Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	31-SDMS-12 Rev. 00
	DATE: 14-09-2014G

31-SDMS-12

REV. 00

SPECIFICATIONS

FOR

RELAY AND CONTROL PANELS
FOR
PRIMARY DISTRIBUTION SUBSTATIONS

TABLE OF CONTENTS

1.0 SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirements for design, engineering, manufacture, inspection, testing and performance of Relay and Control Panels (Indoor) intended to be used in the Primary Substations of Distribution Sector in the system network of Saudi Electricity Company.

2.0 CROSS REFERENCE

This Material Standard Specification shall always be read in conjunction with the latest revision of 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 Distribution Sector Purchase Orders 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 60051	Direct Acting Indicating Analog Electrical Measuring Instruments and Their Accessories part-1: Definitions and General Requirements common to to all parts.
3.2	IEC 60297-3-100	Mechanical structures for electronic equipment
3.3	IEC 60439	Low-Voltage Switchgear and Controlgear Assemblies
3.4	IEC 60529	Degree of Protection Provided by Enclosure (IP Code)
3.5	BSI BS IEC 60736	Testing Equipments for Electrical Energy Meters
3.6	IEC 60947	Low Voltage Switchgear and Controlgear
3.7	IEC 60255 (all relevant parts)	Measuring Relays and Protection Equipment-Common Requirements

3.8	IEC 62052-11	Electricity Metering Equipment (AC) General Requirements, Tests and Test Conditions, Part 11: Metering Equipment
3.9	IEC 62053-22	Electricity Metering Equipment (AC) Particular Requirements
3.10	NEMA ANSI C12.1	Electric Meters, Code for Electricity Metering
3.11	NEMA ANSI C12.10	Physical Aspects of Watthour Meters – Safety Standard
3.12	ANSI/IEEE C37.1	Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition and Automatic Control
3.13	ANSI/IEEE C37.90	Standards for relays and relay system associated with Electric Power Appratus
3.14	ANSI/NFPA 70	National Electrical Code
3.15	ANSI/ECA 310D	Cabinets, Racks, Panels and Associated Equipment
3.16	11–TMSS–10	Power and/or Control Cable, Copper or Aluminum Conductor, 600/1000 V Rating
3.17	11-SDMS-01	Low Voltage Power and Control Cables
3.18	40-SDMS-02A	Electronic Revenue CT and CT/VT meters
3.19	38-SDMS- 03	LV Digital Panel Meters
3.20	38–TMSS–05	Annunciator Systems
3.21	31-SDMS-11	Terminal Blocks

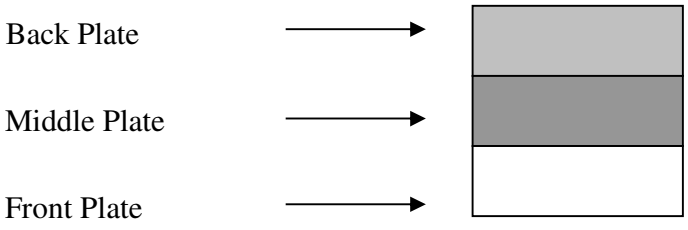
4.0 GENERAL DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 Fabrication

4.1.1 The indoor panels shall be metal enclosed, free standing, integrally designed with all necessary controls, instruments, meters, protective and auxiliary relays and other appurtenances. They shall be reinforced to provide a rigid self-supporting structure and shall be suitable for floor mounting by means of anchor bolts.

4.1.2 The panels shall be fabricated from minimum of 3 mm thick sheet of galvanizes steel or 2 mm thick sheet of an alloy of Aluminum and Zinc, suitably braced and supported. Suitable stiffeners shall be provided for all weight-bearing members such as door frames, front panel etc. Door Frames shall be straight without buckling and shall have smooth opening/closing and latching arrangements.

4.1.3 Bottom of panel shall be covered with three (3), 3mm steel plates as shown in figure 1 below. Suitable knockout slots shall be provided on the back and middle plates to fix gland plates at the sites for entry of external cabling into the panels. The gland and plate assembly shall be vermin proof.



Top view Door side

Figure 1: Bottom of Panel Plates

4.1.4 The enclosure shall provide a degree of protection of at least IP 41 as per IEC 60529 or equivalent. Relay casings shall have a degree of protection of IP 54 as per IEC 60529 or equivalent.

4.1.5 The maximum panel dimensions shall not exceed 800mm (w) × 800mm (d) × 2200mm (h) unless otherwise specified in the Data Schedule. The minimum panel width shall be 700mm unless otherwise specified in the Data Schedule.

4.1.6 Adequate ventilation openings in the form of louvers shall be provided. The ventilation louvers shall be vermin proof and shall be provided with removable filters or removable wire mesh to minimize ingress of dust.

4.1.7 All spare cutouts shall be covered with removable sheet metal cover plates. Mounting brackets as necessary shall be arranged inside the panel for mounting and wiring of devices.

4.1.8 Hinged panel door shall be equipped with hand-operated safety latches. A minimum of three (3) hinges shall be provided for the doors. Doors used to support devices shall be increased in thickness or otherwise strengthened to make them rigid. A Door Stopper shall be provided with each door to hold it in the open position at an angle/angles as specified for each type of panel and also to avoid excessive swinging that may hinder access to or damage other devices in adjacent panels. Door handle shall be provided with padlocking facility to lock with SEC padlock.

