Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	31-SDMS-10 Rev. 00
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REV. 00

SPECIFICATIONS

FOR

AUXILIARY AC/DC PANELS FOR PRIMARY DISTRIBUTION SUBSTATIONS

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1.0 SCOPE

This SEC Distribution Material Standard Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of Auxiliary AC/DC Panels (indoor), intended to be used in the system of Distribution Sector of the Saudi Electricity Company, Saudi Arabia.

2.0 CROSS REFERENCES

This Material Standard Specification shall always be read in conjunction with 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 61869-1	Instrument Transformer, Part1: General Requirements
3.2	IEC 61869-2	Instrument Transformer, Part -2: Current Transformer
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 Indicators and Actuators
3.5	IEC 60076-11	Power Transformers, Part 11: Dry Type Transformers
3.6	BSI BS EN 60439-1	Low Voltage Switchgear and Control gear Assemblies, Part 1: Requirements for Type-Tested and Partially Type-Tested Assemblies

3.7	IEC 60529	Degree of Protection provided by Enclosures
3.8	IEC 60616	Terminal & Tapping Markings for Power Transformers
3.9	IEC 60664	Insulation Co-ordination for Equipment Within Low Voltage Systems
3.10	IEC 60947-1	Low Voltage Switchgear and control gear Part1: General Rules
3.11	IEC 60947-2	Low Voltage Switchgear and Control gear, Part 2: Circuit Breaker
3.12	IEC 60255 (relevant parts)	Electrical relays.
3.13	ANSI/IEEE C 57.12.01	General Requirements for Dry Type Distribution and Power Transformer
3.14	ANSI/NFPA 70	National Electrical Code
3.15	40-SDMS-02A	Electronic Revenue CT and CT/VT Meters
3.16	38-SDMS-03	LV Digital Panel Meters

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General arrangement

4.1.1 AC/DC main distribution Board(s)/Panel(s) shall be floor mounted, free standing, metal enclosed dead front or multi-cubicle assembly as specified in the technical data schedule, integrally designed with all necessary control, instruments, meters and other appurtenances.

4.1.2 AC distribution board(s)/panel(s) shall be suitable for installation of 3-phase, 4 wire system inside substation.

4.1.3 The main AC distribution panel(s) shall be in compartmentalized assembly with separate compartments for each power circuit. Cable raceways/alleys shall be provided for each compartment on front side.

4.1.4 Sub-distribution panel(s) may be either floor mounted or wall mounted.

4.1.5 The sub-distribution panel(s) shall be non-compartmentalized cabinet type.

4.1.6 AC sub-distribution panel(s) for single phase power and lighting loads shall have number of outgoing circuits in multiples of six (i.e. two (2) on each bus), uniformly distributed in all three (3) phases. The maximum number of circuits shall be in accordance with NFPA 70/NEC Article 384. All circuits shall be numbered with phase identification.

4.1.7 All panels shall be designed for front access with operating handle of breaker/switches, meters, lamps etc. mounted on the front surface.

4.1.8 All panels shall be completely assembled, wired and tested at the factory.

4.1.9 For (-) 48Vdc Telecommunication applications, the TIE Box, DC Distribution Metering and Low Voltage Disconnect Unit and the AC Distribution Panel, shall be metal enclosed, dead front, non-compartmentalized and with front access only. Refer to Scope of Work / Project Technical Specification for details on the TIE Box, DC Distribution Metering and Low Voltage Disconnect Unit and the AC Distribution panel. The Tie Box and AC distribution panel may be wall mounted or floor mounted depending upon the scheme and Scope of Work / Project Technical Specification, whereas floor mounted metering and low voltage unit is preferred.

4.2 Ratings

Standard nominal AC and DC auxiliary voltages shall be as given below.

Table I

AC Auxiliary Voltage L-L/L-N (Nominal) (V_{rms})	Operating Range	DC auxiliary Voltage V_{dc}	Operating Range
400/230	±10%	125	101.5 to 136.3
400/230	±10%	48	42 to 56
220/127	±10%	- 48	- 42 to - 56

4.3 Enclosure

4.3.1 The load bearing members such as mainframe, mounting brackets etc. shall be fabricated from a minimum of 2.5mm thick steel sheet suitably braced or

supported. The non-load bearing members like side, rear, top doors etc. shall be fabricated from a minimum 1.5mm thick steel sheet suitably braced or supported. Where other metals are used, the thickness may be modified to provide equivalent strength and deflection if approved by SEC.

4.3.2 Each panel shall have sufficient strength to withstand strains caused by transportation, handling and thermal dynamic forces of short circuits.

4.3.3 The Panels shall be reinforced to provide a rigid self-supporting structure. The freestanding panels shall be floor mounted by means of anchor bolts whereas for wall mounted panels suitable mounting brackets shall be provided.

4.3.4 Each floor-mounted panel shall be furnished with a removable, bolted rear door if required whereas wall mounted panels shall be with hinged front door(s) only.

4.3.5 Each compartment shall be provided with dedicated hinged front door with handle and provision for a key/padlocking. The doors shall be provided with gaskets to ensure dust and vermin proofing.

