Saudi Electricity Company	الشركة السعودية للكهرباء

SEC Distribution Materials Specifications	32-SDMS-08
	DATE: 30-03-2013G

32-SDMS-08

SPECIFICATIONS

FOR

METAL CLAD SWITCHGEAR FOR PRIMARY DISTRIBUTION SUBSTATIONS

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1.0 SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of Metalclad Switchgear 11 kV, 13.8 kV, 33 kV or 34.5 kV, intended to be used in the distribution system of the Saudi Electricity Company, Saudi Arabia.

2.0 CROSS REFERENCES

This Material Standard Specification shall always be read in conjunction with latest SEC General Specification No. 01-SDMS-01, titled "General Requirements for All Equipment/Materials", which shall be considered as an integral part of this SDMS.

This SDMS shall also be read in conjunction with SEC Purchase Order or Contract Schedules for project, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision/amendments of the following Codes and Standards shall be applicable for the equipment/material covered in this SDMS. In case of conflict, the vendor/manufacturer may propose equipment/material conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirements of this SDMS.

3.1 IEC 61869-2 Instrument Transformers, Part 1: Current Transformers

3.2 IEC 61869-3 Instrument Transformers, Part 2: Inductive Voltage Transformers

3.3 IEC 60051 Direct Acting Indicating Analog Electrical Measuring Instruments and their Accessories

3.4 IEC 60073 Basic and safety principles for man-machine interface, marking and identification-Coding principles for indication devices and actuators

3.5 IEC 60255-21-1 Vibration, shock, bump and seismic tests on measuring relays and protection equipment-Section one: Vibration tests (sinusoidal)

3.6	IEC 60376	Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment
3.7	IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um =1.2 kV) up to 30 kV (Um = 36 kV) Part 1: Cables for rated voltages of 1 kV (Um = 1.2 kV) and 3 kV (Um = 3.6 kV)
3.8	IEC 60529	Degree of Protection provided by enclosure (IP Code)
3.9	IEC 60947-5-1	Low-Voltage Switchgear and Controlgear, Part 5: Control Circuit Devices and Switching Elements, Section 1: Electromechanical Control Circuit Devices
3.10	IEC 61850	Communication networks and systems in substations
3.11	IEC 62271-1	High-voltage switchgear and controlgear-Part 1: Common specifications
3.12	IEC 62271-100	High-voltage switchgear and controlgear-Part 100: Alternating-current circuit-breakers
3.13	IEC 62271-200	High-voltage switchgear and controlgear - Part 200: AC Metal-Enclosed Switchgear and Controlgear for Rated Voltages above 1kV and up to and including 52kV
3.14	ANSI/IEEE C37.20.2	Metal-clad Switchgear
3.15	IEEE C57.13.2	IEEE Standard Conformance Test Procedures for Instrument Transformers

4.0 BASIC REQUIREMENTS AND GUIDELINES

4.1 General

a) Switchgear shall be compact, simple for operation with highly secured performance.

b) Switchgear shall be suitable to operate at ambient temperature varying from 55 °C to – 5 °C, under dusty, dry climate out door conditions as given in 01-SDMS-01.

c) Switchgear shall comply to the Specifications of SEC and relevant IEC Standards.

4.2 Bid Proposal.

The Manufacturer shall provide the following along with his bid proposal, in addition to the requirements stipulated in the Purchase Order or Contract documents:

a) Scope of Equipment Supply.

b) Data Schedule for all SEC Materials Standard Specifications (SDMS, TMSS and SMSS) as given in this SDMS shall be duly filled-in.

c) Technical literature, brochures and list of users in the electric utility sector.

d) Complete type test reports/certificates of all major equipment.

e) A declaration from the Manufacturer that the bid proposal is in accordance with the technical Specifications and associated SEC, material Standard Specifications. Otherwise the Manufacturer must state clearly any exception or deviation items from SEC Standards, these guideline Specifications and drawing plans and the reasons for exceptions or deviations.

(f) All documentation relating to this project shall be in English.

4.3 Base Design Phase.

The base design phase is a period of 4-6 weeks of preliminary design following the issue of Purchase Order or award of Contract.
Six (6) sets of the base design package shall be submitted to SEC for review and comments at the base design review meeting which will be held by the SEC four (4) weeks after the receipt of the base design package.

The base design document shall consist of :

a) Detailed list of equipment to be supplied.

b) Following design drawings, as a minimum, but not limited to:

- Drawing Control Sheet.

- One-Line Diagram (Main one-line diagram, AC and DC auxiliary one-line diagram, etc.).

- General arrangement of the switchgear (giving details of various components).

c) Literature (specifications, manuals, brochures, drawings and completed Data Schedules) of the following materials, as a minimum, but not limited to:

1) Switchgear.
2) Relays.
3) Instruments.
4) Control Panels.
5) CTs/PTs.

d) Following calculations and specifications, as a minimum, but not limited to:

1) CT and PT Sizing, including auxiliary CTs.
2) AC and DC auxiliary supply design with sizing of auxiliary transformer, batteries, chargers, etc.
3) Grounding Conductor Sizing.

e) Details of site commissioning tests to be carried out.

4.4 Design Review Drawings.

Following the base design phase, other detailed/manufacturer drawings shall be submitted by the Manufacturer for approval by SEC. The list of detailed drawings to be submitted for approval shall be mutually agreed to between the Manufacturer and SEC.

4.5. Manufacturer Progress Reporting.

The Manufacturer shall submit to SEC, a monthly progress report on the manufacture of the switchgear.

The progress report shall include among other items:

a) Design.

b) Procurement of Components.

c) Testing and Commissioning.

d) Overall Completion.

The format shall be mutually agreed to between the Manufacturer and SEC.

4.6 Test and Inspection.

All equipment and materials shall be subject to inspection and tests as required in relevant SEC Materials Standard Specification, QA/QC Procedures and applicable industry standards or as may be decided by the SEC.

All design (type) and production (routine) tests prescribed in this SDMS and relevant SEC Materials Standard Specifications shall be performed in accordance with the applicable industry standards. In lieu of actual design (type) tests, the Manufacturer may submit complete certificate reports or tests performed previously on identical units to the SEC for review and approval during the bidding stage.

a) The Manufacturer shall submit for all major equipment a detailed testing and Inspection program of respective manufacturers to the SEC for review, at least three (3) months before the commencement of manufacturing.

b) The Manufacturer shall employ a reputable independent vendor inspection agency to witness factory tests and inspect the equipment and materials that will be purchased for the manufacture of this switchgear. The Manufacturer shall submit pre-qualification documents for his proposed vendor inspection agency for approval of SEC. The Manufacturer shall provide all technical specifications to the independent vendor inspection agency. The entire test inspection report shall be submitted for acceptance by the SEC.

c) SEC will also send its employees or its inspectors to witness the factory tests and Manufacturer will bear all the expenses involved.

d) Four (4) initial sets of all factory tests reports shall be submitted by the Independent inspection agency to the SEC for review and approval. The

equipment shall not be shipped ex-factory unless the test reports have been accepted, and shipping clearance is given by SEC.

e) It shall be the vendor's responsibility to obtain all the necessary Certificates of.

f) Conformity and/or other documentation required for import and/or registration of the unit.

g) The unit shall undergo the vendor's mandatory Pre-Delivery Inspection (PDI). Prior to the delivery, the PDI documents shall be forwarded to SEC for approval.

4.7 Commissioning and Site Tests.

The guidelines for Commissioning Tests and Checks as per SEC Standards and Specifications witnessed by SEC personnel:

The Manufacturer shall develop detailed commissioning and equipment site tests based on the requirements of SEC Standard to be performed at a SEC station.