4.1.9 Each panel shall have removable type lifting eyes or lifting beams installed on the top. The panel shall be capable of being rolled over rollers into installations position without distortion or damage. The panel base shall be capable of withstanding such movements without distortion or damage.

4.1.10 The interior of the panel shall be painted white, conforming to RAL 9003 (Signalweib) and the exterior shall be conformed to 01-SDMS-01. The design of the interior of the panel shall allow sufficient access to the terminals of all devices for removal and repair. The design shall ensure that the heat generated by various apparatus mounted in the panel shall not affect the performance of any of the devices.

4.1.11 An assembly of panels shall comprise one or more panels, group mounted to form a complete line-up of panels. Each line-up shall be provided with detachable side/end covers to facilitate future expansion and inter-panel wiring.

4.1.12 Panel, which forms a continuous line-up, shall be provided with internal knockouts to facilitate inter-panel wiring and anti vibration pads to avoid vibration transfer from one panel to the other.

4.1.13 Control and relay panels shall normally be simplex type board and in some special case duplex type board.

4.1.14 If specified, duplex type panel board shall normally be walkthrough with pad lockable doors provided at each end. The padlock provided by SEC shall have 6mm diameter shackle with 25mm clearance. The walkthrough passage shall provide reasonable space to enable testing work and maintenance.

4.2 Miscellaneous Electrical requirements

4.2.1 Auxiliary power supply for AC shall be 400/230V_{ac}, three /single phase, unless otherwise specified in the Data Schedule. AC devices shall be capable of operating in the voltage range of ± 10%. All AC power circuits shall be protected by internally DIN rail mounted miniature circuit breakers (MCBs).

4.2.2 Auxiliary power supply for DC shall be 125V_{dc} unless otherwise specified in the Data Schedule and all DC operated devices shall be capable of operating in the voltage range of 100V_{dc} to 140V_{dc} (normal) unless otherwise specified in the Data Schedule. Suitable MCBs with auxiliary contacts for alarm shall be provided to protect all DC power circuits.

4.2.3 Normal current transformer secondary shall be 1A or 5A and voltage transformer secondary shall be 115/√3 V or 110/√3 unless otherwise specified in the Data Schedule.

4.2.4 All indication lamps provided in the panels shall be LED type unless otherwise specified in the Data Schedule.

4.2.5 Power supply to different circuits shall be functionally segregated.

4.2.6 A fluorescent strip light with electronic ballast and operated at 400/V_{ac}/230V_{ac} (as specified in the Data Schedule) minimum 20W and controlled by a door switch shall be provided in each panel.

4.2.7 A 400V_{ac}/230V_{ac} (dual) flush mounted, grounding type duplex convenience outlet shall be provided at the front bottom of each panel frame.

4.2.8 Each panel shall be provided with one maintenance telephone receptacle located at the front bottom of panel frame. The modular receptacle shall be flush mounted and shall be wired to the terminal block in the panel. The receptacles shall accept RJ11 plugs.

4.2.9 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.

4.3 Terminal Blocks

4.3.1 Terminal blocks shall be SEC approved spring-loaded type. The terminal blocks body shall be manufactured from insulating material, which is dimensionally stable, resistant to cracking and not subject to moisture absorption. The design shall be such that the accumulation of dust and moisture is minimized, but the creepage distance between poles or to ground shall be at least 8mm. Insulating barrier shall be incorporated between groups of terminals wherever necessary to achieve adequate isolation.

4.3.2 The terminal block shall be suitable for the size of wires that are to be terminated in the block. Groups of terminal blocks shall be identified using engraved labels. Terminals shall be clearly and consecutively numbered up to two digits in each terminal block.

4.3.3 If a common termination is required between termination blocks, preformed jumpers or manufacturer's own shorting device shall be used.

4.3.4 Not more than two (2) terminations shall be connected to one side of a terminal block.

4.3.5 Terminal blocks shall be assembled on side panel mounted DIN rails and shall be arranged in one tier. The DIN rails shall be mounted vertical. The distance between termination blocks and raceways shall be 80mm.

4.3.6 Shrouds shall be fitted to all terminal blocks used for circuits, which may be subject to high voltages such as current transformer, voltage transformer and protection pilot circuits.

4.3.7 Terminal blocks shall be grouped according to function, i.e. Power Supplies (AC or DC), VT, CT, DC controls, annunciation, SOE, SCADA etc. and shall be labeled accordingly. Terminal blocks for different voltages (AC or DC), CT, PT shall be located separated DIN rails.

4.3.8 Each CT circuit shall be provided with a disconnecting CT shorting type terminal with ground link. Opening of the link shall enable all CT and relay wiring to be tested clear of ground. There shall be only one ground link per CT circuit.

