

# TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

## 1.00 GENERAL

This specification covers the design, manufacture, assembly, testing at manufacture's works before dispatch and delivery of metal clad partitioned, SF6 gas insulated, switchboard panel confirming to IEC-62271-200. The switchboard panels for line bays, transformer bays, bus coupler/Bus-section bays, etc. shall be fitted with Vacuum circuit breakers, three position disconnecting and earthing switches, voltage transformers, current transformer, metering instruments, protection relays, cable terminal ends for incoming & outgoing cable feeders etc. as per foregoing specification.

## 2.00 REFERENCE STANDARDS

2.01 The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the relevant standards, specification and codes of practices, referred to herein & in Section GTR, and shall be the latest editions including all applicable official amendments and revisions as on the date of opening of bid. In case of conflict between this specification and those (IS Codes, Standards etc.), the former shall prevail. In addition to relevant standards specified in Section-GTR, following standards shall also be applicable:

<b>IEC 62271-200</b>	Gas insulated metal-enclosed switchgear for rated voltage above 1kV and up to and including 52 kV
<b>IEC 62271-102</b>	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V
<b>IEC 62271-207</b>	Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV
<b>IEC 60376</b>	New Sulphur hexafluoride
<b>IEC 62271- 200</b>	High voltage metal enclosed switchgear & control gear Circuit breakers
<b>IEC 60044-1</b>	Current Transformers
<b>IEC 60044-2</b>	Voltage Transformers
<b>IEC 62271-209</b>	Cable connections for gas-insulated switchgear

2.02 The components and devices which are not covered by the above standards shall conform to, and comply with, the applicable standards, rules, codes, and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer and the manufacturer shall list all such applicable standards, codes etc.

2.03 Equipment conforming to any other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to the standards listed above.

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### **3.00 EQUIPMENT SPECIFICATION**

#### **3.01 Switchgear Panel**

- a) Gas insulated Metal clad switchgear shall be complete with all the accessories for efficient and trouble-free operation. The equipment offered shall be safe, reliable and compact to install. The workmanship shall be high order. The circuit breaker, switches and protective device etc shall be latest design so as to ensure rapid and efficient interruption of fault current low arc energy, small arcing time and freedom from fire hazards.
- b) The GIS shall be designed, manufactured, and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric stress and insulation coordination etc. shall be maintained during design, selection of raw material, manufacturing process etc. so that the GIS provides long life with least maintenance.
- c) The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.
- d) The switchgear panel shall be free standing, floor mounted, fully compartmentalized, metal enclosed construction complying requirements of IEC 62271-200. Each circuit shall have a separate vertical panel with required compartments for circuit breaker, cable termination, main bus bars and auxiliary control devices.
- e) The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of it's constituent live parts.
- f) The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes. The Service Class Continuity of Switchgears shall be **LSC 2-PM** (as per IEC 622771-200).
- g) All necessary equipment required for Gas handling at site (if any), shall be arranged by the supplier at their own cost.
- h) All louvers (if provided) shall have very fine brass or GI mesh screen. Tight fitting gasket / gaskets are to be provided at all openings in relay compartment. Relays shall be fully flush mounted on the switchgear panels at a suitable height from operator point of view.
- i) Switchgear shall have an Internal Arc Classification of IAC-A-FLR 25 KA, 1 sec. The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Gas Pressure relief device/Explosion Vent/Pressure relief duct shall be provided for each SF6 gas compartment, so that in case of a fault in a compartment, the gases produced are safely vented out. The pressure relief device/Explosion Vent/Pressure relief duct shall not however reduce the degree of protection of panels under normal working conditions.