4.3.6 Panel/compartment shall be equipped with hand operated safety latches. A doorstopper shall be provided with each hinged door to hold the door in open position, if required.

4.3.7 Any one compartment door of main distribution board/panel shall be Provided with a pocket to keep schematic drawings or circuit diagrams, contained in an envelope of durable non-fading material suitable for protection against climatic conditions specified in 01-SDMS-01.

4.3.8 Mounting brackets, as necessary shall be arranged inside each panel for mounting of circuit breakers and other devices. All equipment shall be suitably located to facilitate easy access for operation, maintenance and replacement as per ANSI/NFPA 70 or equivalent.

4.3.9 The enclosure shall be provided with a degree of protection of at least IP41 as per IEC 60529 or equivalent.

4.3.10 Adequate ventilation openings in the form of louvers shall be provided, wherever required. Ventilation louvers shall be vermin-proof and shall be provided with removable filters or removable wire mesh to minimize ingress of dust.

4.3.11 The panel design shall ensure that the heat generated by various apparatus mounted inside the panel shall not affect the performance of any of the devices. Heat loss calculations shall be provided, if requested by SEC.

4.3.12 The maximum height of panel shall be 2200mm including mounting channels.

4.3.13 Maximum two air circuit breakers shall be mounted in a vertical section.

4.3.14 The main distribution panel may consist of one or more sections to form a complete panel assembly. Each panel shall be provided with detachable (bolted) side/end cover to facilitate future expansion.

4.3.15 Cold punctured cutouts shall be provided in panels/individual compartment for front access mounting of circuit breaker push buttons, operating handle, instruments, relays, switches etc.

4.3.16 All panels shall be designed for bottom cable entry through cable glands, All cutouts, except cable gland cutout, shall be suitably casketed for dust proofing. All spare cutouts shall be covered with metal cover plates.

4.3.17 Floor mounted free standing panels shall have removable type lifting eyes or lifting beams installed on top of the panels and shall be capable of being rolled into installation position without distortion or damage. The panel base shall be capable of withstanding such movement without distortion or damage.

4.3.18 The paint finish of panel(s) shall be RAL 7033

4.3.19 Miscellaneous Electrical Features

a. Lighting controlled by toggle switch shall be provided in each vertical section of the panel. Toggle switch for light(s) in the cubicle shall be conveniently located beside each door. Fluorescent strip lights are preferred over incandescent lights.

b. A thermostatically controlled 230V, AC, single-phase anti-condensation heater with overriding manual control shall be provided within the panel. Switch for manual overriding shall be located adjacent to the light switch. Space heater capacity shall be as required to maintain the compartment and section internal temperature above the dew point.

c. A 230V, 20A, AC single-phase duplex receptacle outlet having parallel slot with grounding U-slot shall be provided in each panel. The outlet shall be suitable for use with three (3) pin plug.

d. A pair of heavy-duty shrouded terminals shall be provided in DC distribution board, which is suitable for the connection of a heavy current discharge tester.

4.4 Circuit Breakers

4.4.1 General requirements

a. The circuit breaker shall generally comply with IEC 60947-2.

b. The circuit breaker shall be air type (ACB) and/or Molded Case (MCCB)/Miniature Circuit Breakers (MCB) type as specified hereunder based upon their function:

i. AC auxiliary power system:

The incoming and bus-tie circuit breakers feeding the "Main" distribution panel shall be ACB type and 4pole.

All the remaining feeder breakers shall be MCCB. However feeder circuit rated for 32A and below may be provided with MCB subject to SEC approval.

ii. DC auxiliary system:

All circuit breakers shall be MCCB. However feeder circuit rated for 32A and below may be provided with MCB subject to SEC approval.

c. Multi-pole breakers shall have a single operating handle, which shall operate all poles simultaneously to close or trip the breaker. The operating handle shall clearly indicate whether the breakers are in "ON" or "OFF" or "TRIPPED" position.

d. The breaker shall be rated for minimum short time withstand current of 50 kA at 220V and 25 kA at 400 V or otherwise as specified in Data Schedule.

e. Circuit breakers shall be sized and selected in accordance with load requirements and shall be rated for 20% overloading. Calculations in evidence of adequacy of the offered sizes shall be furnished to SEC.

f. Circuit breaker shall be temperature compensated and de-rated for specified ambient conditions.

g. The main terminals shall be tin plated copper.

h. The circuit breaker operating mechanism shall ensure quick make and break operation and shall not hold in any intermediate position. Fault on any one pole shall trip all the poles simultaneously.

i. The breaker shall be designed for panel mounting and indoor applications.

j. Circuit breakers shall be provided with sealable, self-fitting, knock out type terminal covers.

k. The contacts shall be heavy duty spring loaded type and shall be silver plated.

l. The number of outgoing circuits provided shall meet the total requirement of AC/DC power supply for the substation, unless otherwise specified in the Data Schedule.

m. Each circuit breaker shall be provided with Brass or hot-dipped galvanized steel bolts of sufficient length for panel mounting the breaker on specially adapted accessories.

n. Circuit breaker of the same interrupting rating, similar application and with the same type overloading elements shall be interchangeable.

o. Overload and short circuit settings shall be site adjustable type.

p. Circuit breakers shall be provided with auxiliary contacts for alarm purpose unless otherwise specified in the Data Schedule.

