsulated. All high voltage components/ parts must be fully gas insulated sealed hermetically and safe-to-touch. The Switchgear (primary section) panel shall be filled with insulating gas at site or in factory and fitted with gas monitoring device with contact. SF6 may be used as an insulating medium, not for quenching.

All control and monitoring elements should be accessible from the front.

The arrangement of the Circuit-breaker in the panel must be such that in the event of any necessary inspections both the operating mechanism and the arc chambers can be removed and reinstalled from the front or back in a verifiably short time. The bus bars must remain in uninterrupted operation and there must be no reduction in either the insulation level (additional measures such as protective barriers are not permitted) or personal safety. Confirmation must be provided with the quotation.

Each sealed-off gas compartment must have its own pressure relief facility, which in event of arcing fault prevents uncontrolled rupturing of the compartment. The manufacturer must guarantee an adequate pressure reserve between the operating value of the pressure relief and the rupturing pressure of the vessels. The pressure relief facilities must limit the effects of a fault arc to one compartment. Gas escaping under pressure must divert in a direction that is not dangerous for operating personnel; the same applies to fixed parts (rupture diaphragms etc).

Pressure monitoring takes place with contact-making manometer gauges with scale, which function independently for each bus bar section, three-position switch gas compartment or bus bar voltage transformer set respectively or temperature compensated gas sensors for each gas compartment, which shall be equipped with self-supervision. The gas pressure gauge shall be installed at the front of the switchgear panel and shall be easily visible.

The gas compartments must be well sealed both mutually and to their surroundings. The gas loss must not exceed 0.1% per year and compartment. The filling pressure must be selected so that after thirty years of operation the full test voltages can still be withstand, without any topping up.

The use of plastics must be minimized, in order to likewise minimize the risk of fire in the event of a fault.

The Current transformer must be of the di-electrically non-stressed ring type mounted outside the gas compartment and shall be easily replaceable without gas work.

The Voltage transformer for both busbar and incomer shall be of plug-in-design separate housing filled with SF6 gas to be connected to the bus bar and located outside of the gas enclosure and disconnectable by a three position isolation switch.

Incoming of 800 sq. mm. and outgoing 500 sq.mm. Cable termination shall be totally insulated. Provision should be kept for plug-in connection of at least

a) Four cables per phase for all switching station incoming .

b) Two cables per phase for all switching station outgoing .

The LV compartment shall be made of high quality sheet steel with powdered coated painting with sufficient space for mounting secondary equipment.

The complete switchgear must be compact in dimension as space is very limited.

Interlocking between the Circuit breaker and three position switch should meet the following conditions:

- to prevent the disconnector from switching under load, they may only be actuated with the circuit-breaker open
- the three-position switch must be prevented from switching through from the closed state in to the "ready-to-earth" position.
- the three-position switch can only be brought into the earthing position if the circuit breaker is open.
- closing of the circuit-breaker must be blocked for as long as the three position switch has not reached a definite switching position.
- for earthing of the feeder, reliable "interrogation interlocking" must be provided. Only the three-position switch is switched into the "ready-to-earth" position, feeder can be earthed and short-circuited by closing the circuit-breaker.

Gas compartment must be provided with gas pressure monitoring by pressure gauge with signaling contacts, to signal any increase drop of gas pressure.

The individual panels are to be connected by solid insulated, plug-in bus bars outside the SF6 Gas compartment. The bus bar is to be located in a metal-clad compartment.

The switchgear must be extendable at both ends of the bus bars. The Vacuum Circuit Breaker as a making/breaking unit, including operating mechanism, must be maintenance free.

The three-position disconnector (ON-OFF-EARTH) is to reduce the number of functional elements within the encapsulation and together with the circuit breaker, provide make- proof earthing.

In order to reduce the number of mechanical parts within the encapsulation, the operating shafts are to be located outside the encapsulation. The switches are to be operated without a seal via gas-

tight welded-in bushings.

The material of the SF6 containers is to consist of non-corroding high-quality steel or aluminium. The live parts are to be insulated against the earthed housing by SF6 gas.

The Instrument Transformers are to be exchangeable toroidal-core or ring type which are to be used outside the SF6 encapsulation so that they are not exposed to dielectric stress.

The cable terminals of the 3-Phases are to be located horizontally next to one another on one level and are to be easily accessible from the front or rear.

7.1.3.2 High Voltage Section

The High Voltage section must be maintenance free and immune to environmental influences. The installation must be resistant to accidental arcs.

All switches are to be operated from the front. The circuit breakers must be remotely controllable.

Capacitive dividers in the bushing to the bushing to the cable terminal compartment are to allow safe testing for dead state at the panel front. The degree of protection of the switchgear must not be reduced here.

7.1.3.3 Gas Compartment Technology

The sealed gas compartment must have its own pressure relief device which prevents uncontrolled bursting of the gas compartment when an accidental arc occurs. The manufacturer must guarantee a sufficient pressure reserve between the operating pressure of the pressure relief devices and the bursting pressure of the container.

The gas compartment must be tightly sealed. The filling pressure is to be such that at least 30 years service is guaranteed without the necessity of refilling. The design of the HV compartment shall be such that no disruptive discharge will occur between live parts and between live parts and earth even at atmospheric pressure at maximum system voltage.

The pressure of the SF6 gas is to be monitored inside the gas compartment by means of pressure-gauge boxes or temperature compensated sensor with self-supervision. In this way, complete temperature compensation can be achieved. Any pressure drop beyond the safe level as specified by the manufacturer shall be indicated in the form of sound and light alarm. Each Bus-section shall have individual pressure monitoring arrangement.

7.1.3.4 Locking Devices

Three-position disconnectors (ON-OFF-EARTH) must be mechanically and electrically locked and against the circuit breaker.

The inductive type Cast-resin insulated Voltage transformer shall be mounted outside the primary enclosure. The VTs can be plugged into the bus bar. The Voltage transformer on bus bar must be designed for 80% Power frequency withstand voltage so that repeat tests can be carried out on the bus bar without removal of the transformer. However, the voltage transformer on bus bar must be capable of withstanding over 100% power frequency withstand voltage under normal operating conditions.

The LV compartment shall be made of high quality sheet steel with powdered coated painting with sufficient space for mounting secondary equipment.

7.1.3.5 Current Ratings

Every current-carrying part of the switchgear including current transformer, busbars, connections, contacts and joints shall be capable of carrying its specified rated current at rated frequency continuously and in no part shall its temperature rise exceed that specified in relevant standards.

7.1.3.6 Corona

Equipment shall be designed so as to minimize corona or other electrical discharge and radio interference. Tests for corona and radio interference shall be carried out by the Contractor at his Works and on Site.

7.1.3.7 Local, Remote and Supervisory Control

Circuit breakers and motorized disconnectors shall be electrically controlled locally, remotely and by supervisory control. Also manual option should be available from panel front.

Position indication of these devices shall be provided via auxiliary switches on their operating mechanisms and the Contractor shall include the supply and fitting of the necessary auxiliary switches.