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- j) The switchgear shall be cooled by natural air flow.
- k) Total height of the switchgear panels shall be finalized during detail engineering in line with building design. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be generally less than 700 mm.
- l) Suitable interlock & Indications shall be provided to prevent opening of any HT compartment doors, in case the incoming HT supply is ON.
- m) Suitable base frames made out of steel / Aluminum channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates shall be in Bidder's scope. The bidder may offer panels with built in base frame ready for dispatch and suitable for installation on indoor cable trenches.
- n) The switch board shall have the facility for extension on both sides.
- o) SF6 gas leakage rate should not exceed 0.5% per annum.
- p) A thermostatically controlled space heater with common MCB shall be provided for various compartments.

### **3.02 Circuit Breakers (VCB Type)**

- a) The circuit breakers shall be of Vacuum type. It shall comprise of three single pole interrupting units or 3-pole interrupting unit, operated through a common shaft by a sturdy operating mechanism.
- b) Circuit breakers shall be re-strike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. Anti-pumping features shall be provided for each breaker. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.
- c) Circuit breaker shall be provided with two trip coils.
- d) Suitable indicators shall be provided on the front of panel to indicate OPEN / CLOSED conditions of the circuit breaker, and CHARGED / DISCHARGED conditions of the closing spring, SF6 gas density monitor for all gas compartments.

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- e) The rated control supply voltage shall be as mentioned elsewhere under Technical parameters. The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 85-110% of the rated voltage. The trip coil shall operate satisfactorily under all operating conditions of the circuit breaker upto its rated short circuit breaking current at all values of control supply voltage between 70-110% of the rated voltage. The trip coil shall be so designed that it does not get energized when its healthiness is monitored by indicating lamps and trip coil supervision relay.
  
- f) The time taken for charging of closing spring shall not exceed 60 seconds. The spring charging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor which shall only charge the closing spring. Opening spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor, a continuous sequence of closing and opening operations shall be possible. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is anywhere between 85-110% of rated voltage. The initial temperature shall be as prevalent in the switchgear panel during full load operation with 40 deg. C ambient air temperature. The motor shall be provided with Over load protection.
  
- j) Motor windings shall be provided with class E insulation or better. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.

### **3.03 Disconnecting & Earthing Switches**

- a) Each Switchgear panel shall be provided with three (3) position disconnecting-cum-earthing switch of required rating.
  
- b) It shall be possible to control these switches from front of the panel & remotely from SCADA/SAS through IED.
  
- c) Necessary indication shall be provided on the front of the panel for Close/Open status of the three position switches.

### **3.04 Control and Interlocks**

- a) The circuit breaker shall normally be controlled remotely from SAS/SCADA system through closing and trip coils. However, it shall also be designed to control locally from Indoor Switchgear panel. Suitable mimic on Panel shall be provided.
  
- b) Facilities shall be provided for mechanical tripping of the breaker in an emergency. Facility shall also be provided for manual charging of the stored energy mechanism for a complete duty cycle.

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- c) Necessary mechanical & Electrical interlocks shall be provided between CB, Isolator & Earth switches for failsafe operation.
- d) Each CB, Isolator & earth switch shall have 2 NO + 2 NC Auxiliary spare contacts for future use by owner.

### **3.05 Busbars and Insulators**

- a) Busbar shall be of copper of adequate size and bus bar size calculation / supporting type test report shall be submitted for approval. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.
- b) Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators.
- c) Bus bar cross-section shall be uniform throughout the length of switchgear board. All Indoor switchgears (GIS Type) manufacturer's Standard design i.e. bus bar (SF6/Solid core/epoxy insulated) various gas chambers, placing os various equipment's in the panel etc shall be acceptable.
- d) Busbar insulators shall be of arc and track resistant, high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. In case of organic insulator partial discharge shall be limited to 100pico coulomb at rated Voltage  $\times 1.1/\sqrt{3}$ .
- e) All busbars shall have suitable phase identification. Bus switching scheme shall be as per Single Line diagram attached with bidding documents.
- f) The temperature of the busbars and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Standards, duly considering the specified ambient temperature (40 deg. C).