4.4.2 Air Circuit Breaker (OPTIONAL)

a. Air circuit breaker shall be four pole withdraw-able and be of the following three (3) positions:
   i. Service position All circuits (main and auxiliary)

		connected
ii.	Test position	All auxiliary circuits connected and main circuits disconnected
iii.	Withdrawn position	All circuits disconnected

Trolley with wheel brakes shall be provided for handling the ACBs in withdrawn position. All auxiliary wiring shall be automatically disconnected in the withdrawn position.

b. All main contacts shall be guaranteed for the life of the breaker. The arcing contacts shall be removable and fitted with arc suppression devices (arc chutes).

c. The circuit breaker shall be electrically and mechanically trip free.

d. Air circuit breaker shall be electrically operated and shall have provision for motorized closing via stored spring energy mechanism with facility for manual closing and tripping. During manual spring charging operation electric supply to the spring charging motor shall get disconnected.

e. A DC motor shall charge the closing spring. The spring shall automatically recharge after closing of the circuit breaker enabling successive O - CO operation without replenishing the energy system.

f. A mechanical position indicator shall be provided to indicate the 'OPEN" and "CLOSE" positions of the circuit breaker. The markings shall be in white letter as "Open" or "O" on green back ground and "Close" or "C" on a red back ground.

g. Trip circuit supervision relay shall be provided to monitor the healthiness of the trip coil in breaker 'OPEN' as well as 'CLOSE' position.

h. CLOSING and TRIPPING Circuits shall be individually fused in both legs.

i. Control switches for electrically operated circuit breakers for CLOSE and TRIP control shall be of spring return type with pistol grip handles.

j. Breaker shall trip automatically at the time of insertion and withdrawal.

k. Arrangements shall be provided for pad locking the circuit breaker in "Service" and "Withdrawn" positions.

l. The circuit breakers shall be suitable for special application of "Automatic Transfer Switching" scheme as per clause 4.12 of this specification.

m. All fixed isolating contacts shall be fully shrouded against accidental contact when the circuit breaker is withdrawn or shall be equipped with automatic shutters with means of padlocking in the closed position.

n. Air circuit breakers shall be fitted with over current, short circuit and earth fault protections.

o. Anti-pumping feature shall be provided against sustained closing command.

p. A minimum of two independent normally open (NO) and two normally (NC) potential free auxiliary contacts shall be provided in addition to those required for the operating mechanism control and interlocks. All auxiliary contacts shall be mechanically driven.

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

r. Circuit breakers shall be designed to permit full accessibility for inspection and maintenance.

s. DC supply for spring charging motor, trip coil and closing coil shall be $125V_{dc}$.

t. Mechanical indication on the front of the breaker shall be provided to indicate the following:

   i. Service position
   ii. Test position
   iii. Withdrawn position

4.4.3 Molded Case Circuit Breakers (MCCBs)/Miniature circuit Breakers (MCBs)

a. MCCBs/MCBs shall be of fixed type, manually operated by means of a toggle type handle and shall have quick make and break spring mechanism, which is mechanically trip free.

b. MCCBs/MCBs shall be usable in both AC and DC current applications. MCCBs/MCBs used in AC auxiliary power systems shall be either triple pole with neutral link (TPN) or single pole with neutral link (SPN) as applicable, whereas all MCCBs/MCBs used in DC auxiliary power system shall be double pole (DP). For telecom application, 125V DC systems shall also have double pole breakers, for (-) 48V DC systems however, breakers shall be single pole and shall be installed in the negative pole.

c. All three phase AC MCCBs shall be equipped with over load, short circuit and earth fault releases.

d. Circuit breakers shall be provided with a pair of auxiliary contacts for alarm/indication.

e. The circuit breaker shall be rated for minimum 20Amps normal operating current for station equipment and 6Amps for Telecom equipment or otherwise as specified in data schedule.

f. The handle position shall be clearly indicated as follows:

i.	Top position	ON
ii.	Central position	TRIPPED
iii.	Bottom position	OFF

The “ON”, “TRIPPED”, and “OFF” handle positions shall be engraved/indelibly marked in “RED”, “YELLOW” and “GREEN” markings respectively.

g. Protection co-ordination between upstream ACB/MCCB and downstream MCCB/MCBs shall be achieved and supporting curves, calculations shall be submitted to SEC for approval. The selection of setting may be electronic or with adjustable notch. Rating of MCCB i.e. frame size and trip/current size shall be clearly mentioned in the Data Schedule.

4.5 Busbars

4.5.1 All busbars shall be made of high conducting tinned copper of at least 98% conductivity and of uniform cross section.

4.5.2 Busbars and inter-connectors shall be insulated with colored PVC heat shrink sleeve.

4.5.3 Busbars shall be rated and braced to withstand full available short circuit current.

4.5.4 The neutral busbar in a 3-phase, 4-wire system shall be of the same capacity as the phase buses. The neutral bus bar and neutral terminal blocks shall be insulated from the panel structure.