For supervisory control, the interface between the automation devices and the control equipment being provided under this Contract shall be as specified in **Section–7.2** (Switching station Automation system)

7.1.3.8 Circuit Breakers

7.1.3.8.1Type

33 KV Gas Insulated circuit breakers having vacuum interruption facility shall have spring operating mechanism.

7.1.3.8.2Operating Duty and Performance

i) General

The requirements of IEC-62271-100 in respect of type tests, service operation and the making and breaking of fault currents shall apply to all types of circuit breakers. Designs shall be suitable for interrupting 3-Phase ungrounded faults.

ii) Test Certificates

Circuit breakers shall be covered by test certificates issued by a recognized testing laboratory certifying the operation of the circuit-breaker at duties corresponding to the rated breaking capacities of the circuit-breakers. The test duty shall not be less onerous than the requirements of IEC 62271 or equivalent. Test certificates shall be submitted with the Bid. Test certificates should conform to current standards for type test approval tests.

iii) Rate-of-Rise of Restriking Voltage

Attention is drawn to the requirements of the minimum inherent rates of rise of restriking voltage of test plant arrangements. Where not specifically stated in the test certificates submitted with the Bid, the Bidder shall certify that the TRV to which the circuit- breaker was subjected during the short circuit tests was the most severe condition that could be imposed by the available test plant for a first phase-to-clear factor of 1.5.

Any device incorporated in a circuit breaker to limit or control the rate of rise of restriking voltage across the circuit breaker contacts shall likewise be to the Engineer's approval and full descriptions of any such device shall be given.

iv) Interrupting Duties

In addition to the requirements of IEC 62271 for interrupting terminal faults, circuit- breakers shall be capable of coping with the interrupting duties produced by the switching of low inductive currents associated with reactors or transformer magnetizing currents, or by the switching of capacitor currents associated with overhead line-charging, cable-charging or capacitor banks as may be applicable. Circuit breakers shall be restrike-free type for these duties.

Circuit breakers shall be capable of interrupting currents associated with short-line faults and the out-of-phase switching conditions that may occur in service.

Bids should include a statement of the accumulative breaking capacity which the circuit- breakers are capable of before maintenance is required.

v) Insulation Coordination

The insulation strength across the open circuit breaker shall be at least 15 per cent greater than the line to ground insulation strength for all impulse, switching surge and power frequency voltage conditions.

7.1.3.8.3 General Arrangement

For indoor switching-station circuit breaker shall be suitable for mounting directly on the cubicle. Evidence shall be provided that enclosures subject to pressures in excess of normal atmospheric pressure during service operation have withstood approved pressure tests without leakage, permanent distortion or any temporary distortion such as might cause mal-operation of the circuit breaker.

7.1.3.8.4Contacts, Arcing chambers and insulation

Separate arcing contacts shall be provided on the circuit breakers to protect the main contacts from burning during operation and shall be arranged to ensure arcing after commutation of the main current always occur in the arcing zone between the arcing contacts.

Design shall permit rapid repair or replacement of complete interrupting chambers of SF6 circuit breakers.

Static and moving seals shall be designed to prevent any leakage of gas or oil or ingress of moisture whilst in service and without deterioration.

Pressure sensitive devices to prevent switching at SF6 gas, pneumatic or hydraulic operating pressures outside the declared limits of operation shall be included.

Where single rods or tubes are utilized for operating the moving contacts of circuit breakers, they shall be securely pinned at each end to prevent rotation or displacement of the contacts. Tubes shall be plugged in an approved manner where contacts or other parts are fixed to the tubes.

Circuit breakers of the SF6 type shall not comprise materials liable to deterioration or create undesirable chemical action when in contact with oil or SF6 and its by products under service conditions. Precautions to minimize the presence of moisture and other by products of arcing in SF6 design shall be incorporated.

Noise made by the circuit breaker when operating under all specified conditions shall be such as to cause a nuisance to residents beyond a radius of 100m. The acceptance noise level shall be in accordance with approved standards.

7.1.3.8.5Operating Mechanisms

Circuit-breaker mechanisms shall be "trip free" as defined in IEC 62271 and BS 5311:1976. It is recognized that it may be necessary for contacts to close momentarily prior to opening to ensure satisfactory current interruptions.

Each part of the operating mechanisms shall be of substantial construction, utilizing such materials as stainless steel, brass or gunmetal where necessary to prevent sticking due to rust or corrosion. The overall designs shall be such as to reduce mechanical shock to a minimum and shall prevent inadvertent operation due to fault current stresses, vibration or other causes.

An approved mechanically operator shall be provided on each circuit-breaker operating mechanism to show whether the circuit breaker is open or closed. Each phase shall incorporate a mechanical indicator or other approved means of position indication where operating mechanism designs do not utilize mechanical coupling between phases. Where circuit breakers comprise three independent units it shall be possible to make independent adjustments to each unit. For 3-Phase operation the three units shall make and break the circuits simultaneously. In the event of any phase failing to complete a closing operation, provision shall be made for automatic tripping of all three phases of the circuit breaker.

Power closing mechanisms shall be recharged automatically for further operations as soon as the circuit-breaker has completed the closing operation and the design of the closing mechanisms shall be such that the cannot be operated inadvertently due to external shock forces resulting from short circuits, circuit-breaker operation or any other cause.

Circuit-breaker operating mechanisms capable of storing energy for at least two complete closing and tripping operations, local to the equipment and without recharging, are preferred. Mechanisms incapable of storing energy for at least two complete operations shall utilize the switching station DC supply for recharging the mechanism.

7.1.3.9 Operating Cubicles

Circuit-breaker operating mechanisms, auxiliary switches and associated relays, control switches, control cable terminations and other ancillary equipment shall be accommodated in aluzinc/anodized coated sheet aluminum vermin-proof and weatherproof cubicles. Where appropriate the cubicles may be free standing. Cubicles are to be painted with RAL 7044 & RAL 7032 colour.

Cubicles shall be of rigid construction, preferably folded but alternatively formed on a framework of standard rolled steel sections and shall include any supporting steelwork necessary for mounting on the circuit breaker or on concrete foundations. Bolts or carriage keys shall not be used to secure the panels or doors. All fastenings shall be integral with the panel or door and provision made for locking. Doors and panels shall be rigid and fitted with weatherproof sealing material suitable for the climatic conditions specified.

Cubicles shall be well ventilated through vermin-proof louvers comprising a brass gauge screen attached to a frame and secured to the inside of the cubicle. Divisions between compartments within the cubicle shall be perforated to assist air circulation. In addition, thermostat controlled anti-condensation heater of an approved type shall be provided and controlled by a single pole switch mounted within the cubicle.

Access doors or panels shall be glazed where necessary to enable instruments to be viewed without opening the cubicles. The arrangement of equipment within the cubicle shall be such that access for maintenance or removal of any item shall be possible with the minimum disturbance to associated apparatus.

Circuit breaker control position selector and circuit-breaker operating control switches as specified in the Specification shall be installed in the cubicle. Circuit-breaker control from this position will be used under maintenance and emergency conditions only.

Where practicable an approved schematic diagram of the part of the control system local to the circuit-breaker, identifying the various components within the cubicle and on the circuit- breaker and referring to the appropriate drawings and maintenance instructions, shall be affixed to the inside of the cubicle access door. The diagram shall be marked on durable non- fading material suitable for the specified site conditions.

7.1.3.10 Voltage Transformers

Voltage transformers shall comply with IEC 61869 the requirements of this specification.

Separate sets of fuses or MCBs shall be provided at the VT for:

a) Each protection scheme

b) Instruments, recorder etc.

c) Synchronizing

The circuits for each main protection scheme shall be segregated in separate multicore cables from the VT to the protection panels. An (VT failure) alarm shall be provided for each set of fuses and MCB s.

The 33 KV voltage transformers shall be of the following specifications and ratings: 33 KV /√3: 110V /√3, 110V/√3 for each phase with accuracy class 0.2 and 3P. The insulation value of the PT shall be rated maximum system voltage 36 KV and nominal 33KV, BIL-170 KV and Power Frequency withstand voltage for 1 min. 70 KV. The burden of the PT shall be 50VA.