4.3.9 Twenty percent (20%) spare terminals shall be provided on each terminal block.

4.3.10 Terminal Blocks for SCADA and SOE shall be knife type.

4.4 Relays, Meters and Instruments

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

4.4.1 Mounting facilities

a. Relays (including auxiliary relays) shall be located and accessed from locations most convenient for maintenance, inspection, target reset and testing. Each panel shall be equipped with front mounted USB communication port (if not provided as part of the relay) for numerical relays, wherever applicable, each panel shall be equipped with internally mounted protocol converter.

b. All meters and instruments shall be flush type or semi-flush mounted. Energy meters shall be provided with FT type test block facilities.

c. Accessories such as power supply units, DC/DC converters, protocol converters, auxiliary CTs etc., shall be located inside the panel.

d. All relay targets & indication lamps shall be visible while the glass door is closed.

e. Not more than 2 lockout relays shall be installed in a row on a front mounted 19" rack. At least 15cm space shall be available around lock out or similar type relays. Minimum of 10mm space shall be available between all other relays mounted inside the panel.

4.4.2 Testing facilities

a. Meters, instruments, relays and indicating type transducers shall have test facilities separate from protection, so that testing and calibration can be done without equipment outages. Test facilities shall be mounted on the front of the panel and shall be similar in function to type Field Test (FT) switches.

b. The CT and VT circuits to all relays shall be isolated through test switches that facilitate shorting and grounding of the CTs and shall be clearly labeled. Test facilities shall be mounted on the front of the rack.

c. All trip and protection signaling circuits shall be wired through FT switches and clearly labeled.

d. SOE annunciator and SCADA points shall each have a common isolating switch to block all functions. This shall be on a protection set basis.

4.4.3 Instrument Transformer Grounding

a. The grounding of CVTs, GIS VTs shall be appropriately provided with CVT box and GIS VTs box. In case of Medium Voltage VTs ground shall be provided inside cubicles or as specified.

b. Normally, for current transformers grounding for all protection, the CTs neutral will be grounded in LCC panel in 11 (eleven) terminal CT shorting and isolating arrangement or as specified. For each CT circuits (nine) terminal shorting and isolating arrangement shall be provided at the entry of relay and control panel or as specified.

4.4.4 Metering Devices

Metering devices shall be provided as per SEC specification 38–SDMS–02. Energy meter shall confrom to specification 40-SDMS-02A (latest revision) Metering devices for various lines and transformers shall be as per Table I and Table II respectively, unless otherwise specified in the Project Technical Specification/Scope of Work.

Table I

(Meters and Metering Devices for various lines)

Metering Device	Nominal System Volatge		
	69 kV	33/34.5 kV or 11/13.8 kV	
		Incoming Line	Outgoing line
Voltmeter	x	x	N.A
Ammeter	x	x	x
Digital Power Demand meter (DPDM)	x	x	x
Energy Meter	x**	x	x

Power factor Meter	x*	x	X*
Frequency Meter	x***	N.A	N.A
Synchronizing frequency meter,Synchronizing Volt meter, Synchroscope	x***	As per PTS / SOW	
	Legend x = Required N.A. Not Applicable • On outgoing bulk customer lines only ** Energy meters with export and import shall be provided for all inter-tie lines,bulk customers and feeders *** On out going bulk customer lines and all inter tie lines only		

Table II

(Meters and Metering Devices for Various Transformers)

METERING DEVICE			Volt meter	Ammeter	Digital Power Demand Meter	Energy Meter
Power Transformer	69/13.8 kV	69 kV side	N.A	x	x	x
		13.8 kV side	x	x	x	x
	34.5 kV/13.8 kV or 33 kV /13.8 kV	34.5kV side or 33 kv side	x	x	x	x
		13.8 kV side	x	x	x	x
Station Sevice Transformer	HV side	N.A	x	x	x	x
LEGEND	x= Required N.A Not applicable					

4.5 Wiring

All wiring used within the panels shall be rated 600/1000V, with PVC insulated stranded annealed copper conductor. All wires shall be adequately rated for thermal withstand of short circuit currents, in accordance with back-up tripping time.

4.5.1 Size of wires

All CT secondary related circuits within the panel shall not be smaller than 2.5mm^2. For SCADA digital and analog input signals, SOE, Annunciator and status/alarm signaling circuits, wire size shall not be less than 0.8mm^2. For SCADA control output signals and all other circuits the wiring size shall not be less than 1.5mm^2.

4.5.2 All spare contacts from trip relays shall be wired to the terminal blocks for future use. Out of these, 2 (two) contacts from tripping relay shall be wired up to the terminal blocks through FT switches.

4.5.3 Color coding of panel wiring

DC Circuits	: Grey (Trip circuits shall be provided with red ferrule at the terminal block)
PT Circuits	: Red
Alarm Circuits	: Blue
CT Circuits	: Yellow
AC Power Circuits	: Black
1 Core (for grounding)	: Green or green with yellow stripes

4.5.4 All wiring shall be made without splices. Wiring from terminal blocks to relay or device terminals shall be without intermediate splices or connections. All conductor termination shall be done at terminal blocks. Control wires shall be multi-stranded and shall be terminated with suitable hooked crimps or ring type terminations. Spade or boots lace type crimps shall not be used.

4.5.5 Wiring troughs and raceways

a. Panel internal wirings shall be laid in accessible wiring troughs. The AC wiring and DC wiring shall be run in separate raceway. Signaling cables shall be shielded type and bundled separately. CT and PT wiring shall also be bundled separately.

b. The combined cross sectional area of all wires shall not exceed 50% of the interior cross sectional area of the raceway. In addition to the slack provided when routing the wires, extra 300mm length shall be accommodated in the trough. All cables shall be properly laid and tied in the cable trough.

c. External cables coming into the panels shall be terminated to only one side (left or right) of all terminal blocks. Factory wiring and field wiring shall not be mixed in the same raceway.

d. Wiring for lights and convenience outlets may be run in the same raceway in individual panels and in rigid PVC jacketed flexible conduits between panels.

e. At least 10% spare cable cores shall be provided and terminated at the terminal blocks farthest from the cable entry.