4.5.5 The Busbars shall be mounted on insulators and firmly jointed. Busbar joints, contact surfaces with breakers and other devices shall be silver plated to ensure good conductivity.

4.5.6 Vertical sections (droppers) shall be connected to the main bus by means of busbars and not by cable connections or vertical cable drops.

4.5.7 Transparent acrylic plate/cover shall be provided between busbars and compartment doors.

4.6 Relays, Meters, Instruments and Contactors

4.6.1 In the main distribution panels of AC and DC systems, relays and contactors shall be designed such that reasonable mechanical shock or external vibration does not operate or damage them.

4.6.2 Relays shall be of back connected, dust proof, flush mounted and switchboard type. The relay modules shall be rack mounted withdrawable / plug in type.

4.6.3 All relays shall have test terminal block facilities. Test facilities shall be mounted on front of the rack.

4.6.4 Relays and contactors shall be mounted in locations most convenient for maintenance, inspection and testing.

4.6.5 Relays, meters and instruments shall be provided as specified in the scope of work/technical specification.

4.6.6 Upper edge of protective relays and meters shall not be higher than 2.0m to allow convenient maintenance, inspection, target reset and testing from ground level.

4.6.7 The bottom of any relay or test block shall not be less than 300mm from floor level.

4.6.8 DC under-voltage relay shall be included in the panels with two pairs of normally closed contacts rated for 125Vdc.

4.6.9 LED type indicators with current limiting series resistor shall be provided.

4.6.10 DC contactors shall be two-pole electromagnetic type with adequately rated main and auxiliary contact for operation and indication. Coil shall be rated for 125Vdc.

4.6.11 The following meters, instruments and relays shall be furnished conforming to respective standards.

a. For each station auxiliary transformer one 3 phase, 4 wire Digital Power Demand Meter (DPDM) to read current, voltage, MW and MVAR with maximum demand and MWH and MVARH.

b. For each bus one digital voltmeter.

c. For Bus-tie breaker feeder one digital ammeter.

d. All AC meters shall be rated for 60Hz operation. All meters shall be capable of withstanding long duration overloads up to 120% of the rated electrical input quantity (ies) without affecting calibration. All meters shall be provided with a zero adjustment accessible from outside the case and located in the front. All meters shall be of flush mounted type, direct reading, back connected, dust proof and switch board type, having removable transparent dust tight window cover. Accuracy class of ammeter and voltmeter shall be Class 0.5 or better.

e. Each DC distribution as well as sub-distribution panels shall consist of one (1) voltmeter and one (1) ammeter at the incoming side.

f. In main AC distribution panel following relays shall be provided on the incomer.

i. 3-phase over-current relay
ii. Earth fault relay
iii. Over/under voltage relay
iv. One trip relay (94) to trip the breaker in case of activation of any fault relay mentioned above and to block the auto changeover scheme.

g. In main DC distribution panel following relays shall be provided on the incomer.

i. Earth fault relay
ii. Over/under voltage relay

4.7 Instrument Transformers

4.7.1 Bar primary/window type Current Transformer (CTs) shall be used.

4.7.2 The secondary windings of each CT shall be rated as specified in Data Schedule and shall be grounded at one point only.

4.7.3 CT accuracy class shall be as specified in Technical Data Schedule.

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

4.7.5 The looping of feeder cables or secondary conductors through the window of window type CTs is not acceptable.

4.7.6 Potential transformers shall be provided with fuse on primary side.

4.8 Raceways

4.8.1 An adequate raceways system shall be provided for all wiring on each side of each panel and between panels. Horizontal raceways for inter-panel and front-to-rear panel wiring shall be provided as applicable.

4.8.2 A complete system of separate vertical raceways shall be provided for all factory and field wiring, including vertical raceways along both sides of each panel.

4.8.3 Panel internal wiring shall be laid in accessible wiring trough throughout the entire length of the panel assembly. The AC wiring and DC wiring shall be run in separate raceway. Signaling cables shall be shielded type and run in a separate raceway and shall be separated as far as practical from all power cables and at right angle to such wiring when the spacing is less than 300mm.

4.8.4 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 panel framework. Bends in the wiring shall be carefully made in such a manner that the insulation is not damaged.

4.8.5 The combined cross sectional area of all conductors or cables shall not exceed 50% of the interior cross-sectional area of the raceways.

4.9 Wiring and Terminal Blocks

4.9.1 All wiring within the panels shall be installed and tested at the factory unless otherwise specified. All wiring used within the panels shall be heat and flame retardant, rated for 90ºC maximum operating temperature, type SIS as listed in ANSI/NFPA 70 or approved equivalent, rated 600/1000V, with insulated tinned stranded annealed copper conductor and shall not be smaller than 2.5mm^2. All CT secondary related circuits within the panel shall not be smaller than 2.5mm^2.

4.9.2 For SCADA digital and analog input signals, SOE, Annunciator and status/alarm signaling circuits wiring size shall not be less than 0.8mm^2 up to the first termination point, only if the associated device cannot accommodate larger wire sizes. For SCADA Control Output Signals the wiring size shall not be less than 1.5mm^2.

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

4.9.4 Wiring shall be made without splices. Where screw type terminals are used, the control wires shall have solder less insulated ‘O’/ring type, tin-plated copper crimp type terminal. Spade/fork type wire lugs shall not be used.