During or after commissioning, training shall be given to operations staff covering the Operations and Maintenance of the complete unit.

A list giving full details of the site tests, tools and equipment to be used shall be submitted by the Manufacturer for review and acceptance by SEC, six (6) months prior to the scheduled date of tests. Scheduled dates of all field/site tests shall be submitted to SEC two (2) months prior to arrange for the REPRESENTATIVES of SEC to witness the tests.

The commissioning and equipment site testing shall be done in strict compliance with the normal work schedule of SEC i.e. 8 hours per day, 5 days per week.

4.8 Record Books.

Upon completion of the manufacture, the Manufacturer shall submit eight (8) sets of record books containing the following documents as a minimum:

a) Approved design and manufacturer drawings.

b) All calculation sheets.

c) Brief technical specification of all components.

d) Operation and maintenance manual consisting of:

- Manufacturer's instructions manual applicable to each component or material.
- Manufacturer's set-up procedures, including mechanical tolerances for maintenance or repair purposes.
- Complete set of Manufacturer's drawings and catalogs with identified parts for each device and other essential information for SEC cataloging and ordering replenishment parts.

Note: All documents in item (d) shall be originals.

4.9 Spare Parts.

Manufacturer shall provide recommended spare parts list required for O&M of switchear without including as part of bid.

4.10 Warranty

A minimum warranty of twenty four (24) months shall be granted with effect from the final acceptance/commissioning date by SEC. The limits shall be those submitted with the bid and accepted by SEC.

5.0 DESIGN AND CONSTRUCTION REQUIREMENTS

5.1 General

The switchgear shall be air insulated, natural cooled up to current rating of 2000A and complete metalclad type for indoor service and shall be of manufacturer's standard design which meets or exceeds the requirements of this Specification in all respects.

5.2 Switchgear Assembly

5.2.1 The switchgear assembly shall be of single bus bar type and suitable for extension at both ends without cutting and drilling. Welding is also prohibited for field assembly of the cubicles. It shall be possible to dismantle and remove any middle panel from the switchgear line-up without dismantling/removing the adjacent switchgear panel.

5.2.2 Each switchgear feeder panel shall consists of; busbar, Circuit breaker, Current transformer, Voltage transformer (if applicable), earthing switch, cable compartment, low voltage compartment with control and protection devices as per the protection requirement.

5.2.3 Loss of service continuity of the switchgear shall be "LSC2B" and Internal Arc Fault Accessibility type shall be "A with Front, Lateral & Rear acess (AFLR)". Enclosure of each panel shall be segregated from the adjacent panels especially for bus bar compartments. Arc Flash Detection and Rapid Fault Clearance shall be provided by utilizing light or pressure or heat sensors.

5.2.4 It shall be possible to move the circuit breaker from service position to test position and vice versa without opening the panel front door.

5.2.5 The switchgear enclosure, bus bar, bus bar supporting insulators and the internal barriers shall be adequately rigid and able to withstand short circuit stresses as demonstrated by test reports of the arc-proof tests of identical switchgear units.

5.2.6 Door and panels shall have sufficient thickness and rigidity to support devices, and they shall be easy to open and close.

5.2.7 The switchgear shall have a bus riser transition panel with a removable bus bar link to effectively isolate the bus-tie breaker. The removable bus bar link open gap shall have a dielectric withstand voltage at least 10% in excess of that of the switchgear. Also, sufficient space and bare bus connections shall be available at both sides of the bus bar link, beyond all bolted connections to facilitate the connection of bus filed grounds and Ductor (Contact Resistance) test leads during maintenance.

5.2.8 Mimic diagram shall be provided on the front panel of each switchgear panel.

5.2.9 The switchgear enclosure colour finish shall be as per 01-SDMS-01.

5.3 Ratings

5.3.1 Unless otherwise specified in SOW/TS, the continuous current ratings of circuit breakers and bus bars in switchgears rated 11kV and above shall be standardized at design ambient temperature of 40ºC with natural cooling as specified in below Table.

System Nominal Voltage (kV)	Rated Continuous Current (Amps)
33 or 34.5	630, 1250, 1600
11 or 13.8	630, 1250, 2000

5.3.2 The switchgear shall be capable of carrying the specified rated current continuously at the design ambient without exceeding the temperature rise limit of various parts stated in IEC 62271-1.

5.3.3 The switchgear and controlgears shall have the same short time current rating as specified in the Data Schedule.

5.3.4 Partial discharge level of all equipment and components of the switchgear including bus support insulators shall be as per relevant IEC.

5.3.5 The insulation level of the switchgear shall be as specified in 01-SDMS-01.

5.3.6 The indoor metalclad switchgear shall be enclosed in a ventilated general purpose enclosure. The degree of protection of the enclosure shall be IP40 as per IEC 60529.

5.3.7 Each switchgear panel shall be furnished with hinged front door(s) and a removable, bolted rear panel.

5.3.8 A warning sign shall be fastened by screws or rivets on each rear panel. The sign shall be written in both Arabic and English, as follows:

"لا تفتح هذه الخلية الا عندما يكون المفتاح في وضع التأريض"

"DO NOT OPEN THIS PANEL UNLESS THE GROUNDING SWITCH IS IN 'ON' POSITION".

5.3.9 The door of the low voltage compartment shall have a door stopper to hold the door in the "open" position.

5.3.10 The enclosure design shall have clear access to the primary cable termination compartments from bolted rear or front panel cover/lockable front door with safety measures to lockable front door. The entry of primary cables to the enclosure shall be from the bottom of the switchgear.

5.3.11 Ventilation or pressure relief openings shall be so arranged that in case of any arcing fault inside the switchgear, the gas or vapor escaping will not endanger personnel operating the switchgear and will not enter into adjacent panels thereby preventing spreading of the fault.

5.3.12 All ventilation louvers shall be vermin-proof and shall be provided with removable filters to minimize ingress of dust.

5.3.13 Provision shall be made for expansion and contraction of the enclosures due to thermal cycling, taking into account the specified ambient conditions and temperature rise due to load variations.

5.3.14 Interior of the enclosure shall be treated for anti-condensation or painted.

5.4 Main Bus Conductors and Connections

5.4.1. The main bus conductors and connections shall be made of electrolytic grade copper and shall be continuously rated. All bus bar connections shall be silver plated. Vertical sections (tee-off droppers) shall be connected to the main bus by means of bus bars and not by cable connections or vertical cable drops. Connection between main busbars and circuit breakers (tee-off-droppers) shall have the highest continuous current rating of circuit breaker that can be installed in the switchgear panel.

5.4.2. All bus bars and bus bar risers shall be fully insulated for its thermal rating. Bus bar connections shall have readily removable insulating covers or molded boots.

5.4.3. In the cable compartment, fire retardant insulating barriers shall be provided between phases as well as between phases and metallic partitions of the panel. The insulating barriers shall not obstruct termination of three-core cables.

5.4.4. For field interconnecting bus joints, appropriate insulating material shall be supplied to insulate the bus joints. All insulating materials shall be flame resistant, non-hygroscopic and non-tracking in the presence of corona.

5.4.5. Provision shall be made to allow for thermal expansion of the conductors due to normal load currents and short circuit currents. Provisions shall be made for extending the bus bar at either end without any need for cutting or drilling the copper bar.

5.4.6. The bus bar and its connections shall be able to withstand the mechanical stresses under the specified short circuit conditions.

5.5 Power Circuit Breakers

5.5.1. Power circuit breakers shall be 3-pole, single throw, vacuum or SF6 type, mounted on a draw-out carriage and shall be physically and electrically interchangeable with others of the same type and rating within the switchgear assembly and suitable for local and remote control. The circuit breakers shall comply with IEC 62271-100 or ANSI C37.06. The SF_6 gas shall conform to IEC 60376 or ASTM D2472.