4.5.6 Cable supports

a. Cable supports shall be provided for wiring run directly to all devices. Wiring extensions from raceways or bundles to the devices shall be neatly formed, securely tied or clamped and supported to the panel framework. Cable supports shall not hinder access to devices for maintenance and testing purpose. Bending in the wiring shall be made in such a way that the insulation is not damaged.

b. Adequate means of protection, such as velcro type fasteners, plastic flexible, etc shall be provided to prevent damage to wiring where it passes from one compartment to another and from a fixed compartment to a hinged panel where additional means shall be incorporated to avoid damage of conductors at the hinged joint.

4.5.7 Ferruling

a. All internal wiring terminations shall be identified by legible markings at the device terminals. Each end of every wire shall be identified

indicating local device number and terminal number and destination device number and terminal number as per Figure 1. Markers shall be ferrule type, permanently marked and shall be made of material that shall not deform or deteriorate. Adhesive type terminal markers shall not be used.

b. Ferules shall be non-removable 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 be white or yellow with clearly legible black lettering.

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

4.5.8 Wiring between panel sections

Where an assembly of panels is involved, the wiring between sections shall be provided. One end of the wires shall be terminated on terminal blocks and the other end shall be bundled and suitably tagged before shipment of the individual panels.

4.5.9 External connections

a. Inter panel wiring shall be through raceways provided at the interior top of the panel. Suitable cutouts shall be provided for this purpose.

b. All external cabling shall be brought to the panel from the panel bottom unless otherwise specified in the Data Schedule. The cabling shall enter the panel through suitable gland plates as specified in section 4.1.3 to prevent contact with sharp metal edges.

c. Front plate is for maintenance and therefore shall not be used for cabling.

4.6 Grounding

4.6.1 A copper ground bus 150mm^2 shall be provided running the entire length of the panel line-up and shall be located minimum 50mm above the bottom of the panel. Not more then two (2) panel device grounding connections shall be made at any one point on the ground bus. Suitable drilled and tapped holes with screws shall be provided, adequate for grounding the sheaths for the total number of cables to be installed in the panel.

4.6.2 Two (2) solderless ground connectors shall be provided on the ground bus, one on each end section of the bus for connection to station grounding system. The ground connectors shall be suitable for bare copper ground conductor of size 95mm^2.

4.6.3 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.

4.6.4 All hinged doors and panels shall be properly bonded with minimum 6 mm^2 copper braids.

4.6.5 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.

4.7 Mimic Bus Diagram

4.7.1 Unless otherwise specified, the front of the control panels shall be furnished with a mimic bus diagram. Color of mimic bus shall be as follows:

RAL 1018 – Zinkgelb	69kV
RAL 8001 – Ockerbraun	34.5kV/33kV
RAL 5003 – Saphire Blue	13.8kV/11 kV
RAL 9017 – Black	for neutral /ground

4.7.2 The control board shall be equipped with a mimic diagram showing the circuits controlled. The diagram shall show busbars, feeders, power

transformers, Circuit breaker, Disconnect Switches, Grounding Switches, Busbar Isolating links, CT, VT, reactors, etc., for each voltage level.

4.7.3 For conventional type control panels, the mimic bus material shall be brass, copper with baked enamel finish or aluminum with anodized finish. Dimensions of mimic bus shall be 10mm wide × 2mm thick.

4.7.4 The mimic bus shall be attached to the panel at a convenient height, but in no case shall be less than 900mm from finished floor, by stainless steel screws. Attachments shall be closely spaced to firmly hold the mimic bus to the face of the panel.

4.7.5 Control panels of mosaic type shall have colored tiles at a convenient height, but in no case shall be less than 900mm from the finished floor.

4.8 Annunciator System

If specified in the Data Schedule, annunciator system(s) shall be provided on the respective control panel(s) in accordance with SEC Transmission Material Standard Specification No. 38-TMSS–05 unless otherwise specified in PTS /signal list.

4.9 Nameplates and Device Identification

4.9.1 Each panel shall bear a nameplate of stainless steel, fastened to the panel by stainless steel screws or rivets. The nameplates shall be permanently and legibly marked in English with the following information:

a. Manufacturer's name or trademark

b. Year and place of manufacture

c. Panel Type Designation or Identification reference

d. SEC Purchase Order No. or Contract No. or J.O. No.

e. 31-TMSS-01, Rev. 0

4.9.2 The panel designation shall be as per the PTS drawing. Each panel of the line up shall be provided with nameplate of adequate size to indicate the function of the panel.

4.9.3 Front panel nameplates for CTs, VTs, FT switches and other devices including each instrument, relay, control/test switch etc., shall be visible and made of non-corrodible material other than plastic and fixed by screws. Each FT switch shall have a separate nameplate of dimensions 158mm by 40mm.