4.9.5 Wiring of meters/relays mounted on the doors shall be mechanically protected.

4.9.6 Color coding of panel wiring shall be as follows:

DC circuits	:		Grey (Trip circuits shall be provided with red ferrule at the terminal block)
CT circuits	:		Yellow
Alarm circuits	:		Blue
AC power circuits	:	4 Core	Red, Yellow, Blue, Black (Neutral)
		3 Core	Red, Yellow, Blue for 3-phase
		2 Core	Red, White or Yellow, Black (for neutral) for 2-phase
		2 Core	Red, Black (Neutral)
		1 Core	Black
		1 Core	(Usage limit to grounding conductor) Green or Green with yellow stripes

4.9.7 Ferruling

a. All internal wiring terminations shall be identified by legible markings at the device terminals. Each end of every wire leaving a cubicle shall be identified indicating local device number and terminal number and destination device number and terminal number as per Figure-1. All internal panel wiring shall have identification showing both locations of termination each end of the wire. All wiring terminating on termination block shall have to terminal identification repeated on the terminal block itself. Markers shall be ferrule type, permanently marked and shall be made of material that shall not deform or deteriorate and shall withstand a temperature of 90ºC. Adhesive type terminal markers shall not be used.

b. Ferrules shall be non-remove able without re-termination of the wire and they shall not be free to easily slide along the wire insulation. Ferrules shall not be of split type. Moreover, one sleeve shall be used for complete ferrule.

c. The finish of all ferrules shall be such that the color does not change considerably with age and they shall be resistant to the accumulation of dust.

d. Ferrules shall normally be white/yellow with clearly legible black lettering.

e. All trip circuits shall be provided with red ferrule at the terminal block.

4.9.8 Terminal blocks

a. All terminal blocks shall be SEC approved spring-loaded type for use with flat, hooked type crimps. If a common termination is required between terminal blocks, preformed wire jumpers or manufacturer's own shorting bar can be used. Compatible end stops, end plates, barriers and terminal block identifications shall be used. Groups of terminal blocks shall be identified using engraved labels.

b. Terminal block for CT secondary wiring shall be provided with shorting and grounding facilities. All PT circuits shall be provided with link type terminal blocks to facilitate isolation of PTs from the circuit to perform voltage injection tests. These terminal blocks shall be clearly marked with phase, function, core number and ratio.

c. In special circumstances where wire sizes exceed the terminal block capability, correctly sized terminal blocks shall be used after SEC approval.

d. In all instances, terminal blocks shall be mounted on DIN rails. The DIN rails shall be mounted on the bottom and sides of the panel.

e. Terminal blocks shall be grouped according to function, i.e. Power Supplies (AC or DC), CT, DC controls, annunciation, SCADA etc. The function shall be labeled accordingly. Terminal blocks for different voltages (AC/DC) shall be located on separate DIN rails.

f. 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 other end shall be bundled and tagged properly.

g. Not less than twenty (20) percentage spare terminals shall be provided on each terminal block.

h. All spare contacts of relays, contactors, switches etc. shall be wired up to the terminal block for future use.

4.10 External Cabling

4.10.1 All external cabling to floor mounted panels shall be brought to the panel from bottom, unless otherwise specified.

4.10.2 Removable plates underneath the terminal blocks shall be punched for installation of incoming conduits or control cables.

4.10.3 Cabling shall enter the panel through suitable cable gland to prevent contact with sharp metal edges.

4.10.4 In cable compartment, 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.

4.10.5 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

a. ensure that cable entry is exactly below the termination point

b. provide adequate vertical space for holding incoming cables from conduit entry to connectors

c. provide adequate space for cable termination devices

4.10.6 Terminal lugs for power cables shall be suitable for use with copper or aluminum conductor material.

4.10.7 All terminal lugs for power cables shall be of bolted type with two crimping element per lug.

4.11 Grounding

4.11.1 All metal parts in the panel shall be effectively bonded together.

4.11.2 A copper ground bus of minimum 300mm^2 in size shall be provided running the entire length of panel line-up and firmly bolted to the housing shall be provided. The ground bus shall be located minimum 50mm above the bottom of the panel.

4.11.3 Two (2) solder less ground connectors shall be provided on the ground bus, one on each end section of the bus for connection to the station grounding system. The ground connectors shall be suitable for bare stranded copper ground conductor of 120mm^2.

4.11.4 Non-conductive coatings such as paint shall be removed at all points of connection between the ground bus and the panel assembly to ensure good electrical contact.

4.11.5 All hinged doors and panels shall be properly grounded with minimum 35mm^2 copper braids at least two different locations. For sub-compartment and interior doors, smaller sizes can be used for copper braids.

4.11.6 Devices mounted on the panel shall be grounded as required. Each connection to the ground bus shall be arranged in such a way that it may be disconnected without disturbing the continuity of the ground bus or any other device ground connection.

4.11.7 Draw out carriage of all removable elements shall have a direct ground connection with the panel ground bus through suitable flexible or pressure sliding contact type connections designed to carry the rated fault current for the rated duration.