### **3.06 Earthing and Earthing Devices**

- a) The grounding system for GIS shall be designed and provided as per IEEE-80-2000 and CIGRE- 44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.
- b) A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switchboard. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar. The earth bus shall have sufficient cross section to carry the momentary short-circuit and short time fault currents to earth without exceeding the allowable temperature rise.
- c) Suitable arrangement shall be provided at each end of the earth bus for bolting to station earthing grid. All joint splices to the earth bus shall be made through at least two bolts

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and taps by proper lug and bolt connection.

- d) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure framework and the truck shall be maintained even after painting.
- e) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.
- f) VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.
- g) The panel shall have **Voltage Presence Indicator (VPI)** to warn the operator against earthing of live connections.
- h) All hinged doors shall be earthed through flexible earthing braid.

### **3.07 Instrument Transformers**

- a) All current transformers shall preferably be ring type whereas voltage transformers (PT) shall be cast resin insulated type. **PT must ne metalized touch proof type without any HT HRC fuse at Primary.**
- b) Instrument transformers shall be suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 40 deg. C. The class of insulation shall be E or better.
- c) All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.
- d) The parameters of instrument transformers specified in this specification are indicative and shall be finalized by the Employer during detailed engineering, considering the actual burden of various relays and other devices finally selected. In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him, he shall offer instrument transformer of adequate ratings without any cost implication.

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- e) All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.
- f) All voltage transformer's secondary circuits shall have suitable HRC/MCB protective devices.

### **3.08 Numerical Protection Relays (IEDs)**

3.08.01 Indoor switchgear panels shall have communicable numerical protection relays (IEDs) complying with IEC-61850 on all feeders which shall be networked on Ethernet to communicate with substation SAS/SCADA system on IEC-61850. These IEDs shall also be used for control & monitoring the switchgear from SAS. In addition to status of devices (CBs/Isolators/Earth Switches) and equipment alarms, Metering data shall also be made available to SAS/SCADA station from protection IEDs. Further, multifunction meters with Modbus protocol are also envisaged, which will be connected in daisy-chain-link to communicate to station SAS. Modbus to IEC 61850 converter shall be provided for integration with SAS.

The Bidder's scope shall include the followings:

- a) Communicable Numerical Protection Relays (with IEC 61850) in each of the feeders & Bus-section/Bus coupler
  - b) IED's / Numerical Relays shall have digital display, Single line diagram (SLD) display to facilitate settings, relay operations and to view measurement, event and alarm etc.
  - c) Relays shall have built in Local/Remote Selector Switch.
  - d) Cat5e Ethernet cable for connection of Numerical Relays (IEDs) to Ethernet switches and Optical cable between Ethernet switch (for indoor switch gear IEDs) and ring/ redundant network of Substation LAN switch shall be used.
  - e) Required number of Ethernet switches mounted in Indoor Switchgear panels for communication with IEDs on IEC 61850 protocol.
  - f) The SAS/SCADA system has been envisaged as part of main substation. Bidder shall facilitate in successful Integration of Numerical Relays to the SAS/SCADA system through Ethernet switches.
- 3.08.02 All Numerical relays shall be of proven design for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity for the intended application.
- 3.08.03 All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Heavy duty binary output contacts of IEDs to be used for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays.

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- 3.08.04 Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal-operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.
- 3.08.05 All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts as per approved scheme. These I/O points shall be used for wiring of status of devices (CB/Isolator/Earth switch) and equipment alarms etc.
- 3.08.06 Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.
- 3.08.07 Relays shall have event recording feature with time stamping. Event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.
- 3.08.08 All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power factor etc.
- 3.08.09 All numerical relays shall have provision of both current (CT) and voltage (VT) inputs as required for protection & measurement purposes using protection cores.
- 3.08.10 All numerical relays shall have built-in key pad / keys to allow relay setting from relay front. Resetting of relay shall be possible from remote SCADA.
- 3.08.11 Relays shall have suitable output contact for circuit breaker failure protection (LBB) logic.
- 3.08.12 Relays shall have self diagnostic feature with continuous self check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.
- 3.08.13 Contractor shall submit applicable Type Test reports for Numerical relays as per IEC including report for IEC 61850 protocol from accredited lab.