7.1.3.11 Load Break Switch

The Switch shall be three pole gang operated, be quick make quick break type, have visible position indication, have manual emergency operation, have motorized operation and have anti-pumping feature. Operating Sequence O – 3 min – CO – 3 min – CO. Motor operated spring operated mechanism (Supply Voltage Motor : 230 VAC Control : 110 VDC). Earthing Switch shall be integral with GIS withstand full short circuit current have independent operating mechanism be mechanically interlocked be pad lockable. Mechanical interlocking shall prevent

- Closing earth switch when LBS is closed
- Closing LBS when earth switch is closed
- Unsafe operating sequence
- Incorrect cable access

The equipment shall provide Indications ON, OFF, EARTH. The switch shall be suitable for SCADA Compatibility for (with RTU Interface) Status Monitoring, Alarm Transmission etc.

7.1.3.12 33 kV Potential Transformer (PT) Panel

7.1.3.12.1 Applicable Standards

The PT Panel shall comply with the latest editions of:

- IEC 61869-1 (Instrument Transformers – General)
- IEC 61869-3 (Inductive Voltage Transformers)
- IEC 62271-200 (Metal Enclosed Switchgear)

7.1.3.12.2 Service Conditions

Parameter	Requirement
System Voltage	33 kV
Highest System Voltage	36 kV
Frequency	50 Hz
Installation	Indoor
Ambient Temperature	-10°C to +55°C
Relative Humidity	Up to 100%
Altitude	≤1000 m

7.1.3.12.3 Potential Transformer (VT/PT)

Item	Requirement
Type	Cast Resin / Epoxy Insulated
Rated Voltage	33/√3 kV
Highest Voltage	36 kV
Frequency	50 Hz
Number of Phases	3
Connection	Star-Star
Accuracy Class (Metering)	0.2
Accuracy Class (Protection)	3P
Rated Burden	50 VA
Insulation Level	70/170 kV
Voltage Factor	1.2 Continuous, 1.9 for 30 sec

7.1.3.12.4 Secondary Voltage

- 110/√3 V phase-to-neutral

7.1.3.12.5 Fuse Protection

Primary Side
- HRC Current Limiting Fuse

Secondary Side
- MCB
- Fuse Links

7.1.3.12.6 Metering

Provision for

- Voltmeter
- Voltage Selector Switch
- Energy Meter Interface
- Protection Relays interface
- SCADA Interface

7.1.3.12.7 Protection

The PT panel shall provide

- Secondary Fuse Protection
- PT Failure Alarm
- Secondary Voltage Monitoring
- Phase Failure Indication

7.1.3.13 Current Transformers

Current transformers shall comply with IEC 61689 the requirements of this Specification. Primary winding conductors shall be not less than 100 sq. mm section and shall have a one second

short time current rating not less than that of the associated switchgear. Secondary windings of each current transformer shall be earthed at one point only. Magnetization and core loss curves and secondary resistance shall be provided for each type and rating of current transformer. Where the Contractor wishes to provide current transformer ratios differing from those specified, he shall first obtain approval in writing from the Engineer for each specific instance.

Current transformers for balanced protective schemes, including neutral current transformers where appropriate, shall have identical turn's ratio and shall have magnetization characteristics for each specific instance.

Except where stated in the Schedule of Requirements, all current transformers shall have a maximum continuous primary current rating not less than the primary current rating of the bay in which they are installed.

Current transformers shall be capable of withstanding, without damage, the peak and rated specific short-time currents of their associated equipment. They shall also withstand continuously a current equal to 1.2 times the CT ratio.

Current transformers provided for protective gear purposes shall have over current and saturation factors not less than those corresponding to the design short circuit level of the system. The output of each current transformer shall be not less than 15 VA with an accuracy limit factor (ALF) of 20 and it shall be ensured that the capacity of the current transformers provided is adequate for operation of the associated protective devices and instruments. Where double ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformer indicating clearly the connection required for either ratio. These connections and ratio in use shall be shown on appropriate schematic and connection diagrams.

The accuracy class of all protection CTs shall be 5P or better and that of metering CTs shall be 0.2s or better and factor of security shall be equal or less than 10. The burden of 33KV CT for measurement shall be 15VA and for protection 15 VA (At maximum CT ratio).

Current transformers for all unit type protection shall be of the low reactance type and their performance shall be stated as per IEC standard (low reactance current transformers are preferred for all forms of protection). Current transformers may be shown to be low reactance by virtue of their construction as per IEC Standard.

If all the constructional requirements are not met, then type tests will be required to prove that the

current transformers are low reactance; the primary test current shall not be less than the through fault(stability) current of the protection.

The CT cores for each Main protection scheme shall be segregated in separate multi- core control cables from the current transformer through to protection panels.

Where double ratios are specified with multiple windings, it shall be possible to select either ratio for each winding without alteration to the number of primary turns.

Neutral current transformers shall be of the outdoor totally enclosed, porcelain bushing type complete with suitable mounting steelwork/cast resin insulation as specified and complete with terminal box for secondary connections.

The Contractor shall provide details of their method of calculating the outputs of the current transformers for each type of protection specified and shall submit calculations for all the current transformers to the Employer before starting manufacture.

Current transformer shall be capable of withstanding without damage at full load, peak and rated short time current.

Current transformers shall be located on the non busbar side of the circuit breaker except where current transformers are provided on both sides of the circuit breaker.

The 33 KV feeder (incoming/outgoing) panel CTs shall have two cores for metering and one core for protection. The capacity, ratio and accuracy class of the CT will be of the following specification and rating:

For 33 KV Incomer and BUS Coupler Feeders:

For incoming feeder

2400-1600/1-1-1A,	1st core 15 VA, acc. 0.2s & FS ≤10 for metering.
	2nd core 15 VA, acc. 0.2s & FS ≤10 for metering.
	3rd core 15 VA, acc. 5P20 for protection.

For outgoing feeder

800-400/1-1-1A,	1st core 15 VA, acc. 0.2s & FS ≤10 for metering.
	2nd core 15 VA, acc. 0.2s & FS ≤10 for metering.
	3rd core 15 VA, acc. 5P20 for protection.

The insulation value of the CT shall be rated maximum system voltage 36 KV and nominal 33KV, BIL-170 KV and power frequency withstand voltage for 1 min. 70 KV.

7.1.3.14 Interlocking Facilities

Disconnectors, earthing switches, circuit breakers, etc., shall be provided with an interlocking system, which ensures safe operation of the equipment under all service conditions.

The items of plant supplied under this Contract shall be complete with all interlocking facilities needed for the final arrangement, avoiding the need for future modifications.

Where mechanical key interlocks are employed, they shall be effective at the point where hand power is applied so that stresses cannot be transferred to parts remote from that point.

Tripping of the circuit breaker shall not occur if any attempt is made to remove a trapped key from the mechanism. Emergency tripping devices shall be kept separate and distinct from any key interlocking system and shall be clearly labeled, suitably protected from inadvertent operation but readily accessible.

Circuit breakers shall be interlocked so that, except under maintenance conditions, it is not possible to close a circuit breaker unless the selected bus bar and circuit disconnectors are closed.

Except as stated below, disconnectors shall be so interlocked that they cannot be operated unless the associated circuit breaker is open.

All electrical interlocks shall so function as to interrupt the operating supply, and an approved system of interlocks shall be provided which shall cover the emergency hand operation of apparatus which is normally power operated. Failure of supply (or its restoration after an outage) or of connections to any electrical interlock shall not produce or permit faulty operation. Electrical bolt interlocks shall be energized only when the operating mechanism is being operated. Visible indication shall be provided to show whether the operating mechanism is locked or free. Approved means, normally padlocked, shall be provided whereby the bolt can be operated in the emergency of a failure of interlock supplies.