4.12 Automatic Transfer Switching Scheme

4.12.1 For AC system

a. Two service transformers shall feed auxiliary load of the entire substation auxiliaries. One transformer shall be capable of feeding the entire load in case of emergency/shut down of other transformer. The bus shall be operated in split bus mode with bus tiebreaker normally open. In case of failure of any one incoming feeder, other shall take over the entire load by closing bus tiebreaker after an adjustable time delay of 0- 30sec. On restoration of the source the changeover shall be manual only.

b. The scheme shall also have provision for manual operation which shall be achieved by manual live changeover scheme incorporating a three

(3) position selector switch to trip the desired selection without by passing the protection requirements of automatic sensing and disconnection of faulty section.

c. Short duration paralleling is, however, permitted during manual transfer operations only. An alarm shall be activated followed by tripping of Tie Breaker, after an adjustable time delay of 0-60 Sec., when all the three breakers are closed.

d. The Automatic Transfer Switching Scheme (ATS) control supply shall be 230Vac automatically selected to and derived from the healthy incomer supply or 125Vdc from station battery.

e. In case of fault (other than under/over voltage) this auto transfer scheme shall be blocked by the trip relay.

f. Auto transfer scheme (control alarm and logic circuits) shall be mounted inside the panel, in an accessible position isolated from the live parts.

4.12.2 For DC System

An Auto Transfer Scheme (ATS) shall be provided in case of a DC system with three chargers. The third charger acts as standby with automatic change over in the event of failure of either of the remaining two chargers. In Main DC distribution board each DC bus shall have a circuit breaker at the charger incomer. In the event of failure of any one charger, its supply to the respective DC bus shall trip automatically and the standby charger shall take over the load of that faulty charger immediately. For this purpose ATS shall receive a charger failure signal from the charger panel. On restoration of the faulty charger the changeover shall be manual only. Both the breakers of the standby charger feeding two DC buses shall not be ON at any given time

4.13 Nameplate

4.13.1 Each main and sub-distribution panel shall bear nameplate of stainless steel/Aluminum or other non-corrodible material fastened to the panel by stainless steel screws or rivets. The nameplate shall be permanently and legibly marked in English and Arabic contain the information as per ANSI C57.16 or equivalent IEC Standard and additional information as follows:

a. Rated Voltage (V)
b. Rated Current of Bus bar (A)
c. Rated Current of Incoming Unit
d. Rated Current of outgoing Unit
e. Short circuit current rating (kA)
f. CT ratio Installed
g. SEC Purchase Order.
h. Manufacturer /vendor name and trade mark
i. Year of manufacture
j. Gross weight when fully equipped
k. Sr. No.
l. 31-SDMS-10 Rev:0

4.13.2 Each panel of the line-up shall be provided with a nameplate of adequate size to indicate the function of the panel.

4.14 Device identification

4.14.1 Appropriate identification in the form of an 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 of appropriate size and fixed by screws.

4.14.2 Each device shall be permanently identified to correspond to the device identification symbol utilized in the wiring diagrams and function. This identification shall be adjacent to the terminals of the device. Standard device numbers shall be provided to protective relays.

4.14.3 The devices mounted on the front door shall also bear an identification tag from inside.

5.0 TESTS

All the tests shall be carried out in accordance with IEC 60439 or equivalent ANSI. The test results shall be provided to SEC for review and approval.

5.1 Design (Type) Tests

All design (Type) tests prescribed in the relevant IEC or equivalent ANSI/IEEE standards, as listed under clause 3.0 including (and not limited to) below mentioned tests shall be performed on a complete functional assembly of one representative

unit/panel have same design, arrangement and ratings as of those to be supplied or on the first unit/panel of every new design, rating size to be supplied to SEC.

i. Short Circuit Test.
The panel rated 400V and 220 V shall be capable of carrying the short circuit current 25 kA and 50 kA symmetrical (rms) for 2 seconds respectively.

ii. Temperature Rise Test
   a. Temperature rise test shall be conducted as per BSI EN 60439-1
   b. Temperature, at any point shall not exceed 60 ◦C relevant to the maximum ambient temperature as specified in SEC specifications no. 01-SDMS-01
   c. For instructions inside the panel, the temperature shall not exceed the allowable temperature of the instrument

iii. Salt spray test and tape scratch shall be as per specification 01-SDMS-01

In lieu of the actual design (type) tests, certified test reports of design (type) test performed on an identical unit/panel may be submitted to SEC for review and approval during bidding stage.

5.2 Production (Routine) Tests

All production (routine) tests prescribed in the relevant IEC or equivalent ANSI/IEEE Standards as listed under clause 3.0 shall be performed on every panel assembly prior to delivery to SEC.

5.3 Tests for relay, meters and instruments

Tests for relays, meters and instruments shall comply with the manufacturer's standard tests.

5.4 Special tests

Functional checks of the complete panel shall be performed in the factory against the Approved Vendor Drawings and as per this standard requirement. All circuits & Wiring shall be tested with simulated functional condition for proper operation.