5.5.2. The circuit breaker operating sequence (operating duty cycle) shall be O-0.3s-CO-3min.-CO or O-0.3s-CO-15s-CO as specified in the Data Schedule.

5.5.3. The operating mechanism shall be of the motor-charged spring-operated stored energy type suitable for rapid/fast auto-reclosing of the circuit breaker. The operating mechanism shall employ a 125Vdc motor to charge the closing spring(s) that retains this stored energy until a closing operation is made. The motor shall operate satisfactorily at any voltage between 90Vdc and 140Vdc. The energy storage capability of the

mechanism must be sufficient for an O-CO operation at rated short circuit current or at related required capabilities specified in Data Schedule. Recharging of closing spring shall occur automatically as soon as the closing spring is released.

5.5.4. Means for manual spring charging shall be provided with the circuit breaker both in the "Open" and "Closed" positions. The spring charging motor circuit shall be automatically cut off during manual charging or suitable means of protection shall be provided to the manual charging mechanism to ensure the safety of operator during the resumption of power supply.

5.5.5. The operating mechanism shall be electrically and mechanically "trip free". Anti-pump device shall be provided.

5.5.6. Each circuit breaker shall be provided with one (1) closing coil and two (2) electrically independent trip coils. The tripping mechanism shall operate correctly when either or both trip coils are energized. Both positive and negative of the auxiliary voltage shall be switched when a close or open/trip operation is executed.

5.5.7. Circuit breakers shall be designed so that they cannot be closed unless the closing spring is fully charged. For SF6 circuit breakers, low pressure of SF6 shall initiate an alarm and shall automatically block closing and tripping of the breaker.

5.5.8. Each circuit breaker shall be provided with a visible mechanical position indicating device. The device shall be positively driven in both directions to show whether the breaker is in the "open" or "closed" position in the service, test and disconnected positions and shall be identified with color coding "Green" and "Red", respectively with white lettering. Similar positively driven indicating device shall be provided to indicate the state of the spring. It shall indicate "SPRING CHARGED" when the spring is in a condition to close the breaker and "SPRING DISCHARGED" when the spring is not in a condition to close the breaker.

5.5.9. The circuit-breaker and its operating mechanism have to perform the number of breaking operations at rated current and at rated short-circuit current without maintenance per relevant IEC or ANSI standards. Each circuit breaker shall have a non-resettable mechanical 5-digit operation

counter which shall be readable from the front of the switchgear with the breaker in the service position.

5.5.10. It shall be possible to test all controls and protection trip while the circuit breaker is in the test position.

5.5.11. Each breaker shall have not less than two NO and two NC potential-free auxiliary contacts, mounted on the breaker for remote interlocking service. Additionally, four spare NO and four spare NC contacts shall be provided on each breaker for use on SER (Sequence of Events Recorder) and SCADA. In addition, contacts shall be provided to enable local and remote indication of the Service/Test/Withdrawal position. The auxiliary contacts shall be of class-1, as per Table -6 of IEC 62271-1.

5.5.12. Each switchgear unit containing a circuit breaker shall be furnished with not less than eight (8) NO and eight (8) NC potential-free breaker mechanism operated auxiliary switch contacts mounted in the switchgear unit enclosure for remote interlocking service. Auxiliary switches shall be positively driven in both directions. They shall be mounted so as to be readily accessible for maintenance and designed to facilitate inspection, cleaning and adjustment. Contact surfaces shall be of a metal, which is not subject to oxidization leading to an increase in contact resistance.

5.5.13. Voltage dropping resistors shall not be used in the trip coil and closing coil circuits.

5.5.14. Operating instruction for racking-in and out shall be provided in English and Arabic in the CB compartment.

5.6 Interface

5.6.1. Automatic shutters with manual padlocking facilities shall be provided to prevent access to live equipment when the circuit breaker is withdrawn from the panel. The shutters shall open and close automatically by means of positive drive initiated by the movement of the breaker carriage. For maintenance purposes, opening of the individual shutters shall be possible.

a. The bus bar shutters shall be colored red and shall have white lettering indicating “BUS BAR”.

b. Feeders shall have shutters, colored yellow with black lettering indicating “CABLE”.

c. The bus tie panel both shutters shall be colored red and shall indicate “BUS BAR 1-2” or “BUS BAR 2-3” in white lettering, as applicable.

5.6.2. Control wiring connections between stationary structure and removable element (circuit breaker) shall be provided with self-coupling contacts or manual plug and receptacle for disconnection. The male contacts shall be placed on the removable element while the female receptacles on the stationary structure. Secondary isolating contacts shall be so positioned or designed to prevent the danger of electric shock when disconnected.

The manual control connector shall be either interlocked or inaccessible to prevent connection or disconnection of the control circuits when the circuit breaker is in the service position.

5.7 Grounding Switch

5.7.1. Integral grounding switches shall be provided for incoming and outgoing feeders and bus bars, and shall be manually operated, high speed type, having full short circuit making capability. Grounding switch shall be provided on both sides of bus-section circuit breaker.

a. Grounding switch blades shall be directly connected to the main grounding bus of the switchgear and not through the switchgear metal frame.

b. Metallic linkages of the grounding switches shall be directly connected to the main ground bus.

c. Grounding switches shall be operated from the front of the panel. Operating handles of grounding switches shall be anti-reflex type insulated rod, clearly labeled including positive mechanical indication of "ON" and "OFF" positions. Position indication shall be visible without the need to open switchgear compartment doors.

d. Padlocking facilities shall be provided to enable the grounding switch to be locked in either position.

e. The ground switch operating mechanism shall have an auxiliary switch with contacts for interlocking, local mechanical on/off indication, and remote on/off indication.

5.7.2. If specified in the data schedule, bus bar grounding may be achieved by the use of a grounding truck, made up of modified circuit breaker movable truck, with all required grounding accessories. Bus bar grounding shall be obtained by closing of the grounding truck after plug-in position is made. The grounding truck shall be permanently marked with "Bus bar Grounding Truck" for device identification.

5.8 Interlocks and Safety Features

5.8.1 The switchgear shall be provided with a system of preventive mechanical interlocks to protect the equipment, operator and service personnel from the dangers of mal-operation. The interlocks shall be designed to prevent:

a. A closed circuit breaker being inserted into or withdrawn from the service position.

b. A circuit breaker being closed in other than the service, test or withdrawn positions.

c. A circuit breaker being placed in the service position if the secondary contacts plug has not been fitted.

d. The breaker truck being moved into the service position unless it is correctly located.

5.8.2 Means shall be provided for positively holding the removable element in place when it is either in the service or test position. If a separate withdrawn position is provided with the door closed, removable element shall be positively held in this position.

5.8.3 It shall not be possible to withdraw the breaker from its housing beyond test position unless the spring stored energy mechanism is automatically or manually discharged. In case of manual discharge, appropriate warning plate shall be provided to caution the operator to manually discharge the spring.

5.8.4 Grounding switches shall be mechanically interlocked with associated incoming or outgoing breaker such that grounding switch cannot be closed unless the breaker is withdrawn from service position and that the breaker cannot be inserted in service position unless grounding switch is open.

5.8.5 Grounding switch of an incoming transformer feeder shall also be interlocked with transformer HV breaker and transformer HV disconnect switch such that closing operation of grounding switch in LV side shall not be possible unless HV breaker and HV disconnect switch are open. HV breaker closing operation shall not be possible unless grounding switch in LV side is open. LV circuit breaker closing shall not be possible unless HV circuit breaker is closed.