7.1.3.15 Auxiliary Switches and Contactors

Circuit-breakers, disconnectors and earthing devices and circuit selector disconnectors shall be provided with suitably rated auxiliary switches and contactors, where permitted, to relay circuit information for the purpose of control, protection, indication and metering at the switching station site as required by the relevant section of the Specification. In addition they shall be provided with auxiliary contacts for position indication to the central system control room via the remote supervisory system. Disconnector auxiliary switches are not to be used for current transformer switching circuits.

Auxiliary contactors shall be provided only where the circuit requirement cannot be met by the auxiliary switch arrangements and multiple contractors and relays will not be accepted in lieu of the auxiliary switches except as specifically approved by the Engineer. Auxiliary switches and contractors shall comply with the requirements of this Specification and in particular shall be capable of operation within the same voltage limits as specified for the associated circuit- breaker close and trip coils.

The connections of all auxiliary switches, including spares, and contractors as well as the associated coil connections and interconnections between auxiliary switches, shall be wired to a terminal board located in the operating cubicle or other approved position.

Auxiliary switches and contractors shall be mounted in an approved accessible position clear of the main operating mechanism but with a minimum of additional mechanical linkages and housed in a substantial weatherproof enclosure. Where adjustale linkages are provided to facilitate the timing of the auxiliary switches with respect to the main equipment, approved locking devices shall be fitted.

Auxiliary switch contacts shall be positively operated, make with a wiping action and, where necessary, discharge resistors shall be provided to prevent arcing when breaking inductive circuits.

Except for the contacts employed for control and interlocking, the requirements for auxiliary switches in respect of timing shall be as follows:

For Circuit Breakers

Normally open contacts, with the exception of two sets of this type, shall close in about 10 milliseconds after the making of the main circuit-breaker contacts and shall open in about 10 milliseconds before the separation of the main circuit-breaker contacts whilst the two remaining sets shall close in about 5 milliseconds before the making of the main circuit breaker contacts and open simultaneously with the main circuit contacts.

Normally closed contacts shall close 10 milliseconds after the opening of the main circuit- breaker contacts and open at least 10 milliseconds before the making of the main circuit- breaker contacts.

For Bus Bar Disconnectors

The operating sequence of any disconnector auxiliary switches used in D.C. circuits for high impedance bus bar zone protection shall be such that the auxiliary switches operate:-

a) Before reaching the pre-arcing distance on closing the disconnector.

b) After the pre-arcing distance has been exceeded on the opening of the disconnector.

For Earthing Switches

As for Bus bar disconnector auxiliary switches, Auxiliary switches shall be adjustable from normally-open to normally-closed or vice-versa.

Any deviation from the above should be stated in the GTP of Deviations from Specification.

7.1.3.16 33 KV GIS CUBILES FOR PROTRCTION, CONTROLLING, SIGNALING & METERING:

One panel structure and enclosure assembly with supports, Bus bar compartments, Circuit breaker compartment, LV compartment, V.T Compartment, Cable termination compartment, earthing, Mechanical operating/ Indicating devices, Interlocks, LV compartments with all wiring MCBs, Fuses, Links, Auxiliary relays, Supervision relays, Heater, Humidistat, Indications lamp, control and selector switches, Local and remote switches, Interlocking facilities, Voltmeter with selector switches, Terminal blocks, CTs/ VTs etc. as required for the complete unit for control and protection HV side requirement etc.

All data and documentation shall be supplied with the Bid.

Each item which is obviously necessary for proper function and completion of the work is to be included in the Bid and Contract price, whether especially specified or not.

The switchgear shall be complete in all respects necessary for their effective and trouble free operation when integrated into the system.

1.	Installation	Indoor
2.	Bus-bar Scheme	Single bus bar
3.	Construction	The structure of the cell is made of special sheet clad with convenient treatment which in all respect resists the effected of indoor humid tropicalized climate.
4.	Mounting	Floor Mounting
5.	System	3-Phase, 3-Wire with earthed Neutral
6.	Nominal System Voltage	33 kV Phase to Phase
7.	System Highest Voltage	36 kV Phase to Phase
8.	Rated short duration power frequency withstand voltage	70 kV (rms)
9.	Rated Lightning Impulse withstand voltage	170 kV (peak)
10.	Frequency	50 Hz
11.	Rated normal current for bus bar	3000A
12	Rated normal current for Disconnecting Switch	
	a) for 33 kV Incomer/Bus-coupler	2500A
	b) for 33 kV Outgoing/Aux. Tr.	1250A
13	Rated normal current for circuit breaker	
	a) for 33 kV Incomer/Bus-coupler	2500A
	b) for 33 kV Outgoing/Aux. Tr.	1250A
14.	Temperature rise of any part of the switchgear & control gear	Shall be as per the latest revision of relevant IEC standards.
15.	Rated Short-time withstand Current (Rated short circuit breaking current)	Min 31.5 KA for 3 Sec.
17.	Rated Peak withstand Current (Rated short circuit making current)	Min 78KA
18.	Circuit Breaker Opening Time	≤ 0.05 Sec.
19.	Circuit Breaker Breaking Time	≤ 2/3 Cycle
20.	Rated supply voltage of closing & opening devices and auxiliary circuits.	110 Vdc & 240/415 Vac.
21.	Rated supply frequency of closing & opening devices and auxiliary circuits.	DC & 50Hz.
22.	Rated Operating Sequence	0-0.3sec-CO-3Min-CO
23.	Degrees of Protection by enclosures (IP)	IP4X as defined in IEC 60529
24.	All Current Carrying Parts	Shall be made of copper.

25	Dimensions of all 33 kV Cubicles (including bus bar height and size)	Shall be matched in all respect.
26	Standard	Design, Manufacture, Testing and Performance shall be in accordance to the IEC-62271-200 and other related IEC standards.

7.1.3.17 Incoming & Bus-Coupler Cubicles:

1.	Type of Bus Bar	HDHC copper 3000A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, both spring-operated and stored-energy mechanisms shall be available. With manual Power/Manual, Trip Free, Electrically Spring wound operated by 240 Vac and shunt trip by 110 Vdc from storage battery, 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs. And the disconnector with line earthing provision should be manual & motorized and gang operated
5.	Rupturing Capacity.	1800 MVA, Symmetrical.
6.	Breaking Time.	2-3 Cycle Maximum
7.	Continuous Current Rating.	2500 A
8.	All Current Carrying Parts of Switchgear.	Shall be made of Copper
9.	AC Control Voltage.	240 ± 10% Volts
10.	DC Control Voltage.	110 ± 10% Volts
11.	Cable and Boxes for Incoming.	Suitable for size 4x1Cx800 mm2 XLPE 33kV cables per phase with copper conductors.
12.	Single Phase Current Transformer with Ratio 2400- 1600/1-1-1A of burden & accuracy class-15VA & 0.2S (for measurement) and 15VA & 5P20 (for protection). (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 31.5KA for 3 second & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel).	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)
14.	Numerical programmable type Three Phase combined IDMT Over Cur-rent relay and Earth fault protection relay (with VT input) of 5 or 1 Amps (Selectable), 50 Hz, 110V dc, 3 second operating time ratings having 3 (Three) over current units and one earth fault with current setting range of the O/C & E/F relay shall be from 0.1*In to 30*In (where In is relay nominal cur-rent) for both overcurrent and earth fault element. All O/C & E/F relays shall have both IDMT & DT (51), Instantaneous (50), 52BF, and directional (67/67N) function along with IEC NI, VI, EI, LTI etc. curve setting capability. This relay should have 23 BI, 16 BO (minimum) with	1 set