### **3.09 Control & Protection System**

All numerical relays shall communicate to station SCADA / SAS on IEC-61850 communication protocol. It is envisaged that these protection IEDs shall be used for CB control & monitoring of bay equipments.

#### **3.09.01 Numerical Transformer Protection Relay**

- a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.
- b) The over current element should have the minimum setting adjustable between 20-200% of CT secondary rated current and high set setting 500-2000%.

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- c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current (IDMT) and high set 100-1000%.
- d) The relay shall have selectable directional & non-directional feature
- e) For transformers of rating 5MVA and above, definite time delayed Stand by earth fault protection shall be provided having a pick up setting range of 10% to 40% with a timer delay of 0.3 sec to 3 sec.
- f) The relay shall allow higher setting during transformer charging (inrush) and lower setting during normal operating condition.
- g) Transformer troubles like Buchholz, Winding temperature, Oil temperature & Pressure Relief Device trips etc. (as applicable) shall be wired independently to separate binary inputs of the relay and shall be configured to issue trip command to the breaker. Similarly alarm points shall be wired separately to binary inputs of the relay.
- h) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

### **3.09.02 Numerical Line Protection Relay**

- a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.
- b) The over current element should have the minimum setting adjustable between **20-200%** of CT secondary rated current.
- c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.
- d) The relay shall have selectable directional & non-directional feature
- e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

### **3.09.03 Numerical Bus Coupler/Bus-Section Protection Relay**

- a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.
- b) The over current element should have the minimum setting adjustable between **20-200%** of CT secondary rated current.
- c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.
- d) No bus volt signal shall be configured in the relay for use in control logics and other Protections and Control functions in the Relays.
- e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

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## **3.09.04 Other Control and Protections features**

- a) Control of breakers, three position Isolators & Earth switches shall be carried out from the station HMI of SAS/SCADA system through the LAN and the numerical relays.
- b) The station HMI shall have a graphical dynamic Plant Key Single Line Diagram to view the complete system status. This shall include the status of the switchgears, measurement values, operation counters, graphical alarm representation, etc. Spontaneous changes of a state, typically opening of a circuit breaker from a protection, shall have a specific colour code. All the Breakers with the status shall be clearly displayed along with values of currents, voltages, frequency, active and reactive powers etc.
- c) Schematics requiring auxiliary relays / timers for protection function shall be part of numerical relay. Timer functions shall be configurable for on & off delays as per requirement.
- d) The numerical relay shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.
- e) At least 100 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.
- f) Automatic testing, power on diagnostics with continuous monitoring shall be provided in the IED to ensure high degree of reliability. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be available on the user interface
- g) The alarm/status of each individual protection function and trip operation including measurement values shall be communicated to the SAS/SCADA system.
- h) Sequence of events shall have 1ms resolution at device level.
- i) Measurement accuracy shall be 1%.
- j) It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.

## **3.10 Painting**

Painting of panels shall be as specified in Section-GTR.

## **4.00 ETHERNET SWITCH**

- a) Ethernet switches shall be 'substation hardened ' and shall comply with IEC61850 for communications with IEDs. The Ethernet switches shall be of managed type with two (2) No. of Fiber optic cable ports and at least Sixteen (16) Copper ports to achieve the LAN configuration. More no. of switches or higher ports switch can also be supplied to meet all IEDs & multi-function meters requirements for the LAN. The Ethernet switches shall have features to support the redundant rings. These switches shall be mounted in the

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switchgear Panels. The FO ports shall be Single mode 1000Mbps ports. Copper ports shall be 10/100Mbps ports.

- b) Necessary software for configuration and real-time network monitoring shall be provided along with the Ethernet switches.