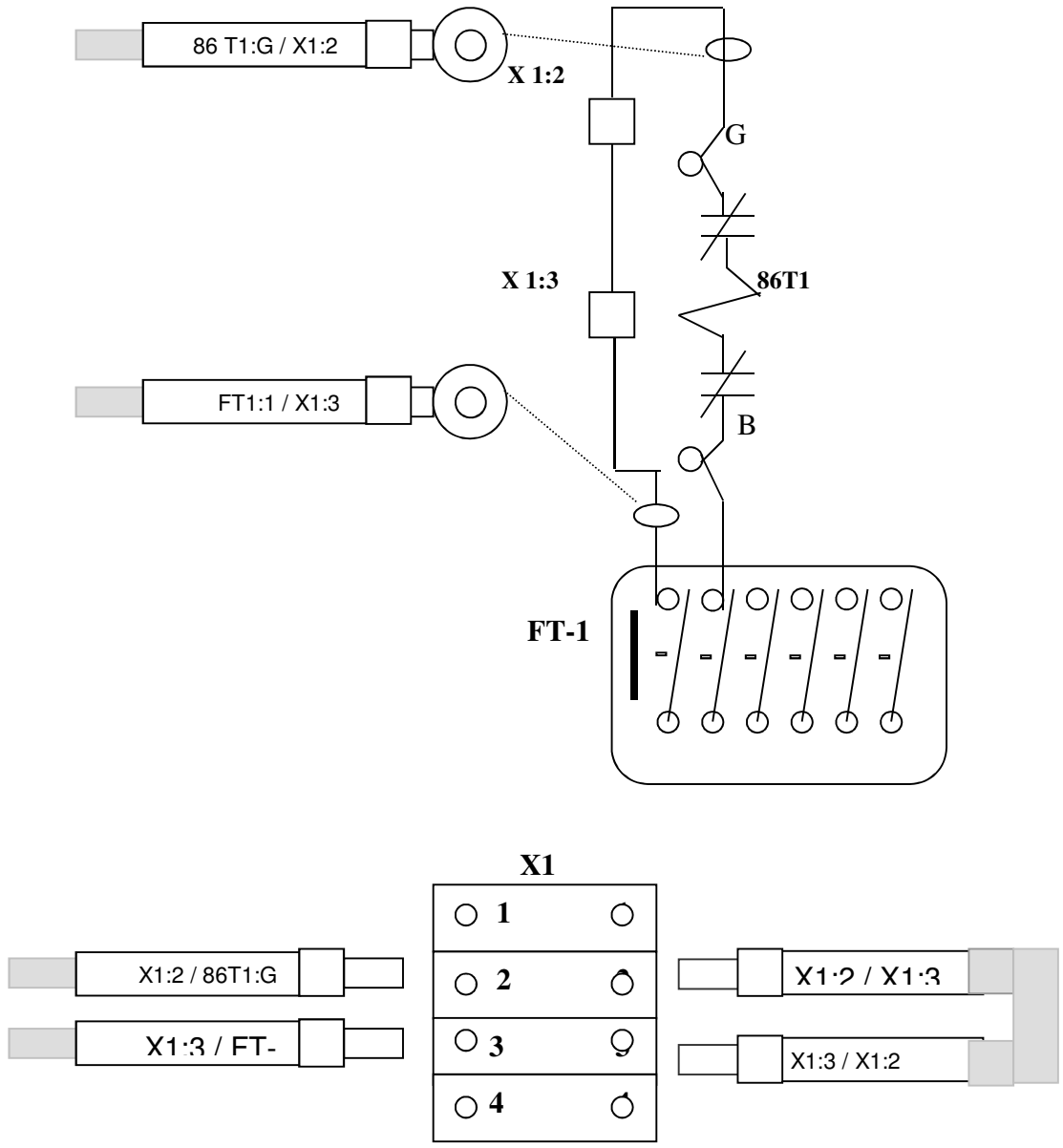

Figure 1: Ferrule Markings

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
3.0	**APPLICABLE CODES AND STANDARDS**			
	Applicable Industry Standards			
4.0	**DESIGN AND CONSTRUCTION REQUIREMENTS**			
4.1	Main Distribution Board Mounting of Sub-Distribution Boards Tie box (for 48 V DC Telecom applications Only) No. of DC Distribution metering and low voltage distribution unit		Dead Front End/ Multi-cubicle Assembly Floor/Wall	
4.2	Rating Auxiliary Power Supply Voltage (Vac) Operating Range Auxiliary Power Supply Voltage (V dc) Operating Range	± 10%	 *	
4.3	Enclosure For AC System Panel Dimensions (mm) Width Depth Height For DC System Panel dimensions (mm) Width Depth Height		 * * * * * *	

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
(Page 2 of 6)

SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	Degree of Protection		IP 41	
	No. of main panels (AC/DC)			
	No. of sub-distribution panel boards (AC/DC)			
4.4	Circuit Breakers			
	No. of outgoing AC circuits of			
	Main Distribution Panel			
	Sub distribution panel			
	Air Circuit Breakers (ACB)		*	
	ACB Make		*	
	ACB Type		*	
	Country of Manufacture		*	
	Catalogue No.		*	
	Normal Rating (V)		*	
	Amp. Capacity (A)			
	Short Circuit Interrupting - Capacity		*	
	Symmetrical (kA)		*	
	Asymmetrical (kA)		*	
	Duration (sec.)			
	Operating Mechanism (Mechanical / Electrical)		*	
	Fuses provided ?		*	
	Fuse type		*	
	Catalogue No.		*	