	rear FO-LC Port for IEC 61850 Communication and rear USB port for relay configuration, Large MIMIC display, CB control button (ON/OFF) (Relay should have communication facilities as per IEC 61850).	
16.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set
17.	All necessary Auxiliary & Signaling relays.	As required.
18.	Numerical Programmable 3 phase, 4 wire, 3 element solid state, indoor type, multi tariff programmable KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, per phase & total KW with maximum demand, KVar, Power factor etc. Numerical Programmable Multifunction KWh Meter shall have communication facilities supported by DLMS/COSEM, IEC 61107 and Modbus or IEC 61850.	1 No.
19.	Indicating digital ampere meter flush mounting type 3 line display to show three phase ampere with accuracy class 1.0 with configurable primary ampere setting (0-2400A) and secondary ampere setting (both 1A and 5A) for connecting to the current transformer	1 No.
20.	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
21.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/ Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position. ANN ACK, ANN reset, Push Button etc.	As required.
22.	33 kV bus incomer Switchgear panel (12 windows Annunciator)	See table below
23.	33 kV PT (for GIS Incomer Line Side)	1 set = 3 nos.
24.	Indicating digital flush mounted voltmeter with three line display having the capacity to toggle between 33 KV line and phase voltages.	1 set
25.	Multifunctional meter (MFM) capable of measuring and displaying MW, MVAR, PF, V, I, f, Φ, etc. distinguishing import and export operation.	1 set

Annunciator:

Main DC Fail	AC Fail	Main Relay Faulty	PT Failure
TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
67 Trip	67N Trip	spare	spare

7.1.3.18 Feeder Cubicles:

1.	Type of Bus Bar	HDHC copper 3000A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, both spring-operated and stored-energy mechanisms shall be available. With manual Power/Manual, Trip Free, Electrically Spring wound operated by 240 Vac and shunt trip by 110 Vdc from storage battery, 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs. And the disconnector with line earthing provision should be manual & motorized and gang operated
5.	Rupturing Capacity.	1800 MVA, Symmetrical.
6.	Breaking Time.	2-3 Cycle Maximum
7.	Continuous Current Rating.	1250 A
8.	All Current Carrying Parts of Switchgear.	Shall be made of Copper
9.	AC Control Voltage.	240 ± 10% Volts
10.	DC Control Voltage.	110 ± 10% Volts
11.	Cable and Boxes for Incoming.	Suitable for size 2x1Cx500 mm2 XLPE 33kV cables per phase with copper conductors.
12.	Single Phase Current Transformer with Ratio 800-400/1-1-1A of burden & accuracy class-15VA & 0.2S (for measurement) and 15VA & 5P20 (for protection). (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 31.5KA for 3 second & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel).	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)
14.	Numerical programmable type Three Phase combined IDMT Over Cur-rent relay and Earth fault protection relay (with VT input) of 5 or 1 Amps (Selectable), 50 Hz, 110V dc, 3 second operating time ratings having 3 (Three) over current units and one earth fault with current setting range of the O/C & E/F relay shall be from 0.1*In to 30*In (where In is relay nominal cur-rent) for both overcurrent and earth fault element. All O/C & E/F relays shall have both IDMT & DT (51), Instantaneous (50), 52BF, and direc-tional (67/67N) function along with IEC NI, VI, EI, LTI etc. curve setting capability. This relay should have 23 BI, 16 BO (minimum) with rear FO-LC Port for IEC 61850 Communication and rear USB port for relay configuration, Large MIMIC display, CB control button (ON/OFF) (Relay should have communication facilities as per IEC 61850).	1 set
16.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set
17.	All necessary Auxiliary & Signaling relays.	As required.
18.	Numerical Programmable 3 phase, 4 wire, 3	1 No.

	element solid state, indoor type, multi tariff programmable KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, per phase & total KW with maximum demand, KVar, Power factor etc. Numerical Programmable Multifunction KWh Meter shall have communication facilities supported by DLMS/COSEM, IEC 61107 and Modbus or IEC 61850.	
19.	Indicating digital ampere meter flush mounting type 3 line display to show three phase ampere with accuracy class 1.0 with configurable primary ampere setting (0-2400A) and secondary ampere setting (both 1A and 5A) for connecting to the current transformer	1 No.
20.	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
21.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/ Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position. ANN ACK, ANN reset, Push Button etc.	As required.
22.	33 kV bus incomer Switchgear panel (12 windows Annunciator)	See table below
24.	Indicating digital flush mounted voltmeter with three line display having the capacity to toggle between 33 KV line and phase voltages.	1 set
25.	Multifunctional meter (MFM) capable of measuring and displaying MW, MVAR, PF, V, I, f, Φ, etc. distinguishing import and export operation.	1 set

Annunciator:

Main DC Fail	AC Fail	Main Relay Faulty	PT Failure
TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
67 Trip	67N Trip	spare	spare

The protection, control & metering panels for 33KV system shall be simplex type so as to accommodate all the control equipment, relays, meters etc. as necessary for completeness of the protection/control scheme without overcrowding and cramping.

The panels shall be vermin and dust proof free standing type completely metal enclosed by sheet steel (2.0 mm thick) with necessary reinforcement color gray with appropriate spray painting. The panels shall be neatly and completely wired before shipment. The work relating to protection, control and Metering for 33KV Switching-stations shall comprise of development of elementary diagram, design, manufacture, test and supply of pre-wired control panels to be installed in the Switching-station control room. The protection, control and panels are to be pre-wired with relays and meters in

position. The elementary primary diagram shall be produced giving a clear representation of each protection, control and metering function. The standard design, drawing, manufacturing, testing & performance shall be in accordance to the IEC-60298 standards.

7.1.3.19 PT Panel Cubicles:

1.	Type of Bus Bar	HDHC copper 3000A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
	Load Break Switch (LBS)	1 (one) no. Three-phase SF_6 (or approved gas-insulated) Load Break Switch, manual and motorized operated, gang operated, with integral Earthing Switch, suitable for indoor GIS, rated 36 kV, 630 A continuous current, short-time withstand current 31.5 kA for 3 seconds, complete with electrical and mechanical interlocks.
4.	Operating Mechanism	Manual and motorized operation, spring-assisted quick make/quick break mechanism, 240 V AC motor supply with local/manual operation facility.
	Short-Time Withstand Current	31.5 kA for 3 seconds
	Voltage Transformer	Three (3) Nos. single-phase epoxy resin insulated VTs, Ratio $33000/\sqrt{3} : 110/\sqrt{3} : 110/\sqrt{3}$, Class 0.2 (metering) & 3P (protection), 50 VA minimum, complete with primary HRC fuses and secondary MCBs.
	VT Supervision Relay	1 Set
	Indicating digital flush mounted voltmeter with three line display having the capacity to toggle between 33 KV line and phase voltages.	1 set
	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
	Auxiliary & Signalling Relays	As required
	Mimic Diagram with LED Indication	1 Set
	All necessary MCBs, Push Buttons, Selector Switches, Wiring, Terminal Blocks, Hooter, Test Links, Lamps, etc.	Complete in all respects

7.1.3.19.1 Optional Provision of Bus Potential Transformer (Bus PT):

The 33 kV GIS may be offered with either:

1. A dedicated 33 kV PT (Voltage Transformer) Panel, as specified in the Schedule of Requirements; or

2. An integrated Bus Potential Transformer (Bus PT) installed within each 33 kV GIS bus section and supplied as an integral part of the respective GIS incoming, outgoing, bus-coupler, bus riser, or bus section panel, provided that all functional, operational and protection requirements specified in this tender are fully complied with.