5.8.6 Bus bar grounding switch shall be interlocked with the incoming circuit breaker and bus section breaker as well as with all outgoing breakers on the respective bus side, such that the grounding switch cannot be closed unless all associated circuit breakers are open and withdrawn from service position, and the associated circuit breakers cannot be closed unless the bus bar grounding switch is open.

5.8.7 The bus bar grounding, when used, shall be so interlocked such that grounding of the bus bar shall not be possible unless the associated incoming and bus section breaker(s) as well as all the outgoing feeder breakers are open and withdrawn from service position. Manufacturer shall provide evidence in support of this arrangement.

5.9 Low Voltage Compartment

The Low voltage compartment of the switchgear shall be provided, as applicable, with the following:

5.9.1. One (1) Local/Remote selector switch. Provision shall be made for locking the switch in either position.

5.9.2. One (1) circuit breaker control switch. The switch shall have three positions (trip-normal-close) with a spring return to normal and padlocking facility in the normal position.

The control switch shall follow the convention of closing the circuit breaker in the clockwise direction.

5.9.3. Indicator lights shall be LED type to indicate the breaker status as follows:

Red: breaker closed, one for each trip coil adjacent to the control switch

Green: breaker open, one for closing coil adjacent to the control switch

For outgoing and station service feeder panels only, the red and green lights shall be wired in series with the trip and close coils, respectively to supervise the status of each coil, in accordance with clause 4.12.10.

For incomers and bus tie breakers, the red and green light indications shall be achieved through the breaker auxiliary switches. The healthiness of the breaker trip coils shall be monitored via the trip circuit supervision relays which are located in the control room.

5.9.4. One (1) multifunction meter and one (1) electronic KWH meter with data saving and remote communication facility for each incoming and outgoing feeder panel, and one (1) voltmeter for each bus section shall be provided. KWH meter shall conform to 40-SDMS-02A.

5.9.5. If specified in the Data Schedule, one (1) auto-reclose IN/OUT selector switch and one (1) auto-reclose lockout reset push button shall be provided for outgoing feeder panels only.

5.9.6. One (1) 230Vac LED light. The light shall be controlled by toggle and door switch. Switch shall be identified with engraved or embossed nameplate.

5.9.7. One (1) thermostatically controlled space heater rated 230 Vac and designed for continuous operation with a manual ON/OFF control switch.

5.9.8. One (1) 15A, 230Vac and one (1) 10A, 400Vac flush type, parallel slot, grounding type convenient outlets shall be provided in the incoming and bus-tie breaker panels.

5.9.9. Lot, Nameplates

5.9.10. Lot, Relays and Relay manufacturer's test blocks (see clause 4.12). SCADA Interposing Relays for Trip and Close.

5.9.11. The bus riser/metering panel shall contain the following :

a. Bus differential protection relay and supervision relay or protection as specified in SOW/TS with relay manufacturer's test blocks.

b. One (1) multifunction meter

5.9.12. Indication lamps in addition to specified shall be provided on the front of transformer and feeder panels and connected through capacitor voltage dividers to monitor the cable circuits dead or live.

5.9.13. Interior color finish of LV compartment shall be RAL 9003 (signal white).

5.10 Relays, Meters and Instruments

5.10.1 Relays, meters and instruments shall be provided as specified in the Project Scope of Work (SOW/TS) and shall be located in a low voltage compartment of the same feeder breaker panel while for the other breaker panels, they shall be installed in separate relay and control panels. All outgoing feeder breaker panels shall be povided with SEF Relays.

5.10.2 All protective relays shall be mounted in 19 inch racks. If relays cannot be rack mounted they may be flush mounted.

5.10.3 Target indicators shall be provided on all relays performing protective or tripping functions. Relay contacts shall be self-aligning.

5.10.4 All meters shall be switchboard fixed-type and flush or semi-flush mounted. Accuracy class of all digital meters shall be 0.5 per IEC or 0.3 per ANSI. Accuracy class of all revenue meters shall be 0.2 per 40-SDMS-02.

5.10.5 The meters shall be fitted with dust and moisture proof covers and shall have non-reflecting glass. Analog meters shall have 240°scale and dimensions 96 x 96mm.

5.10.6 Meters, instruments and indicating type transducers shall have test facilities separate from protective relays, so that testing and calibration can be done without equipment outages. Test facilities, suitably shrouded, shall be similar in function to type FT-1 test switches and shall be mounted on the front panel.

5.10.7 Upper edge of protective relays and meters shall be no higher than 2.2m to allow convenient maintenance, inspection, target reset, and testing from ground level. As a special case, where upper edge of protective relays higher than 2.2 m, suitable means shall be provided for the accessibilty to the relays with SEC prior approval.

5.10.8 All accessories such as DC/DC converters and transducers shall be located inside the panel or as specified in SOW/TS.

5.10.9 For outgoing and station service feeder panels, each indicating light shall have a current limiting resistor to facilitate replacing the bulb without activating the respective trip/close coil. The rating of the resistor shall be selected to provide adequate illumination of the lamp at normal operating conditions.

Shorting of the lamp terminals shall not damage the resistor itself or blow the control circuit fuses (or trip the control circuit MCBs) considering that maximum DC control voltage is limited to 110% of its nominal rating. This shall be met by restricting the current passing through the trip coil to less than 25% of its minimum pick-up current.

5.10.10 The trip 1, trip 2, close and spring charge circuit MCBs shall be located at the switchgear in the LV compartment.

5.10.11 All switchgear MCBs shall have normally open auxiliary contacts. Each breaker shall have its MCB contacts connected in series with the Trip Circuit 1 positive supply located on that breaker. Any MCB operation shall de-energize the breaker DC supervision relay and provide an alarm.

5.10.12 In substations, with Substation Automation IEDs shall be installed in the LV compartment. Control and Protection requirements, Communication protocol etc. shall be as per relevant Material specification, IEC standards or SOW/TS.

5.11 Instrument Transformers

5.11.1 Current Transformers (CTs)

a. For 13.8 kV feeders Current transformers (CTs) shall be installed on cable side or both bus and cable sides of circuit breakers as per the PTS/SOW with CT requirements stated in the data schedule. For 33 kV/34.5 kV feeders, CTs shall be installed on cable side or both bus and cable sides with CT requirements stated in the data schedule. No CT shall be mounted on a breaker truck. CTs shall be of epoxy resin encapsulated design per IEC 61869-2.

b. The mechanical and thermal current ratings of CTs shall be coordinated with the momentary and short circuit current of the associated circuit breaker, respectively.

c. Switchgear shall be delivered with all CT secondary windings shorted out. All CT secondary leads shall be wired out to terminal blocks. The secondary windings of each CT shall be rated as specified in Data Schedule, and shall be connected to the ground bus by a direct copper connection, via a removable link at one point only.

d. CTs for bus bar differential and restricted earth fault (REF) relays shall be of single-ratio type. Other relaying CTs shall be of dual-ratio type.

e. Metering CTs shall be of single-ratio or dual-ratio as per Data Schedule.

f. Relaying and metering accuracy class for standard burdens shall be as specified in Data Schedule.

g. The looping of feeder cables or secondary conductors through the window of window type CTs is not acceptable. Cascaded CTs will not be acceptable.

h. Primary and secondary terminals and polarity shall be marked as per applicable standards.