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	Closing Coil			
	Rated Voltage (Vdc)		*	
	VA burden		*	
	Operating Range (Vdc)		*	
	Tripping Coil			
	Rated Voltage (Vdc)		*	
	VA burden		*	
	Operating Range (Vdc)		*	
	Spring Charging motor			
	Rated Voltage (Vdc)		*	
	VA burden		*	
	Operating Range (Vdc)		*	
	Closing Time (ms)		*	
	Opening Time (ms)		*	
	Number of auxiliary contacts			
	NO Contacts		*	
	NC contacts		*	
	Auxiliary Contacts provided for alarm	Yes/No.		
	No. of NO contacts		*	
	No. of NC contacts		*	
	Trip			
	No. NO contacts		*	
	No. of NC contacts		*	
	Molded Case Circuit Breaker (MCCB)			
	MCCB make		*	

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
(Page 4 of 6)

SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	MCCB Type		*	
	Country of manufacture		*	
	Catalogue No.		*	
	Nominal Rating (V)		*	
	AC Voltage (Vac)		*	
	DC Voltage (Vdc)		*	
	Ampere Capacity (A)			
	AC		*	
	DC		*	
	Short Circuit Interrupting Capacity			
	Symmetrical (kA)		*	
	Asymmetrical (kA)		*	
	Duration (Sec)		*	
	Operating Mechanism (Mechanical /Electrical)		*	
	No. of Auxiliary Contacts			
	NO contacts		*	
	NC contacts		*	
	Auxiliary Contacts provided for Alarm			
	No. of NO contacts		*	
	No. of NC contacts		*	
	Trip		*	
	No. of NO contacts		*	
	No. of NC contacts			
	Protection Release setting through Electronic / Potentio meter		*	
	Other (specify)		*	

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	Miniature Circuit Breaker (MCCB)			
	MCB make			
	MCB Type		*	
	Country of manufacture		*	
	Catalogue No.		*	
	Nominal Rating (V)			
	AC Voltage (Vac)			
	DC Voltage (Vdc)		*	
	Ampere Capacity (A)			
	AC		15/20	
	DC		15/20	
	Short Circuit Interrupting Capacity			
	Symmetrical (kA)		*	
	Asymmetrical (kA)		*	
	Duration (Sec)		*	
	Auxiliary Contacts provided for Alarm			
	No. of NO contacts		*	
	No. of NC contacts		*	
4.5	Bus bars			
	Rate Voltage (V)		*	
	AC Voltage (Vrms)		*	
	DC Voltage (Vdc)		*	
	Current (A)		*	
	Short time Current for 1 sec. (kA)		*	
	Size of bus bar (mm x mm)		*	
	No. Of Bus bar		*	
	Material of Bus bar		*	

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
4.6	Relays, Meters, Instruments and Contactors			
	Complete list of required protective Relays and Dc contactors provided		Yes	
	Drawing Attachments			
	Relay one line diagram		*	
	Panel layout		*	
	Technical literature or catalogue of all Relays/ and Dc contactors required		*	
	Relays			
	Make		*	
	Type/Function		*	
	AC Meters			
	KWH meter			
	Relevant SDMS		*	
	Make		*	
	Accuracy class		0.5	
	AC Ammeter			
	Make		*	
	Accuracy Class		0.5	
	AC Voltmeter			
	Make		*	
	Accuracy class		0.5	
	DC Meters (for Distribution and Sub Distribution panels)			

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	DC Ammeter			
	Rang		*	
	Make		*	
	Accuracy Class		1	
	DC Voltmeter			
	Range		*	
	Make		*	
	Accuracy Class		1	
	DC meters (For Telecommunication panels)			
	DC Ammeter			
	Range		*	
	Make		*	
	Accuracy Class		1	
	DC Voltmeter			
	Range		*	
	Make		*	
	Accuracy Class		1	
4.7	Instrument Transformer			
	CT Secondary Rating (A)		1 A	
	Accuracy Class		0.5	
	Metering		*	
	Protection			
4.9	Wiring and Terminal blocks			
	Type of Insulated wire		*	

TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)
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SEC Enquiry No. _____ Item No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
	Type of Terminal Blocks (Vendor to provide literature or catalogue)		*	
4.11	Grounding Size of copper ground bus (mm x mm) Type of ground clamp or conductor Size of ground conductor (mm sq.)		 * * *	

*** values to be proposed by vendors**

6.0 TECHNICAL DATA SCHEDULE

(AUXILIARY AC/DC PANELS)

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SEC Enquiry No: _____ **Item No: _____**

A) Additional technical information or features specified by SEC.

B) Additional supplementary data or features proposed by Vendor/Supplier.

C) Other particulars to be filled up by Vendor/Supplier.
(Use separate sheet if needed).

Address	Manufacturer	Vendor/Supplier
Name of the Company		
Location & Office Address		
Authorized Name & Signature		
Date		
Official Seal / Stamp		