Where the Bidder proposes an integrated Bus PT arrangement:

a) One (1) set of Bus PT shall be provided for each independent 33 kV bus section.

b) All associated accessories including primary and secondary protection, wiring, terminal blocks, test links, marshalling facilities, auxiliary contacts, supervision circuits and communication interfaces shall be included in the scope of supply.

c) The integrated Bus PT arrangement shall not reduce the operational flexibility, maintainability, reliability or safety of the GIS installation.

d) If the integrated Bus PT arrangement is offered and accepted, no separate 33 kV PT Panel shall be supplied, and the Bidder shall not quote any separate price for the PT Panel in the Bill of Quantities (BoQ). The cost of the Bus PT and all associated equipment shall be deemed to be included in the price of the respective GIS panels.

e) The Bidder shall clearly indicate in the Technical Proposal whether a dedicated PT Panel or an integrated Bus PT arrangement is being offered and shall submit complete technical drawings, single-line diagrams, protection interfaces and GA drawings demonstrating compliance with this specification.

The Employer reserves the right to accept either arrangement, provided that the offered solution fully complies with the technical requirements of this specification without any reduction in functionality or performance.

7.1.3.20 33 KV GIS Auxilary Transformer Cubicles (if LBS type is offered):

1.	Type of Bus Bar	HDHC copper 3000A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
	Load Break Switch (LBS)	1 (one) no. Three-phase SF_6 (or approved gas-insulated) Load Break Switch, manual and motorized operated, gang operated, with integral Earthing Switch, suitable for indoor GIS, rated 36 kV, 630 A continuous current, short-time withstand current 31.5 kA for 3 seconds, complete with electrical and mechanical interlocks.
4.	Operating Mechanism	Manual and motorized operation, spring-assisted quick make/quick break mechanism, 240 V AC motor supply with local/manual operation facility.
	Short-Time Withstand Current	31.5 kA for 3 seconds
	Protection	Primary side HRC fuse, secondary side MCCB
11.	Cable and Boxes	Suitable for size 2x1Cx95 mm2 XLPE 33kV cables per phase with copper conductors.
	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
	Auxiliary & Signaling Relays	As required
	Mimic Diagram with LED Indication	1 Set
	All necessary MCBs, Push Buttons, Selector Switches, Wiring, Terminal Blocks, Hooter, Test Links, Lamps, etc.	Complete in all respects

7.1.3.21 33 KV GIS Auxilary Transformer Cubicles (if VCB type is offered):

1.	Type of Bus Bar	HDHC copper 3000A.
2.	Bus Bar Scheme	Single Bus Bar
3.	Number of Phases	3 (Three)
4.	Operating Mechanism	For Circuit Breaker operation, both spring-operated and stored-energy mechanisms shall be available. With manual Power/Manual, Trip Free, Electrically Spring wound operated by 240 Vac and shunt trip by 110 Vdc from storage battery, 2 Nos. Trip coils. The operating sequence OPEN-CLOSE-OPEN is stored in the springs. And the disconnector with line earthing provision should be manual & motorized and gang operated
5.	Rupturing Capacity.	1800 MVA, Symmetrical.
6.	Breaking Time.	2-3 Cycle Maximum
7.	Continuous Current Rating.	1250 A
8.	All Current Carrying Parts of Switchgear.	Shall be made of Copper
9.	AC Control Voltage.	240 ± 10% Volts
10.	DC Control Voltage.	110 ± 10% Volts
11.	Cable and Boxes	Suitable for size 2x1Cx95 mm2 XLPE 33kV cables per phase with copper conductors.
12.	Single Phase Current Transformer with Ratio 800-400/1-1-1A of burden & accuracy class-15VA & 0.2S (for measurement) and 15VA & 5P20 (for protection). (Characteristics: Epoxy resins insulated and double windings, butyl rubber type. The epoxy resin should be ultraviolet stabilized, fungus resistant & high tracking resistance, short time current ratings 31.5KA for 3 second & extended current ratings 120% of the rated value, secondary double winding, installation shall be in the panel).	3 Nos. (A Phase, B Phase & C Phase Shall have Individual CT)
14.	Numerical programmable type Three Phase combined IDMT Over Cur-rent relay and Earth fault protection relay (with VT input) of 5 or 1 Amps (Selectable), 50 Hz, 110V dc, 3 second operating time ratings having 3 (Three) over current units and one earth fault with current setting range of the O/C & E/F relay shall be from 0.1*In to 30*In (where In is relay nominal cur-rent) for both overcurrent and earth fault element. All O/C & E/F relays shall have both IDMT & DT (51), Instantaneous (50), 52BF, and direc-tional (67/67N) function along with IEC NI, VI, EI, LTI etc. curve setting capability. This relay should have 23 BI, 16 BO (minimum) with rear FO-LC Port for IEC 61850 Communication and rear USB port for relay configuration, Large MIMIC display, CB control button (ON/OFF) (Relay should have communication facilities as per IEC 61850).	1 set
16.	Master Trip & Trip Circuit Supervision (for each trip coil) relays.	1 Set
17.	All necessary Auxiliary & Signaling relays.	As required.

18.	Numerical Programmable 3 phase, 4 wire, 3 element solid state, indoor type, multi tariff programmable KWH Meter of accuracy class 0.2s with the features for measuring the parameters viz. phase voltages, phase currents, per phase & total KW with maximum demand, KVar, Power factor etc. Numerical Programmable Multifunction KWh Meter shall have communication facilities supported by DLMS/COSEM, IEC 61107 and Modbus or IEC 61850.	1 No.
19.	Indicating digital ampere meter flush mounting type 3 line display to show three phase ampere with accuracy class 1.0 with configurable primary ampere setting (0-2400A) and secondary ampere setting (both 1A and 5A) for connecting to the current transformer	1 No.
20.	70W, 240V AC, Single Phase space heater with thermostat and a visible light indicator which indicate the "ON"- "OFF" position of the heater	1 set
21.	All necessary AC DC MCB, TNC Switch, Selector Switch, Limit Switch, Control Switch, Toggle Switch, Link/ Base, Push Button, Indicating/ Illumination Lamp, AC Plug Socket, Wiring, Fuses, Hooter etc. i.e. complete in all respect. Mimic diagram with LED based Semaphore Indicator for Isolator/Breaker/Earth switch position. ANN ACK, ANN reset, Push Button etc.	As required.
22.	33 kV bus incomer Switchgear panel (12 windows Annunciator)	See table below
24.	Indicating digital flush mounted voltmeter with three line display having the capacity to toggle between 33 KV line and phase voltages.	1 set
25.	Multifunctional meter (MFM) capable of measuring and displaying MW, MVAR, PF, V, I, f, Φ, etc. distinguishing import and export operation.	1 set

Annunciator:

Main DC Fail	AC Fail	Main Relay Faulty	PT Failure
TCS-1 Unhealthy	TCS-2 Unhealthy	O/C Trip	E/F Trip
67 Trip	67N Trip	spare	spare

The protection, control & metering panels for 33KV system shall be simplex type so as to accommodate all the control equipment, relays, meters etc. as necessary for completeness of the protection/control scheme without overcrowding and cramping.