5.11.2 Voltage Transformers (VTs)

a. Voltage transformers (VTs) shall be of standard three (3)-winding type for the voltage class of the switchgear and shall have voltage marked ratio and accuracy class for standard burden as specified in Data Schedule.

b. Drawout carriage for VT with padlocking facilities or a fixed type VT with isolating facilities and associated fuses shall be located in an easily accessible place. VT shall be of electromagnetic epoxy encapsulated dry type design per IEC 61869-3, suitable for three-phase star connection with star point solidly grounded. VT shall be provided in a separate compartment for each bus bar and either side of the bus section. VT primary, connected through power cable from the main bus bar is not acceptable. Automatic metallic safety shutter with padlocking facilities shall be provided to prevent access to the HV bus bar when VT is withdrawn. The shutter shall be painted RED and have the word "BUS BAR" painted in white lettering. The shutters shall open and close automatically by means of positive drive initiated by the movement of the VT carriage. For maintenance purposes, opening of the individual shutters shall be possible.

c. Primary circuits of all VTs shall include current-limiting fuses. These fuses shall be mounted in such a way that they must be disconnected from the primary circuit before access can be obtained. A supervision relay for the HV fuses burn out shall be provided with provision of sending an alarm to power control center.

d. VTs shall have two (2) secondary windings. Secondary circuits of all VTs shall be protected by fuses or miniature circuit breakers (MCB). MCB's shall have auxiliary contacts for alarm indication. All secondary leads shall be wired out to terminal blocks in LV compartment.

e. Provisions shall be made for disconnecting the secondary circuit of VT when the primary circuit is disconnected. Provision shall also be made for momentary grounding of the primary winding and current limiting fuses during the disconnecting operation to remove any charges from the windings.

5.12 DC Control Power

Unless otherwise specified, the nominal DC control voltage for closing and tripping of all circuit breakers shall be 125 V_{dc} supplied from station batteries. Trip coils shall operate satisfactorily between 70 V_{dc} and 140 V_{dc} and closing coils shall operate satisfactorily between 90 V_{dc} and 140 V_{dc}. The motor operated mechanism shall operate satisfactorily between 90 V_{dc} and 140 $V_{dc.}$

5.13 Wiring and Terminal Blocks

5.13.1 All wiring within the switchgear shall be installed and tested at the factory unless otherwise specified. All wiring shall be heat and flame retardant, rated 90°C maximum operating temperature, rated 600/1000V, with insulated, tinned, stranded annealed copper conductor, conforming to IEC 60502-1.

All CT secondary circuits within the switchgear shall not be smaller than 2.5 mm^2. For SCADA digital and analog input signals, SOE, Annunciator and status/alarm signaling circuits wiring size shall not be less than 0.5mm^2 up to the first termination point, only if the associated device cannot accommodate larger wire sizes. For SCADA Control Output Signals and all other circuits the wiring size shall not be smaller than 1.5mm^2.

All wires shall be adequately rated for thermal withstand of short circuit currents, in accordance with back-up tripping time.

5.13.2 Color coding of panel wiring shall be as follows :

DC circuits: Generally Grey, (Trip circuits shall be provided with red ferrule at the terminal block) unless other wise specified

VT circuits: Generally Red, unless other wise specified (fitted with R, Y, B sleeves)

Alarm circuits: Blue

CT circuits: Generally Yellow, unless other wise specified(fitted with R, Y, B sleeves)

AC power circuits: 4 Core: Red, Yellow, Blue, Black (Neutral)

3 Core: Red, White or Yellow, Blue for 3 phase

3 Core: Red, White or Yellow, Black (Neutral) for 2 phases

2 Core:Red, Black (Neutral)

1 Core:Black

1 Core: (Usage limited to grounding conductor) Green or Green with Yellow stripes

5.13.3 All wiring shall be made without splices. The control wires shall be multi-stranded flexible and shall be terminated with size 1 hooked crimps or ring type terminals. Spade type, pin type or boot lace type crimp terminals are not acceptable.

5.13.4 Terminal blocks shall be as per 31-TMSS-06. Compatible end stops, end plates, barriers and terminal block identifiers shall be used.

5.13.5 The CT terminal blocks at the first accessible point of termination shall have shorting and grounding facilities by means of a copper bar with shorting screws.

5.13.6 The termination between the ground bus bar and the isolatable link shall be numbered C90 for Overcurrent CT, M90 for Metering CT, B90 for Bus Differential and D90 for Remote Tap Charger Control (RTCC) overcurrent block applications.

5.13.7 CT terminals shall be grouped by function and then sub-grouped by phase. Each phase shall be labeled by appropriate labels attached to the terminal blocks. Each complete CT shall be identified by function and reference number. Where a CT has a dual ratio using secondary tapings, such as S1, S2, S3; the CT terminal block shall have four (4) terminals: S1, S2, S3 and ground.

5.13.8 The shorting bar shall cover the four terminals of each phase. The bar shall be grounded through the grounding terminal block. The other end of the bar shall be held by an insulated screw.

5.13.9 Adjacent to the CT terminal blocks, shall be located two end stops with an appropriate label mounted between them. Each stop shall have formed holes that shall be used to store the CT shorting screws.

5.13.10 All tapping of dual-ratio CTs shall be terminated at the terminal blocks which shall be clearly marked to designate the CTs phase and ratio in use.

5.13.11 All VT circuits shall be provided with sliding link type terminal blocks to facilitate isolation of VTs from the circuit to perform voltage injection tests. These terminal blocks shall be clearly marked with phase, function, core number and ratio.

5.13.12 All spare contacts from protective relays or tripping relays shall be wired to the terminal blocks for future use. At least two (2) spare (1 NO + 1 NC) contacts of lockout relay shall be wired to the terminal block for future use.

5.13.13 All wiring internal to the switchgear assembly shall be laid in accessible wiring troughs throughout the entire length of the switchgear assembly. Internal wiring between the breaker and the LV compartment shall be bundled and neatly formed. There shall be no wiring run as single cores through grommets. The AC wiring shall be bundled separately from DC wiring in the same raceway. Signaling cables shall be shielded type and run in a separate raceway and shall be separated as far as practical from all LV power cables and at right angle to such wiring when the spacing is less than 300 mm.

5.13.14 Cable supports shall be provided for wiring run directly to instruments or devices. Wiring extensions from raceways or bundles to instruments and devices shall be neatly formed, securely tied or clamped and supported to the switchgear framework. Bends in the wiring shall be carefully made in such a manner that the insulation is not damaged.

5.13.15 Wiring for lights, space heaters and convenience outlets may be run in the same raceway in individual panels and in rigid or PVC jacketed flexible

conduits between panels. Wiring of meters/relays mounted on doors shall be mechanically protected.

5.13.16 All internal wiring terminations shall be identified by legible markings at the device terminals in accordance with the connection diagrams. Each end of every wire leaving a terminal block shall be identified indicating local termination point and destination as per Figure 1. Markers shall be of ferrule type, permanently marked and shall be made of material that will not deform or deteriorate and shall withstand a temperature of 90°C. Adhesive type terminal markers are not acceptable.

5.13.17 Where panels are to be shipped in sections and assembled in the field, the wiring between sections shall be provided preformed. One end of the wire shall be terminated on terminal block and the other end shall be bundled and tagged properly.

5.14 Device Identification

5.14.1. Appropriate identification in the form of engraved or embossed nameplate shall be provided on each instrument, relay, control/test switch and other devices. These nameplates shall be made of non-corrodible material and shall be of appropriate size.

5.14.2. Each device shall be permanently identified to correspond to the device identification symbol utilized on the wiring diagrams. This identification shall be adjacent to the terminals of the device. Standard relay device numbers shall be provided for protective relays. For switchgears phase conductors when viewed from operating side, the phase designation shall be R, Y, B from left to right, from front to back and from top to bottom. For reinforced substations the three phases shall be designated as per the existing system.