### **5.00 POWER CABLE TERMINATION**

- a) Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armored, PVC jacketed, single core / three core, unearthed / earthed grade HT power cable(s) as specified in Section -Project. **The cable bushing must be C type placed alongside the width of the panel on the Gas tank. Cable bushing alongside the depth of the panel shall not be acceptable. End termination must be done by Screen separable touch proof kit.**
- b) Adequate clearance shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter-phase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, gland plates etc. and the electrical clearances available shall be submitted during detail engineering.
- c) Cable termination compartment shall have provision for termination of power cables of sizes indicated in the bidding documents. Cable entry shall generally be from the bottom; however, this shall be finalized during detail engineering.
- d) Necessary cable termination plugs shall be part of Indoor switchgear panel supplier for all panels. Scope also includes Panel terminal ends jointing/connection with HT cables.

### **6.00 GENERAL REQUIREMENTS FOR ERECTION**

- 6.01 The contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No parts of structure shall be utilized to lift or erect any equipment without prior permission of the Engineer-in-charge.
- 6.02 Switchgear shall be installed on finished surfaces, concrete or steel sills. Contractor shall be required to install and align any channel sills which form part of foundations. Minor modifications to foundations shall be carried out by the Contractor. Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied loose along with switchgear, they shall be mounted only after the associated switchgear panels have been erected and aligned. The blocking materials, employed for safe transit of instrument and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.
- 6.03 Contractor shall include all special tools required for regular operation & routine maintenance of switchgear.

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### 7.00 CONFIGURATION OF INDOOR SWITCHGEAR PANELS (GIS TYPE)

Sl. No.	Equipment	Unit	IP1 I/C	IP2 O/G	IP3 LT TR	IP4 B/S
1.	CB, three position Isolator & Earth Switch (3-Ph)	Set	1	1	1	1
2.	CB Spring charge indicator	No.	1	1	1	1
3.	ON/OFF indicators for CB	Set	1	1	1	1
4.	ON/OFF Indicators for three position GIS Isolator & Earth Switch	Set	1	1	1	2
5.	ON/OFF indicators for AIS Line Isolator & Line Earth Switch	Set	-	1	-	-
6.	CT (1-Phase)	Nos.	3	3	3	3
7.	VT (1-Phase)	Nos.	-	-	-	6
8.	Multi Function Meter	No.	1	1	1	1
9.	Control switch for Circuit Breaker	No.	1	1	1	1
10.	Control Switches for Three position GIS Isolator & Earth switch (Electrical)	Set	1	1	1	2
11.	DC healthy lamp (white)		1	1	1	1
12.	Trip circuit healthy lamp		1	1	1	1
13.	SF6 Gas Density indicator for each compartment (set)	Set	1	1	1	1
14.	Capacitive Voltage Detection system (CVD)	Set	1	1	1	-
15.	Mimic to represent SLD	Set	1	1	1	1
16.	Voltmeter with selector switch	Set	-	-	-	2
17.	Numerical protection relay (IED)	No.	1	1	1	1
18.	LAN Switches and LAN/FO Cables	Set	AS per requirement			
19.	Cable Termination arrangement including cable end Plugs	Set	AS per requirement			

Notes:

1. IP1 (I/C): Panel for Transformer Incomer feeder
2. IP2 (O/G): Panel for outgoing Line Feeder
3. IP3 (LT TR): Panel for LT Transformer feeder
4. IP4 (B/S): Panel for Bus Sectionaliser
5. Location of VT (I/C or B/S Panel) shall be decided during detail engineering.
6. Numerical protection relay (IED) for all type of panels shall preferably be interchangeable to optimize mandatory spares.