The panels shall be vermin and dust proof free standing type completely metal enclosed by sheet steel (2.0 mm thick) with necessary reinforcement color gray with appropriate spray painting. The panels shall be neatly and completely wired before shipment. The work relating to protection, control and Metering for 33KV Switching-stations shall comprise of development of elementary diagram, design, manufacture, test and supply of pre-wired control panels to be installed in the Switching-station

control room. The protection, control and panels are to be pre-wired with relays and meters in position. The elementary primary diagram shall be produced giving a clear representation of each protection, control and metering function. The standard design, drawing, manufacturing, testing & performance shall be in accordance to the IEC-60298 standards.

7.1.3.22 FOR 33 KV GIS PANEL FEATURES:

Each GIS panel shall be equipped with the following:

a) (i) Instruments and Relays described elsewhere. All the relays shall be IEC 61850 protocol type for automation network of the 33kV Switching-station. In addition, numerical relay shall have sufficient contacts and shall be configured for SAS operation. Intermediate auxiliary relay with sufficient spare contacts shall be used for controlling CB or any other switching devices through numerical relay in case of SAS operation.

(ii) The numerical bay control IED's shall be mounted together with all the relevant bay protective relays in cubicles which is to be integrated with SAS.

b) Status indicating discrepancy, Control switches for 33 kV Circuit Breaker with safety arrangements.

c) Illuminated Circuit Breaker and Isolator position switches.

d) Signaling relays (annunciator, compact type) to yield audiovisual signals on faults and have reset Feature

e) The inside of the panel will have all auxiliary relays to sense the operation of gas relays, temperature, over current, differential relay operation failure of auxiliary voltage DC & AC etc. and to transmit for tripping and fault signaling.

f) All inside equipment described and required shall be neatly arranged inside the panel.

g) Thermostat control heater with status indicating Illumination lamp (LED) shall be provided.

h) The terminal blocks for connecting the incoming multi-core cables shall be placed at the bottom part and necessary glands/opening shall be provided for the entry of the outside cables.

i) Sufficient-working spaces shall be provided inside the panel between instruments and wiring for easy approach.

j) All AC, DC auxiliary power circuits and PT secondary circuits entering the control panel shall be provided with MCCB. Separate MCBs shall be provided for DC supply to Power, Control and Alarm & Indication circuits.

k) Provision to hang danger/caution board.

l) The panel shall be SCADA/SAS compatible and hence all intelligent devices, digital energy meters etc. shall comply IEC61850. All physical connections for control, measurement and status indication shall be made SAS ready.

m) Sufficient spare terminals (at least 20%) in each terminal block.

n) There must be two trip coils, both trip coils shall be energized by separate contacts of trip relay for protection tripping. However, for manual tripping, only one trip coil can be engaged only.

o) All CT Terminal blocks shall have shorting, isolating and jacking (test barrel) facility while PT terminal blocks shall have isolating and jacking (test barrel) facility.

p) Circuit Breaker control indicating switches and isolating position indicating lamps to indicate spring Charge/ Readiness for closing and healthy trip circuit indicating readiness for tripping

q) Signaling/Indicating lamps shall be LED type only.

r) Auxiliary relays, trip relays with spare contacts, fuses.

s) All necessary switches etc.

t) Provision for lighting etc.

u) 70W, 230V AC, 1-phase heater with thermostat and control switch. and a visible light indicator which indicate the "ON"- "OFF" position of the heater

v) Mimic diagram along with semaphore for CB, DS and ES. Mimic diagram shall contain LED based Semaphore Indicator instead of moving Semaphore indicator. The color and size of the mimic shall be as described below:

Mimic diagram. The color and size of the mimic shall be as described below :

33 KV	GREEN	½" X 1/8"

w) Ferrule marking and color coding for all type of wiring shall be as follow:

1. Ferrule marking:
   - i. "C"-for O/C & E/F protection circuit
   - ii. "D"- for metering circuit
   - iii. "E"-for PT circuit
   - iv. "L"- for Alarm & Indication circuit
   - v. "S"- for fault recorder
2. Color coding:
   - i. "Black"- for phases of AC supply
   - ii. "White"- for neutral of AC supply
   - iii. "Grey"- for control circuit
   - iv. "Brown & Grey"- for (+) and (-) DC supply respectively
   - v. "Red, Yellow, Blue, Black"- for CT and PT circuit V.
   - vi. "Yellow with green strip"- for earthing.

x) Detailed schematic diagram of control circuit inside panel.

y) Over current & Earth fault protection shall be combined in one relay.

z) Annunciator shall have 12 nos. window for incoming and outgoing panel and 12 nos. windows for auxiliary transformer panel with built-in buzzer.

aa) Necessary communication cable and software shall be supplied.

bb) All type of tripping shall be done through Master Trip relay.

cc) Indicating/Signaling Lamps shall be of LED type. Following LED Indicators including Lamp test facility shall be provided in the panel:

●	●	●	●	●	●	●	●
DC available	AC available	CB open	CB close	Spring charged	CB tripped	CB in test position	CB in service position

dd) The painting shall be gray outside and glazed white inside. (RAL 7032)

Besides the provisions of control, signal, protection and metering described, any other provisions to suit with the requirement of associated equipment of the concern feeder shall be provided. All meters and relays shall be flush mounting. There shall be panel grounding terminal. The bidder shall quote the particulars of various protective relays, meters, Auxiliary relays signaling relays, discrepancy control and position indicating switches etc. of the control panel, mentioning the names of the manufacturers. Each 33KV panel will be connected to 02

DC supply source with redundant hot stand by configuration. Annunciator window shall be 4X3 for incoming and outgoing panel.

Tenderer shall supply related software with licenses (2 copy) and manuals describing trouble shooting procedure (3copies). Two set relay test plug and two set of meter test plug has to supply for each switching station.

Besides the provisions of control, signal, protection and metering described, any other provisions to suit with the requirement of associated equipment of the concern feeder shall be provided. All meters and relays shall be flush mounting. There shall be panel-grounding terminal.

The tenderer shall quote the particulars of various protective relays, meters, Auxiliary relays signaling relays, discrepancy control and position indicating switches etc. of the control panel, mentioning the names of the manufacturers.

7.1.3.23 GIS PANEL CONSTRUCTION DETAILS

a) The Control and Relay Board shall be of Simplex, completely metal closed and the access door shall be provided at the back of each Panel where no instruments or relays shall be mounted. The indicating and signaling devices etc. shall be mounted on the front side and the auxiliaries which shall be inside the Panel.

b) Cubicles shall be drip-proof, and vermin proof, with the minimum IP41 protection degree. Equipment shall be arranged to give reasonable access to all components mounted on the panel front and inside.

c) The individual panel shall be approximately 2300 mm. in height with suitable width and depth to accommodate the equipment. Individual piece of Channel base of PCM Panel is to be provided to obtain the flexibility of inter-changing the Panel, if any.

d) Each panel shall be fabricated from steel sheet (minimum 2mm thick) with necessary steel member reinforcement to make the structure self-supporting. All joints are to be welded and ground to be made smooth.

e) Doors shall be secured by locking integral handles and locking provision shall be made.

f) Mounting brackets required shall be arranged inside the panel for mounting and fixing auxiliary devices and terminal blocks.

g) Instruments meters control switches and protective relays shall be mounted on the front panel only. Panel output mounting studs and support brackets shall be accurately located.

h) Finished panel surface shall be free of waves and other imperfections exterior panel surfaces shall be send blasted, ground smooth, filled, panel and finished with gray enamel. Interior surface shall be sand blasted, primed and finished with glass white enamel.

i) The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciator, audible alarms, horizontal and vertical wiring trough, wiring supports, interior lighting system, terminal blocks , fuses and links etc.

j) The supplier shall furnish internal panel wiring and circuit protection. The supplier shall provide one 100W, 240, AC strip heater in the panel. The heater shall have a separate switch.

k) A lamp shall be fitted inside each cubicle and an utility socket in selected cubicles and so arranged that all wiring is illuminated as evenly as possible without dazzle. The lamps shall be controlled from a door switch. The sockets shall be fused.

l) Design, material selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent front outside, with all exterior surfaces tune and smooth.

m) Cable entries to the panel shall be from the bottom. The bottom plates of the panel shall be fitted with removable gland plates and fixed with cable glands.

n) Engraved name plate shall be provided at the top of the front enclosure.