5.15 Cable compartment

5.15.1 Provisions shall be made for the connection of all power cables including proper terminal connectors or lugs, clamps, or terminations. The location of the power cable connections shall be arranged to ensure that cable entry is exactly below the termination point and provide adequate vertical space, with a minimum of 700 mm, for training incoming cables from conduit

entry to connectors and to provide adequate space for cable termination devices.

5.15.2 Provisions shall be made for the connection of all power cables including proper terminal connectors or lugs, clamps, or terminations. The location of the power cable connections shall be arranged to ensure that cable entry is exactly below the termination point and provide adequate vertical space, with a minimum of 700 mm, for training incoming cables from conduit entry to connectors and to provide adequate space for cable termination devices.

5.15.3 In case an extension box is required to meet the vertical space requirement, the extension box shall be a part of the switchgear supply. It shall be supplied by the switchgear manufacturer.

5.15.4 The bottom plate of power cable entry to the switchgear panel shall be of non-magnetic material. The bottom plate for outgoing feeder panels shall be of two pieces with holes drilled for entry of cable and shall be provided with clamps as specified in clause 4.17.4 below. The bottom plate for incoming and station service transformer panels shall be of a single piece without any holes drilled.

5.15.5 Adequate structural supports (clamps for XLPE cable) for power cables inside the cable compartment shall be provided.

5.15.6 The cable termination compartments shall be designed to accept heat shrinkable cable terminations. The boots over the cable terminals, if required, shall also be of heat shrink or molded PVC type.

5.15.7 Cable size up to 630 mm2 shall be able to terminate in the cable box. Provision shall be made for connection of two or more cables per phase as per circuit capacity (Viz. transformer incomer, feeder, etc.).

5.16 <u>External cabling</u>

5.16.1 Power cables

a. Termination of power cable shall be bolted type. R, Y, B phase shall be marked.

b. Termination for conductors 400 mm2 and larger shall be suitable for 4 hole NEMA pad, 12 mm (½ in.) stud. For conductors smaller than 400 mm2 terminals shall be suitable for 1 hole NEMA pad, 12 mm (½ in.) stud.

5.16.2 Control Cables/Wires

a. All external control cables/wires shall be brought to the panel from the bottom, unless otherwise specified.

b. Control cables/wires shall enter the panel through suitable cable glands to prevent contact with sharp metal edges. The gland-plate assembly shall be vermin proof.

5.17 Grounding

5.17.1 An uninsulated electrolytic copper grounding bus sized for the rated short circuit current and running the entire length of the switchgear assembly shall be provided. Provision shall be made for extending the ground bus at either end without any need for cutting or drilling the copper bar.

5.17.2 An uninsulated electrolytic copper grounding bus sized for the rated short circuit current and running the entire length of the switchgear assembly shall be provided. Provision shall be made for extending the ground bus at either end without any need for cutting or drilling the copper bar.

5.17.3 Provision shall be made to terminate ground connection on each end of the ground bus by using bare ground conductor 120 mm2 thu 240 mm2.

5.17.4 All hinged doors and panels shall be properly bonded by unspliced flexible wire or 10mm2 Cu braids.

5.17.5 All devices or equipment shall be grounded as required. Each grounding connection to the ground bus shall be arranged so that each may be disconnected without disturbing the continuity of the ground bus or any other ground connection.

5.17.6 Drawout carriage of all removable elements shall have a direct ground connection with the switchgear ground bus through suitable flexible or pressure contact type connections designed to carry the rated fault current for the rated duration.

5.17.7 Ground wire shall be separate from control and communication cables.

5.18 Accessories

The following accessories shall be supplied by Contractor/manufacturer as applicable:

5.18.1 One handling device (adjustable trolly) for removing each size of circuit breaker from the switchgear assembly, which shall be capable of putting the circuit breaker on the floor.

5.18.2 A set of each relay manufacturer's test plugs accessories for relay testing and protective relay test set and portable test equipment for meters.

5.18.3 Portable device for racking circuit breaker from one position to the other. Two such devices shall be provided when one line-up of switchgear is supplied. One device per line-up shall be provided if more than one line-up is supplied.

5.18.4 A set of test jumper cables (one for each line-up of switchgear) or equivalent with appropriate end fittings to permit connections of all secondary control contacts for test of the circuit breaker in the withdrawn position. The test jumper cables shall be long enough to permit testing when the breaker is completely removed from the panel.

5.18.5 One set of high voltage portable testing plugs of continuous current rating of 200A for insertion into circuit breaker isolating contacts shall be provided.

5.18.6 A suitable box or container shall be supplied for storage of test plugs.

5.18.7 Crank lever or equivalent device for manual charging of the spring-operated stored energy closing mechanism of the circuit breaker and closing grounding switch.

5.18.8 Any special tools required for swtchgear maintenance, erection and relay adjustments.

5.19 Nameplates

5.19.1 The switchgear assembly shall have a "Danger High Voltage" warning sign written in Arabic and English.

5.19.2 Switchgear assembly shall also bear a nameplate permanently and legibly marked in English with the information in accordance with IEC 62271-200 or equivalent ANSI Standards, plus the following additional information:

a. SEC Purchase Order Number or Contract Number or J.O. Number

b. 32-SDMS-01, Rev. 01.

5.19.3 Each circuit breaker shall have a nameplate as per IEC 62271-100 or ANSI C37.06.

5.19.4 The circuit breaker operating mechanism, CTs, VTs and FT-1 switches shall also bear nameplates.

5.19.5 Each FT-1 switch shall have a separate nameplate of dimensions 160mm by 44mm. Minimum letter height shall be 12mm for cubicle/circuit labels and 7mm for all other labels.

5.19.6 The nameplate for the switchgear assembly and the circuit breakers shall be made of stainless steel. The nameplate shall be fastened by stainless steel screws or rivets. The panel designation shall be as per PTS drawing. Other nameplates for CTs, VTs etc. may be made of non-corrodible material other than plastic. Engraved labels in Gravoply are acceptable.

5.20 Drawings

The switchgear manufacturer shall supply the following size A drawings as a minimum:

5.20.1 General arrangement and sectional view drawing of Switchgear Panel of each type.

5.20.2 Switchgear Layout Drawing.

5.20.3 Single Line Diagram.

5.20.4 General Arrangement and Component List of Circuit Breaker.

5.20.5 AC Schematic.

5.20.6 DC Schematic.

5.20.7 Panel Wiring Diagram.

5.20.8 Component List of Switchgears with sub-supplier (make) and country of manufacture.

6.0 TESTS

6.1. All equipment shall be tested in accordance with the latest applicable IEC or ANSI/IEEE Standards.

6.1.1 Type (Design) Tests

a. All type tests prescribed in the applicable IEC or ANSI/IEEE Standards shall be performed on the first unit of every new design, rating or size of the corresponding equipment to be supplied to SEC, in accordance with the table below.

b. Arc-proof test shall also be performed in cable compartment, Breaker compartment and Busbar compartment on an identical switchgear panel in accordance with Annexure A of IEC 62271-200.

c. Certified test reports of type tests performed on identical equipment acceptable to SEC may be submitted for review and acceptance in lieu of the required type tests above.

6.1.2 Routine (Production) Tests

a. All routine tests prescribed in the applicable IEC or ANSI/IEEE Standards shall be performed on the corresponding equipment in accordance with the table below and test reports shall be submitted for review and acceptance.

b. Routine test reports from original manufacturer of all circuit breakers, instrument transformers and grounding switches (or truck) shall be submitted for review and acceptance.

c. Timing tests are required on all circuit breakers.

6.1.3 The site tests shall be performed on the metal-clad equipment and its component in accordance with relevant IEC Recommendations & SEC Commissioning Test Procedures, TCS-P-105.