4.9.4 Inside the panel each device shall be permanently identified to correspond to the device identification symbol utilized in the wiring diagrams with device function. This identification shall be adjacent to the terminals of the device and visible. Standard relay device numbers shall be provided for protective relays. PVC stickers are not acceptable.

4.10 Control Discrepancy Switches

4.10.1 Combined control discrepancy switches for the control of circuit breaker, load break switches, disconnects and high speed grounding switches as specified and required shall have following features:

a. Two locking positions for positions indication of the controlled device by means of a signal lamp built into the transparent knob. If the position of the switch does not coincide with the position of the controlled device that shall be indicated by a blinking light to indicate the discrepancy.

b. Two non-locking positions for actuating the mechanism of the controlled device. The knobs shall be possible to turn from the two preparatory locking positions to the two non-locking positions only by simultaneous pushing and turning of the knob.

c. The knob shall form part of the mimic diagram.

4.10.2 They shall have a square shape for circuit breaker control switches and a round shape for load break switch, disconnector control and grounding switches.

5.0 SPECIFIC DESIGN AND CONSTRUCTION REQUIREMENTS

The following requirements shall be complied with an addition to the requirements of section 4.0 of this SDMS.

5.1 Relay Panels

The panel dimensions shall be as per clause 4.1.5 unless otherwise specified in the Data Schedule. Each panel shall be provided with two front doors with hinges. The foremost

hinged front metal-frame door shall be capable of being opened up to an angle of 120º with suitable stopper and provided with splinter proof and transparent tempered glass of minimum thickness 3mm. The other front hinged door mounted with rack shall be capable of opening in the opposite direction, with a stop provided at 120º, and another stop provided at 160º. Relays and their test facilities shall be accommodated on this door (19 inches rack mounted or as recommended by the relay manufacturer). The rear of the panel shall have a bolted back plate.

5.1.1 Automatic Bus Transfer Scheme (ABTS) / Automatic Control System Equipment (ACSS)

Panel requirements shall be as specified for relay panels. Refer the project technical specification/scope of work for the applicable scheme.

5.1.2 Transformer Auto Changeover Panel

a. The transformer auto-changeover scheme shall be accomplished by the use of microprocessor based Programmable Logic Controller (PLC) designed for use in the substation environment. The scheme shall be initiated by; (1) - the transformer protection, (2) – Stuck breaker protection and (3) – busbar protection. But the scheme shall not be initiated by standby ground fault relay and LV over-current/ground fault relay of the transformer.

b. The scheme shall be arranged to take control over the three (3) transformers together with the respective LV CBs and two (2) bus section CBs, in such a manner that only two transformers shall be continuously in parallel and the third transformer shall either be operated on load with the bus section open or as a hot standby and this control shall be accomplished in any combination of the transformer and the bus section CBs.

c. The following facilities shall be incorporated in the scheme:

i. Auto/Manual selection.

ii. Local and remote (Power Control Center) selection.

iii. The readiness of the scheme shall be indicated when all the five CBs (three (3) transformer CBs & two (2) bus section CBs) are in service condition irrespective of status of the CB

open or close.

iv. Necessary indications for the readiness of the scheme after having completed the imposed task and to perform such a subsequent task shall be available.

v. To take out any CB on Trip On Parallel (TOP) mode from the circuit.

vi. The TOP function shall comprise selection of any one of the five CBs i.e three (3) transformer CBs and two (2) bus section CBs and in the process three (3) transformer may have to be in parallel for a short time depending on the section of CBs on TOP. In the event of simultaneous selection of CBs on TOP only one command of such simultaneous commands to be executed and others are to be aborted in the process.

vii. Auto Close Switching Equipment (ACSE) and TOP shall have individual commands and back indications for IN/OUT selection, such that when the former is 'IN' the latter to be 'OUT' and vise-versa.

5.2 Control Panels

The panel dimensions shall be as per clause 4.1.5 unless otherwise specified in the Data Schedule. The panel shall be of dead front type and hinged door in the rear provided with a stopper at 120º.

5.2.1 Remote Tap Changer Control (RTCC) /Automatic Voltage Control (AVC) Panel

a. Each transformer shall have its own RTCC panel. Panel requirements shall be as specified for control panels. RTCC/AVC scheme shall be as per Project Technical Specification/Scope of Work.

b. RTCC Panel Devices

Unless otherwise specified in the Project Scope of Work/Technical Specifications, the cubicle shall be equipped with the following items as a minimum:

- One (1) Local/Supervisory Selector Switch with Key Interlock
- One (1) Engraved "Auto" Pushbutton with integral Yellow LED
- One (1) Engraved "Manual" Pushbutton with integral Red LED
- One (1) Engraved "Master" Pushbutton with integral Green

LED

- One (1) Engraved "Independent" Pushbutton with integral Blue LED
- One (1) Amber Indicating LED for Follower Operation
- One (1) Yellow indicating LED for "Supervisory" control
- One (1) Red Indicating LED for "Local" control
- One (1) Red Indicating LED for Tap Change in Progress
- One (1) Blue Indicating LED for Out of Step condition
- One (1) Engraved "Raise" Pushbutton for Raise Tap (Raise Secondary Volts)
- One (1) Engraved "Lower" Pushbutton Lower Tap (Lower Secondary Volts)
- One (1) Digital Tap Position Indicator (~92mm × 45mm)
- One (1) Digital Voltmeter for controlled voltage (~92mm × 45mm)
- One (1) Automatic Voltage Regulating Relay (AVR)
- One (1) Lot of SCADA Interposing Relays
- One (1) Lot Raise & Lower Auxiliary Relays
- One (1) Lot time Delayed Alarm Relays
- One (1) Lot Latching Mode Selection Relays
- One (1) FT Switch for CT, PT and Raise/Lower Isolation
- Lot MCBs for AC Control Supply

Refer to 38-TMSS-05 for list of Alarms to be generated from the RTCC Panels.