7.1.3.23.1 Assembly :-

Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC as specified under each equipment in these specifications to demonstrate to the satisfaction of WZPDCL that the switchgear panels comply with the requirements of the relevant IEC standards.

7.1.3.23.2 Casting :-

Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

7.1.3.23.3 Welding:-

Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used. All welders and welding operators shall be fully qualified by such a standard.

7.1.3.24 PANEL WIRING

The supplier shall provide internal wiring and connections, in accordance with the requirements of the following paragraph.

a) All wiring shall be carried out with 1100 volts grade single core, multistrand flexible tinned copper wires with PVC insulation which has provided its utility in tropical region against hot and moist climate and vermin.

b) All wiring used within the panel shall conform to the requirements of these specifications and shall be installed and tested at the factory. All wiring shall be neatly and carefully installed in wring gutters of raceway wiring raceway shall be plastic wiring duct with covers. Instrument wiring on the panel shall be numbered sequentially with color code from the sources to the panel instrument and the number of the source equipment shall be used as a prefix for the individual wire numbers, wiring shall be terminated at terminal blocks plainly lettered or marked in accordance with the manufacturer's connection diagrams.

c) Sufficient clearance shall be provided for all the leads. All the leads for external circuit wiring shall be connected to grounded terminal blocks located for convenient connection of external circuits.

d) Splices will not be permitted in panel wiring. Each wire shall be continuous from end to end and shall not have any joint within itself individually.

e) All the terminal block connections shall be made with ring type lugs. Pre-insulated ring type terminals with crimp guide or per-insulated slotted spring spade terminals shall be provided on devices equipped with individual fitted covers.

f) Arrangement of circuits on terminal block shall be such that all the connections for one circuit, plus any spare conductors, shall have terminal blocks adjacent to the split and shall be provided with wiring required to interconnect the split unit.

g) Terminal Ends of all wires shall be provided with numbered Ferrules. At point of inter-connection where a change of number is necessary, duplicate Ferrules shall be provided with the appropriate numbers on the changing end.

h) Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with

panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected for any purpose. Termination shall be such that no strand of a conductor shall left loose or overhanging. Conductor termination shall be secured to the holding nuts/screws, terminal blocks etc. with washers between the terminals/holding nuts/screw heads. The terminals shall be so connected that no conductor ferrule code gets masked due to overlay of conductors.

i) Wiring connected to the space heaters in the cubicles shall have porcelain beaded insulation over a safe length from the heater terminals.

j) All spare contacts of relays shall be wired up to terminal blocks

k) The size of the wiring used in the panel shall be confirm to the following requirements.

Table 1

Circuit	Permissible size of wire
Metering and Relaying Circuits connected Current Transformer	minimum 4 Sq.mm.
Potential Circuits for metering and Relaying, Control, Visual Audible Alarms and Signaling Circuit	minimum 2.5 Sq.mm

The following colour schemes shall be used for the Wiring:

Table 2

Circuit where used	Colour of Wire
Red Phase of Instrument Transformer Circuits	Red
Yellow Phase of Instrument Transformer Circuits	Yellow
Blue Phase of Instrument Transformer Circuits	Blue
Neutral connection, earthed or not earthed in the instrument Transformer Circuit	Black
A.C. Control Wiring Circuits using auxiliary supply	Black
D.C. Control Wiring Circuit using Battery Supply	Grey
Earth Connection	Green

Closing circuit of the PCM panel shall have Interlocking mechanism with DS/ES switch. DC/AC supply of the 33 kV breaker panel shall be supervised through corresponding PCM panel. Single point grounding of the neutral of CT/PT circuits shall be ensured. It is always recommended that the neutral of CT/PT is grounded at the CT/PT junction box end. Ferrule marking and color coding shall be as per clause "**7.1.3.14.2** FOR 33 KV GIS PANEL FEATURES ".

7.1.3.25 TERMINAL BLOCK

Terminal blocks shall be of clip-on design made out of non-trackable insulating material of 1100 V grade. All terminals shall be stud type, with all current carrying and live parts made of tinned plated brass. The studs shall be of min 4 mm dia brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned plated brass. All blocks shall be shrouded by easily removable shrouds made of transparent die-electric materials.

The terminal connector/blocks shall be disconnecting type terminal connectors for PT and same with automatic shorting of C.T. secondary terminals shall be provided in CT secondary circuit. All other terminal connectors shall be Non-disconnecting type. Terminal should be shock protected in single moulded piece. Terminal block should have screw locking design to prevent loosening of conductor. Provision shall be made on each pillar, for holding 10% extra connection (5% incoming + 5% outgoing).

At least 25% spare terminals for each type shall be provided. All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps for control circuit. For power circuit it shall not be less than 15 Amps.

All CT Terminal blocks shall have shorting, isolating and jacking (test barrel) facility while PT terminal blocks shall have isolating and jacking (test barrel) facility. CT, PT, Control, Alarm etc wiring shall be separately grouped or segregated. All physical connections for control, measurement and status indication shall be made SAS ready hence Terminal Blocks shall be kept reserved if necessary.

7.1.3.26 INDICATING LIGHTS

The lamps shall be of LED type and suitable for being operated on S/S D.C. voltage or AC voltage or P.T. secondary supply as and where applicable. All Lamps shall be interchangeable, panel mounting type with rear terminal connection and shall afford easy replacement from the front of the panel. Lamps shall have translucent lamp covers to diffuse lights and coloured Red, green, Amber, clear white or blue as specified. The lamp cover shall be of screwed type, unbreakable and mounded from heat resisting material. The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

The colour scheme of the signal lamps shall be as follows:

Sl. No.	Functions	Quantity	Color of the Lamp
1	C.B. Spring charged indication	1No	Blue
2	C.B. trip Coil/Circuit healthy indication	2 No	White
3	C.B. Auto tripped indication	1 No	Amber
4	Panel D.C. Fail indication	1 No	Amber
5	P.T. Supply indicating Lamp	2 sets	Red/Yellow/Blue
6	C.B. –ON indication	1 No	Red
7	C.B. –OFF indication	1 No	Green

7.1.3.27 POWER SUPPLY DISCONNECT

Each panel mounted devices requiring AC or DC supply, shall have disconnecting devices (MCB). The MCBs used in DC control circuit shall have a rating of 10 A and 250 V. The fuses shall be modular type with Bakelite frame and reinforced retaining clips.

7.1.3.28 INSTRUMENT AND DEVICES

Indicating, analogue instruments shall be semi flush panel type with 1% percent accuracy class except for energy meters which shall be of 0.2. They shall be approximately 100 mm square with black 250 degree scales on a white back ground.

All AC instruments shall be designed for operation on 1A current transformers secondary and 110V (50 Hz) potential transformer secondary.

7.1.3.29 PANEL LIGHTING

a) The Panel interior shall be illuminated by CFL lamps connected to 230 Volt Single Phase A.C. The illumination of the interior shall be free from shadows and shall be planned to avoid any strain or fatigue to the wireman likely to be caused due to sub-normal or non-uniform illumination. One emergency D.C. light shall be provided for each panel with individual switch with proper identification mark.