6.2. Tests for relays, meters and instruments may comply with the manufacturer's standard tests. Relay circuits shall be tested with simulated fault currents for proper operation.

6.3. Applicable Standards for tests:

EQUIPMENT	APPLICABLE STANDARD
Complete Switchgear Assembly	IEC 62271-200 or ANSI/IEEE C37.20.2
Circuit Breakers	IEC 62271-100 or ANSI/IEEE C37.09
Instrument Transformers	IEC 60044-1 and IEC 60044-2 or IEEE C57.13.2
Grounding Switches	IEC 62271-102

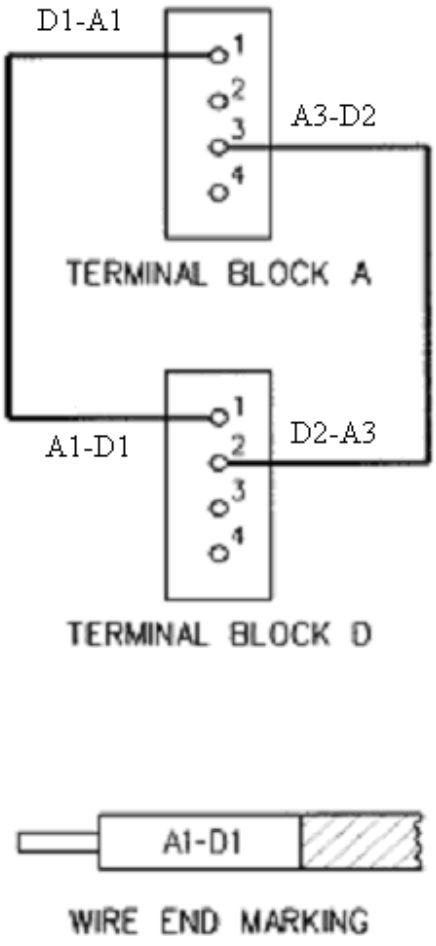

Figure 01: Internal Wire Identification

7.0 DATA SCHEDULE

METALCLAD SWITCHGEAR 11 kV, 13.8 kV, 33 kV OR 34.5 kV

SEC Enquiry No. _____ Date: _____

SEC Purchase Order No. or Contract No. _____ Date: _____

SEC PTS No./Project Title with J.O. No. _____

REFERENCE SECTION NO.	DESCRIPTION		'A'	'B'	'C'
3.0	APPLICABLE CODES AND STANDARDS	*			
5.0	DESIGN AND CONSTRUCTION REQUIREMENTS				
	Mean Altitude above Sea Level	(m)			
	Type of Upstream Neutral Grounding (Solidly grounded, resistance grounded)				
5.2	Switchgear Assembly				
	Switchgear Model Designation	*			
	No. of Panels in the Switchgear for				
	Incoming Feeders				
	Outgoing Feeders				
	Bus tie Breaker(s)				
	Bus Riser/Metering				
	Station Service Transformer				
	Dedicated Feeder(s)				
	Voltage Rating and Material of Bus Support Insulators	*			

	Switchgear Enclosure RAL Color Finish		RAL 7033		
5.3	Ratings:				
	Nominal Voltage of Switchgear & Breaker	(kV_{rms})			
	Maximum Voltage Withstand (Emergency conditions) of Switchgear & Breaker	(kV_{rms})			
	Design Ambient Temperature of Switchgear & Breaker	(ºC)	40ºC		
	1.2/50µs Lightning Impulse Withstand Voltage of Switchgear, Breaker, ES, CT & VT:				
	To ground and between phases	(kV_{peak})			
	Across Isolating Distance (to applicable equipment)	(kV_{peak})			
	Power Frequency Withstand Voltage of Switchgear, Breaker, ES, CT & VT:				
	To ground and between phases	(kV_{rms})			
	Across Isolating Distance (to applicable equipment)	(kV_{rms})			
	Power Frequency Withstand Voltage of Auxiliary Circuits	(kV_{rms})			
	Rated Continuous Current of:				
	Switchgear Main Busbar	(A_{rms})			
	Incomer Circuit	(A_{rms})			
	Bus Tie Circuit	(A_{rms})			
	Outgoing Feeder Circuit	(A_{rms})			
	Metering Feeder circuit	(A_{rms})			

	Station Service transformer circuit	(A_{rms})			
	Rated Short-time Withstand Current of Switchgear, Circuit Breaker, ES & CT	(kA_{rms})			
	Short-time current Duration	(s)			
	Rated Peak withstand current of Switchgear, CB, ES & CT (2.6 × I_{SC})	(kA_{peak})			
	Internal arc fault current for 1(s)	(kA)			
	Degree of Protection of Indoor Enclosure		IP4X		
	Type of material used in metal-cladding		*		
	Minimum thickness of enclosure	(mm)	*		
	Material of partition between bus bar compartments		*		
	Material of seal-off bushing at partition between bus bar compartments		*		
5.4	Busbar Conductors and Connections				
	Material of busbar		(Cu)		
	Busbar insulation material		*		
	Material of insulating covers for bus bars and molded boots for bus bar connections		*		
5.5	Power Circuit Breakers				
	Breaker Model Designation		*		

Breaker Insulation medium	(SF6/ Vacuum)	*		
Rated SF6 gas pressure	(kPa)	*		
Breaker close lockout pressure (if applicable)	(kPa)	*		
Breaker trip lockout pressure (if applicable)	(kPa)	*		
Rated Symmetrical Interrupting Current of Breaker at Nominal Voltage	(kA_{rms})	*		
Rated Peak withstand/ Making Current of breaker	(kA_{peak})	*		
First Pole To Clear Factor of breaker		1.5		
Rated Interrupting Time of breaker	(Cycles/ms)	5/80		
Arcing Time				
Maximum	(ms)	*		
Minimum	(ms)	*		
Rated opening time	(ms)	*		
Rated Closing Time	(ms)	*		
Rated Reclosing Time	(ms)	*		
Rated Close-Open Time	(ms)	*		
Rated Permissible Tripping Delay	(s)	*		

Minimum Opening Time of the first opening pole of the Breaker	(ms)	*		
Rated Operation Sequence		O-0.3s-CO-3min-CO or O-0.3s-CO-15s-CO		
Breaker Design X/R Ratio		17 (Min.)		
Maximum DC resistance of the power carrying circuit from terminal to terminal of circuit breaker	(Ohm)	*		
Temperature Rise at Rated Continuous Current of circuit breaker				
Main Contacts	(°C)	*		
Terminals	(°C)	*		
Rated Out-of-Phase breaking current capability	(kA_{rms})	*		
Rated cable charging current Breaking capability	(A_{rms})	*		
Rated back to back capacitor bank Breaking current, if applicable	(A_{rms})			
Rated Capacitor Bank In-rush Making Current, if applicable	(kA_{peak})	20		
Rated Transient Recovery Voltage for Terminal Fault	(kV_{peak})	*		
Operating Mechanism: Type		*		

Designation		*		
5.5 Spare Auxiliary Contacts				
Total Number of normally Open	(Nos)	*		
Total Number of normally Closed	(Nos)	*		
Rated current	(A_{dc})	*		
Rated voltage	(V_{dc})	*		
Number of close-open operations that can be performed by the mechanism before spring recharge		*		
Time required to charge the closing spring	(s)	*		
Auto-reclose IN/OUT selector switch Required for Outgoing Feeders?		Yes/No		
Auto-reclose lockout reset push button Required for Outgoing Feeders?		Yes/No		
DC Control power				
Breaker Spring Charging Motor				
Rated voltage (48 or 125)	(V_{dc})			
Range of operating voltage	(V_{dc})	*		
Rated current	(A_{dc})	*		
Maximum starting Current	(A_{dc})	*		
Breaker Closing /Tripping Coil				
Rated voltage (48 or 125)	(V_{dc})			
Range of operating voltage	(V_{dc})	*		
Rated current	(A_{dc})	*		