5.2.2 Circuit Breaker Remote Control Panels (Feeder & Transformer)

a. Each control panel shall house the control and metering equipment of one (1) complete cross bay only for breaker and a half scheme. For other schemes, normally each control panel shall house control and metering for one (1) cross bay. However, up to two (2) bays can be accommodated if called for in the Project Technical Specifications/Scope of Work. Mimic bus diagram shall cover the switching scheme and transformer with LV busbars, LV incomer and LV bus tiebreakers.

b. Unless otherwise specified in the Project Technical Specification/Scope of Work, the following requirements shall be provided as a minimum:

i. A three position (open – normal – close) control switch with a spring return to normal position and LED status indictor as under or control switch with position discrepancy lamp as specified shall be provided for each circuit breaker.

Red	:	Breaker closed
Green	:	Breaker open
Yellow	:	Protection trip

ii. Each breaker shall have a Local/Supervisory Selector Switch with key interlock.

iii. A semaphore type indictor shall be provided for each manually operated disconnect switch and ground switch/Maintenance Ground Switch.
For motor operated disconnect/ground switches (High Speed), control switches with LED indicators as under or control switch with position discrepancy lamp as specified shall be provided.

Red	:	Switch closed
Green	:	Switch open

iv. For indoor Gas Insulated Switchgear (GIS) Control Switch with position discrepancy lamp shall be provided for each motor operated Disconnector/Ground Switch and a semaphore type indicator for manual operated disconnect/Ground Switch.

v. Isolation test switches shall be provided for CT and VT circuits in the panel. Watt, Var and voltage transducers for SCADA shall be DIN rail mounted in the control panel.

vi. 2 – Main Protection out of service indicating LED as applicable.

vii. Wherever required, Synchro-check Relay shall be provided on the control panels.

viii. One (1) SCADA interposing trip and close relay shall be provided for each circuit breaker.

ix. One (1) auto/manual synchronizing selector switch shall be provided for each circuit breaker and transformer LV breakers if applicable. One master key switch for all synchronizing selector switches shall be provided. No individual key shall be used. The master key shall have a “Parking Position” on the synchronizing panel.

x. All PT supplies to synchronous check relays shall be supervised by fuse failure relay, which shall block synchronous check relay output for fuse failure conditions.

xi. Voltage, current, watt, VAR meters with appropriate selector switches shall be provided, as applicable. Unless otherwise specified, meters shall be direct input device and shall be driven by transducer outputs except when installed in Mosaic Control Panel. Transducer output for SCADA shall be different from the output used for metering.

xii. For conventional air insulated switchgear a control switch and semaphore type indicator shall be provided for each disconnect switch and ground switch.

xiii. One (1) Digital Power Demand Meter (DPDM) for each line and transformer (HV) and an analog voltmeter with selector switch for line and transformer (MV and LV).

xiv. Control switch with position discrepancy lamps for 13.8kV/11kV or 33kV/34.5kV circuit breaker in transformer panels if required.

xv. Alarm Facia as applicable.

c. The operation shall be possible from the substation control panel or Power Control Center (PCC) when the control selector switch at the switchgear in "Supervisory/Remote" selection. The control selector switches shall also switch the control of the associated in-line disconnectors.

d. Control of a device shall only be possible from the selected location. Remote indication when "supervisory (PCC)" is not selected shall be available for transmission to the Power Control Center (PCC).

e. With either of the control selector switches selected to "Local" it shall not be possible to close the circuit breaker unless a second switch (Synchronising Switch) is selected to the ON position. The synchronizing switch shall have a removable handle, which is locked and irremovable when the switch is ON.

f. When the synchronizing switch in ON position following shall be possible:

i. The close control circuits from the "control Room" and "Switchgear" positions of the two-position selector switch shall be enabled by virtue of contact closure.

ii. The "incoming" and "running" voltages on either side of the circuit breaker shall be connected to common bus wires to the synchronizing panel.

5.2.3 Bus Coupler and Bus Section Panel

a. Each control panel shall house the control and metering equipment of one (1) complete cross bay. Mimic bus diagram shall cover the switching scheme and HV bus tiebreakers.

b. Unless otherwise specified in the Project Technical Specification/Scope of Work, the following requirements shall be provided as a minimum:

i. A three position (open – normal – close) control switch with a spring return to normal position shall be provided for each circuit breaker or Control switch with position discrepancy lamp as specified.

ii. Each breaker shall have a local/supervisory selector switch with key interlock.

iii. Each circuit breaker shall have status indication using LEDs:

Red	:	Breaker closed
Green	:	Breaker open
Yellow	:	Protection trip

iv. For motor operated disconnect, control switches with LED indicators shall be provided as under or Control switch with position discrepancy lamp as specified.