### 8.00 TESTS

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### **8.01 Type Tests**

The contractor shall submit the reports for the following type tests on the equipment to be supplied under the contract:

- A. Switchgear Panel (with Circuit Breaker installed)
  - a. Short circuit duty test
  - b. Short time and peak withstand current test.
  - c. Power frequency withstand test.
  - d. Lightning impulse withstand test.
  - e. Temperature rise test.
  - f. Internal Arc Test as per IEC 62271-200 (for 1 second)
  - g. Measurement of resistance of main circuit
  - h. Test to verify pressure relief operation of the panel **(During internal arc test)**
  - i. Cable charging test
  - j. Short circuit withstand test of earthing device.
  
- B. Circuit Breaker
  - a. Mechanical Endurance Test
  
- C. Current Transformer
  - a. Short time current test
  - b. Temperature rise test
  - c. Lighting Impulse voltage withstand test
  
- D. Potential Transformer
  - a. Temperature rise test
  - b. Lighting Impulse voltage withstand test
  
- E. Switchgear Panel
  - a. IP 4X test

### **8.02 Routine Tests**

All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The manufacturer shall furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

### **8.03 Commissioning Checks / Tests**

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After installation of panels, power and Control wiring and connections, Contractor shall perform commissioning checks as listed below to verify proper operation of switchgear / panels and correctness of all equipment in all respects. In addition, the Contractor shall carry out all other checks and tests recommended by the manufacturers.

### **8.03.01 General**

- a. Check name plate details according to specification.
- b. Check for physical damage!
- c. Check tightness of all bolts, clamps and connecting terminals
- d. Check earth connections.
- e. Check cleanliness of equipment
- f. Check heaters are provided.
- g. H.V. test on complete switchboard with CT & breaker in position.
- h. Check all moving parts are properly lubricated.
- i. Check for alignment of busbars.
- j. Check continuity and IR value of space heater.
- k. Check earth continuity for the complete switchgear board.

### **8.03.02 Circuit Breaker**

- a. Check alignment.
- b. Check correct operation
- c. Check control wiring for correctness of connections, continuity and IR values.
- d. Manual operation of breakers completely assembled.
- e. Power closing / opening operation, manually and electrically
- f. Closing and tripping time.
- g. Trip free and anti-pumping operation.
- h. IR values, resistance and minimum pick up voltage of coils.
- i. Simultaneous closing of all the three phases.
- j. Check electrical and mechanical interlocks provided.
- k. Checks on spring charging motor, correct operation of limit switches and time of charging
- l. All functional checks.

### **8.03.03 Current Transformers**

- a. Megger between windings and winding terminals to body.
- b. Polarity tests.
- c. Ratio identification checking of all ratios on all cores by primary injection of current.
- d. Magnetization characteristics & secondary winding resistance.
- e. Spare CT cores, if any to be shorted and earthed.

### **8.03.04 Voltage Transformers**

## TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

- a. Insulation resistance test.
- b. Ratio test on all cores.
- c. Polarity test.
- d. Line connections as per connection diagram.

### 8.03.05 Cubicle Wiring

- a. Check all switch developments.
- b. It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
- c. All the wires shall be meggered to earth.
- d. Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component / equipment.
- e. Check terminations and connections.
- f. Wire ducting.
- g. Gap sealing and cable bunching.

### 8.03.06 Relays

- a. Check internal wiring.
- b. IR of all terminal body.
- c. IR of AC to DC terminals
- d. Check operating characteristics by secondary injection.
- e. Check operation of electrical/ mechanical targets.
- f. Relay settings.

### 9.00 SYSTEM PARAMETERS:

1	Nominal System voltage	33 kV	11 kV
2	Highest System voltage	36 kV	12 kV
3	Rated Frequency	50 Hz	50 Hz
4	Number of phases/ poles	Three	Three
5	System neutral earthing	As per Vector Group of Transformers	As per Vector Group of Transformers
6	One minute power frequency withstand voltage	70	28
7	1.2/50 microsecond Impulse withstand voltage	170 kV (peak)	75 kV (peak)

## TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

8	Short time rating for bus bars, CB, CT and switchgear Assembly.	25 kA (rms) for one (1) sec.	25 kA (rms) for one (1) sec.
9	Dynamic withstand rating	62.5 kA (peak)	62.5 kA (peak)
10	IAC Rating	25 KA ,1.0 sec	25kA, 1.0 Sec
11	Control supply voltage:		
a)	Trip and closing coils	As per Station DC Supply	As per Station DC Supply
b)	Spring charging motor	As per Station DC Supply	As per Station DC Supply
12	Maximum ambient air temperature	40 deg. C	40 deg. C
13	Degree of Protection:		
a)	HV-live parts	IP65	IP65
b)	Low voltage compartments	IP4X	IP4X

<b>a) CIRCUIT BREAKERS</b>			
1.	Rated Voltage	33 kV	11 kV
2.	CB rated Current		
a)	Incomer Breaker	1250A	1250A
b)	Outgoing feeder Breaker	1250A	1250A
3.	Short circuit breaker Current:		
a)	A.C. component	25 kA	25kA
b)	D.C. component	As per IS: 13118 or IEC-62271	As per IS: 13118 or IEC-62271
4.	Short Circuit making current	62.5 kA (peak)	62.5 kA(peak)
5.	Out of phase breaking Current capacity	As per IEC	As per IEC
6.	Rated line/cable charging Interrupting current at 90° Leading power factor angle	As per IEC	As per IEC
7.	Maximum allowable switching Over voltage under any switching Condition	As per IEC	As per IEC
8.	Rated small inductive current Switching capability with over Voltage less than 2.3 pu	As per IEC	As per IEC
9.	First pole to clear factor	1.5	1.5
10	Operating Duty	<b>O-0.3 Sec-CO-3 Min-CO</b>	<b>O-0.3 Sec-CO-3 Min-CO</b>

## TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

11	Total break time	Not more than 4 cycles	Not more than 4 cycles
12	Total make time	Not more than 5 cycles	Not more than 5 cycles
13	Reclosing	3 phase auto reclosing	3 phase auto reclosing
14	Max. difference in the instants of closing/opening contacts between poles at rated control Voltage and rated operating and quenching media pressures	As per IEC	As per IEC
15	Auxiliary contacts	2NO+2NC for Employers future use besides scheme requirement	2NO+2NC for Employers future use besides scheme requirement
16	Operating Mechanism	Motor wound spring charged stored energy type as per IEC-62271	Motor wound spring charged stored energy type as per IEC-62271
<b>b) CURRENT TRANSFORMER (Incomer/Bus coupler Feeder)</b>			
1.	Rated primary voltage	<b>33kV</b>	<b>11kV</b>
2.	Rated primary current	1000A	800A
3.	Type of CT	1-Phase	1-Phase
4.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
5.	Class of Insulation	Class E or better	Class E or better
6.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
7.	No. of Secondary cores	3	3
<b>c) CURRENT TRANSFORMER (Line Feeder)</b>			
1.	Rated primary voltage	<b>33kV</b>	<b>11kV</b>
2.	Rated primary current	300A	300A
3.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
4.	Class of Insulation	Class E or better	Class E or better
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
6.	Nos. of Secondary cores	2	2
<b>d) CURRENT TRANSFORMER (LT Transformer feeder)</b>			

## TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

1.	Rated primary Voltage	<b>33kV</b>		<b>11kV</b>	
2.	Rated primary current	40A		40A	
3.	Max temp rise	As per IEC:60044-1		As per IEC:60044-1	
4.	Class of Insulation	Class E or better		Class E or better	
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV		2kV	
6.	Nos. of Secondary cores	2		2	
<b>e) VOLTAGE TRANSFORMERS</b>					
1.	Rated primary Voltage	33kV		11kV	
2.	Type	1-phase		1-Phase	
3.	Voltage ratio (kV)	$(33/\sqrt{3})/(0.11/\sqrt{3})$		$(11/\sqrt{3})/(0.11/\sqrt{3})$	
4.	Rated Voltage Factor	1.2 continuous and 1.5 for 30 seconds		1.2 continuous and 1.5 for 30 seconds	
5.	Nos. of Secondary cores	2		2	
6.	Accuracy of Secondary core	Metering	Protn.	Metering	Protn.
		0.5	3P	0.5	3P
7.	Class of insulation	Class E or better		Class E or better	
8.	Rated output burden (Minimum)	5VA		5VA	
F	<b>Bus-Bar/ Bus-Section/Bus Coupler rating</b>				
	Current rating of Bus bars	1250A		1250A	
	Current rating of Bus-Section/ Bus Coupler CB & Isolator	1250A		1250A	

# TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

## REQUIREMENT FOR 33KV CURRENT TRANSFORMERS

### INCOMER / BUS COUPLER FEEDER

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>	<b>Diff. Protn.</b>
Current ratio	1000-500/1	1000-500/1	1000-500/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	5VA	-	-

### LINE FEEDER

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	5VA	-

### LT TRANSFORMER FEEDER

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>
<b>Current ratio</b>	<b>300-150/5-5A</b>	<b>300-150/1</b>
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	5VA	-

Notes: The ratings indicated for instrument transformers are tentative only and may be changed to meet the functional requirements.

# TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

## REQUIREMENT FOR 11KV CURRENT TRANSFORMERS

### INCOMER / BUS COUPLER FEEDER

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>	<b>Diff. Protn.</b>
Current ratio	800-400/1	800-400/1	800-400/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	5VA	-	-

### LINE FEEDER

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	5VA	-

## REQUIREMENT FOR 11KV CURRENT TRANSFORMERS (LT TRANSFORMER FEEDER)

	<b>Metering</b>	<b>O/C &amp; E/F Protn.</b>
Current ratio	100/1	100/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	5VA	-

Notes: The ratings indicated for instrument transformers are tentative only and may be changed to meet the functional requirements.

## TECHNICAL SPECIFICATION FOR 33kV & 11kV Indoor Switchgear (GIS Type)

### 10.00 INPUT SIGNAL TO SAS SYSTEM

The following digital input of 33kV & 11kV Indoor switchgear bays shall be provided through IEDs in the SAS system:

- i) Status of CB, Isolator, Earth switch
- ii) CB trouble
- iii) CB operation/closing lockout
- iv) Trip circuit faulty
- v) Bus VT FUSE Fail
- vi) Back-up overcurrent & earth fault protection Operated
- vii) DC source fail

### 11.00 MULTIFUNCTION METER

The Multifunction meter shall have feature to measure KV, I, MW, MVAR, PF, MWhr, MVARhr with accuracy class of 0.5. Further, multifunction meter shall have bi-directional feature to register/record MWhr values.

### 12.00 MANDATORY SPARES

SI.N	Equipment	Unit	Quantity	
			33kV	11kV
1.	CB Spring charge indicator	No.	1	1
2.	ON/OFF indicator for CB (Mechanical)	No.	1	1
3.	ON/OFF indicator for GIS Isolator/Earth Switch (Mechanical)	No.	1	1
4.	CT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
5.	VT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
6.	Multi Function Meter	No.	1	1
7.	Control switch for Breaker	Nos.	2	2
8.	Control switch for GIS Isolator	Nos.	2	2
9.	Control switch for GIS Earth Switch	Nos.	2	2
10.	DC healthy lamp (white)	Nos.	5	5
11.	Trip circuit healthy lamp	Nos.	5	5
12.	Voltmeter with selector switch	No.	1	1
13.	Numerical protection relay (IED)	No.	1 No. of Each type	1 No. of Each type
14.	Indicator for Line Isolator & Earth Switch	Nos.	5	5
15.	LAN Switch	No.	1	1
16.	Trip coil assembly	Now.	2	2
17.	Closing coil assembly	Nos.	2	2
18.	SF6 gas density indicator	Nos.	2	2