5.9 Low voltage compartment				
Light Points				
Voltage	(V_{ac})	230		
Power	(Watts)	*		
Space Heaters				
Voltage	(V_{ac})	230		
Power	(Watts)	*		
Receptacles				
Voltage	(V_{ac})	230		
Current	(Amp)	15		
Voltage	(V_{ac})	400		
Current	(Amp)	10		
Type of indicator	LED/ Lamp	LED		
Relays, Meters, transducers and Instrument (Specify details, provide a complete list and metering one-line diagram for review)				
Transducers				
Input current	(Amp)	1 or 5		
Output current	(mA)	*		
Accuracy		≥0.25		
Type of meter	Analog/ Digital	*		
Metering Accuracy Class				
Digital meters		0.5		
Analog meters		1.0		
Revenue meters		0.2		
5.10 IEDs				
IED type / Model number		*		

	Make and country of origin		*		
	Functions included in the standard configurations		*		
	Supported functions		*		
	Supported tools		*		
	Optional functions		*		
	Number of physical connection in the standard configuration (analog and binary)		*		
	Supported Communication interfaces and protocols		*		
	Auxiliary Power				
	Mounting				
	Display				
	Operating temperature range				
5.11	Instrument Transformers				
	Type of CT		*		
	Make & country of origin of CT		*		
	Type of CT Insulation Class & locations		*		
	Rated Current of CT Secondary	(A)	1 or 5		

5.11

CT Continuous Thermal Rating					
Single ratio CT		120%			
Dual ratio CT		120%			
Rated Short Time Withstand Current of CT:					
Thermal, I_{th}	(kA_{rms})	*			
Dynamic	(kA_{peak})	$2.6xI_{th}$			
Short time thermal current duration	(s)	*			
Rated parimary short circuit current of CT, (I_{pSC})	(kA_{rms})	*			
Maximum Temperature Rise of CT	(°C)	*			
CT Ratio(s)					
Incomer Circuit					
Bus Tie Circuit					
Out going Feeder Circuit					
Protection					
Metering					
Station Transformer					
Busbar Differential					
Restricted Earth Fault					
CT Burden(s) (VA)/Resistive burden -Rb					
Incomer Circuit	(Ohms)	*			
Bus Tie Circuit	(Ohms)	*			
Outgoing Feeder Circuit	(Ohms)	*			

Station Transformer	(Ohms)	*		
Relaying Accuracy Class(es) of CT				
Incomer Circuit		*		
Bus Tie Circuit		*		
Outgoing Feeder Circuit		*		
Station Transformer		*		
Metering Accuracy Class of CT				
Incomer Circuit		*		
Bus Tie Circuit		*		
Outgoing Feeder Circuit		*		
Station Transformer		*		
CT Secondary winding Resistance at 20ºC, Rct	(ohms)	*		
<u>For class TPS CTs per IEC</u>				
Rated symmetrical short circuit current factor (K_{SSC})		*		
Dimensioning parameter (K)		*		
Excitation limiting secondary Voltage, U_{al}	(Volts)	*		
Accuracy limiting secondary exciting Current, I_{al}	(mA)	*		
Secondary excitation current, I_{mag} at half excitation limiting secondary voltage	(mA)	*		
<u>For class C or K CTs per IEEE / Class P CTs per IEC</u>				

	CT Magnetizing current, I_{mag}	(mA)	*		
	CT Knee point voltage, $V_{k/}$ Secondary limiting e.m.f	(Volts)	*		
	Voltage Transformer				
	Type of construction		*		
	Make and country of origin		*		
5.11	Insulation Class		*		
	Winding Material.	(Cu)	*		
	Rated Voltage Factors		*		
	Rating of Current Limiting Fuse on VT Primary	(A_{rms})	3		
	VT Secondary MCB/Fuse current rating	(A)	*		
	VT Secondary Voltage	(V_{rms})			
	Extended tap Voltage of VT	(V_{rms})			
	VT Voltage Marked Ratio		*		
	VT Burden	(VA)			
	VT Accuracy Class 0.2/3P or 0.5/3P (Metering/Relaying) Accuracy class to be selected as per Project/ Design requirement				
5.16	External Cabling (Details to be provided by the main Contractor)		*	Yes/No	
	Type of termination		Bolted		

Power Cable Details:					
Type of insulation					
Voltage class	(kV_{rms})				
Incomer Circuit					
No. of cable/phase	No	*			
Conductor material	(Cu/Al)				
Area of Cross section	(mm^2)				
Out going feeder					
No. of cable/phase	No	*			
Conductor material	(Cu/Al)				
Area of Cross section	(mm^2)				
Station Service Transfomer-1					
No. of cable/phase	No	*			
Conductor material	(Cu/Al)				
Area of Cross section	(mm^2)				
Station Service Transfomer-2					
No. of cable/phase	No	*			
Conductor material	(Cu/Al)				
Area of Cross section	(mm^2)				
5.17 Grounding					
Copper grounding bus size	(mm x mm)	*			
Method of busbar grounding		*			
Bonding of hinged doors	(mm^2)	≥ 10			
Rated Short-time Withstand Current of grounding switch and bus	(kA_{rms})				
Short-time current Duration	(s)				

5.18	Accessories				
	Adjustable trolley		*	Yes/No	
	Portable device for CB trans.		*	Yes/No	
	Relay Test Plug		*	Yes/No	
	Test jumper cable		*	Yes/No	
	High voltage test plug		*	Yes/No	
	Storage box for test plug		*	Yes/No	
	Manual operation handle for CB & ES		*	Yes/No	
	Special tools for CB/Relay maintenance		*	Yes/No	
	Recommended Clearances:				
	In front of the Switchgear	(mm)	*		
	At rear of the Switchgear	(mm)	*		
	Panel Dimensions (H x D x W)				
	Incoming Feeder Panel	(mm)	*		
	Outgoing Feeder Panel	(mm)	*		
	Station Service Transformer feeder Panel	(mm)	*		
	Bus Tie Panel	(mm)	*		
	Bus Riser/Metering Panel	(mm)	*		
	Panel Weight:				
	Incoming Feeder Panel	(kgs.)	*		
	Outgoing Feeder	(kgs.)	*		
	Station Service Transformer feeder	(kgs.)	*		

Bus Tie Panel	(kgs.)	*	_____	_____
Bus riser/Metering Panel	(kgs.)	*	_____	_____

6.0 TESTS

Optional or Special Test Requirements (if any)

7.0 DATA SCHEDULE

METALCLAD SWITCHGEAR 11 kV, 13.8 kV, 33 kV OR 34.5 kV

A. ADDITIONAL TECHNICAL INFORMATION OR FEATURES TO BE FURNISHED BY SEC:

B. ADDITIONAL SUPPLEMENTARY DATA OR FEATURES PROPOSED BY BIDDER/VENDOR/SUPPLIER/CONTRACTOR:

C. OTHER PARTICULARS TO BE FILLED UP BY BIDDER/VENDOR/SUPPLIER/ CONTRACTOR:

	Actual Manufacturer of Equipment/Material	Vendor/Supplier/ Contractor
Name of the Company Location and address	_____ _____ _____	_____ _____ _____
Name and Signature of authorized Representative and date	_____ _____ _____	_____ _____ _____
Official Seal/Stamp of the Company & Date	_____ _____	_____ _____