Red	:	Switch closed
Green	:	Switch open

v. Voltage and current meters with appropriate selector switches shall be provided as applicable.

vi. One (1) auto/manual synchronizing selector switch shall be provided. One master key switch for all synchronizing selector switches shall be provided. No individual key shall be used. The master key shall have a "Parking Position" on the synchronizing panel.

vii. Semaphore type indicator shall be provided for ground switch.

viii. Synchro-check and voltage monitoring relays.

ix. Alarm Facia

5.2.4 Synchronising Panel

a. Swing type synchronising panel on either ends of the control panel suit (bay) shall be provided for substation . The local control for each circuit breaker (at the substation main control board or at the switchgear) shall be such that when selected the voltages on either side of the circuit breaker are connected to the synchronizing panel.

b. Each synchronizing panel shall consist of:

i. Two (2) voltmeters
ii. Two (2) frequency meters 55 – 65 Hz
iii. One (1) indicating sychroscope
iv. Two (2) lamps to indicate presence of "incoming" and "running" voltages
v. Parking place for common, removable Synchronizing Selector Switch Key

c. The synchronizing panel shall give indications only and its synchroscope shall not be part of the controlling circuit of each circuit breaker.

d. Each circuit breaker shall be provided with a synchro-check relay, which shall be mounted back of panel or flush mounted on each circuit breaker relay panel. The relay shall be permanently supplied with the voltages being compared.

e. Synchro-check relay shall determine whether conditions are correct for permitting closure, having regard to voltage and slip frequency. Each relay shall monitor the closing circuit whether control is from PCC or local. Standard angle setting shall be 35 degrees with slip frequency timer range adjustable between two (2) and ten (10) seconds.

f. Voltage monitoring relays shall be provided to over ride the sychro-check contact in the event of the circuit being dead on one or both sides of the circuit breaker. Failure of a monitoring relay shall not allow the unwanted over ride of the synchro-check contact if the VT voltages is still present.

g. The synchro-check and voltage monitoring relays shall be continuously rated for operation up to 115% of normal voltage and frequency between 55 – 65Hz.

5.2.5 Specific Requirements of other Circuit configuration (Single bus bar installations)

For each type of circuit, only one busbar disconnect control switch shall be provided, otherwise control is similar to section 5.2.2 above. Ratings may be less than 2000A for the bus section switch and instruments shall be scaled accordingly.

5.3 Under frequency Relays

It shall be required (unless specified deletion) to install four staged under frequency and tripping relays with adequate number of output contacts for performing system's load shedding duties. The relays shall be mounted on the bus section protection panels and the number of relays shall be decided as per scheme requirement.

All Control and Relay Panels shall be as per SOW/PTS.

6.0 TESTS

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

6.1 Type (Design) Tests

All type tests prescribed in IEC 60439-1 or ANSI/IEEE C37.21 Standards shall be performed on the first unit of every new design to be supplied to SEC.
In lieu of actual type tests, certified test reports of type tests performed on an identical unit may be submitted to SEC for review and approval during bidding stage.

6.2 Routine (Production) Tests

All routine tests prescribed in IEC 60439 – 1 or ANSI/IEEE C37.21 standards shall be performed on the complete panel assembly.

6.3 Tests for relays, meters and instruments

All relays shall be tested with secondary injection. Operation test of meters shall be applying current and potential source, which include calibration of indicating & recording meters.

6.4 Special tests

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

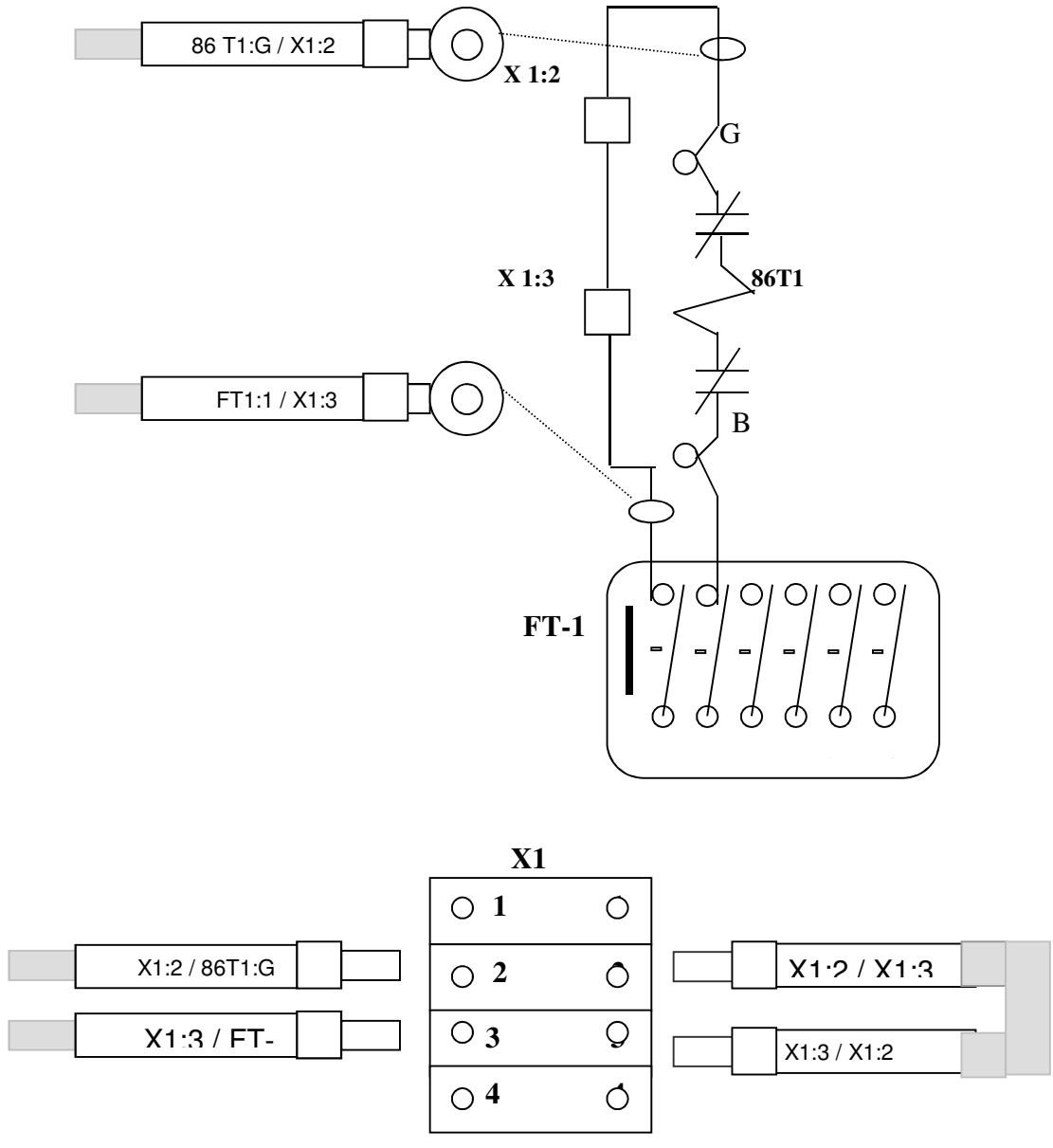


Figure 1: Ferrule Markings

7.0 TECHNICAL DATA SCHEDULE

(RELAY AND CONTROL PANELS)
(Page 1 of 4)
SEC Enquiry No. /P.O. No./ Contract No. PTS No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
3.0	**APPLICABLE CODES AND STANDARDS**			
	Applicable Industry Standards		*	
4.0	**DESIGN AND CONSTRUCTION REQUIREMENTS**			
4.1	Fabrication			
	Degree of Protection		IP- 41	
	Panel Dimensions in mm(W x D x H)			
	ABTS Panel		*	
	RTCC /AVC Panel		*	
	CB Control Panel		*	
	Bus Coupler and Bus Section Panel		*	
	Synchronizing Panel		*	
	Mosaic CB Control Panel (if applicable)		*	
	Panels other than above (if applicable)		*	
4.2	Miscellaneous Electrical Requirements			
	Auxiliary Power Supply AC (V ac) Voltage Range			
	Auxiliary Power Supply DC (V dc) Voltage Range			
	Rated CT Secondary (A)			
	Rated VT Secondary (V)			
	Indication lamps (LED type)			

7.0 TECHNICAL DATA SCHEDULE

(RELAY AND CONTROL PANELS)
(Page 2 of 4)
SEC Enquiry No. /P.O. No./ Contract No. PTS No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Proposed Values
4.3	Terminal Blocks			
	Type of Terminal Blocks (vendor to provide literature or catalogue)		Yes	
4.4	Relay Meters and Instruments			
	Complete List of required Protective Relays, Meters and Instruments Provided?		Yes	
	Drawing Attachments:			
	a. Relay and Metering one-Line Diagram		Yes	
	b. Front and Rear Panel layout			
	c. Rear panel Wiring / Inter connection wiring Diagram		Yes	
	Technical literature or Catalogue of all required Relays, Meters, and Instruments provided.		Yes	
4.5	Wiring			
	Type of insulated wire		*	
4.6	Grounding			
	Size of Copper ground Bus (mm^2)		150 mm^2	
	Size of Copper Ground Conductor		95 mm^2	
4.7	Mimic Bus Diagram			
	Mimic Bus Diagram required ?		Yes	
	Mimic Bus material			

7.0 TECHNICAL DATA SCHEDULE

(RELAY AND CONTROL PANELS)
(Page 3 of 4)
SEC Enquiry No. /P.O. No./ Contract No. PTS No. _____

SEC Ref.	Description	Unit	SEC Specified Values	Vendor Pro-posed Values
4.8	Annunciator System			
	Annunciator System required		Yes	
5.1	RTCC Panels			
	Digital Voltmeter required on HV side (VT available		Yes/No	
	Additional equipment/ devices required? If yes list these			
5.2	Control Switches			
	Type or Model No.			
	Contact Ratings :			
	AC Voltage (V rms)			
	DC Voltage (V dc)			
	Current (A)			
	No. of Contacts			
	No. shipping Section			
6.0	OPTIONAL OR SPECIAL TESTS REQUIREMENTS (if any)			

*** values to be proposed by vendors**

7.0 TECHNICAL DATA SCHEDULE

(TERMINAL BLOCKS)

(Page 4 of 4)

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		