

Substation Design Instruction

Merlin Gerin SM6 12kV/24kV switchgear

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Substation Design Instruction

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SDI 201 Merlin Gerin SM6 12kV/24kV switchgear

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1.0 PURPOSE

To provide the technical and reference information to assist with the safe design, installation, commissioning, operation and decommissioning of Merlin Gerin SM6 12kV/24kV switchgear.

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of the approved SM6 12kV/24kV switchgear manufactured and supplied by Schneider Electric (Merlin Gerin was acquired by Schneider Electric in 1988). This instruction is applicable only with the standard units approved for use by Endeavour Energy for use in the distribution network as detailed in 5.1.1.

The scope of this document provides reference to the various lifecycle stages of the switchgear and therefore should be read in conjunction with:

- Mounting and construction requirements: MCI 0006 - Underground distribution: Construction standards manual
- Earthing design, construction and testing: EDI100 - Distribution earthing design, construct and test
- Specification for new equipment: ETS 0068 - Distribution indoor and padmount substation 12-24kV switchgear
- General details and minimum design requirements: SDI 101 - Distribution substation general details and minimum requirements and MDI 0028 - Underground distribution network design
- Testing and commissioning: SDI 120 - Testing and commissioning for distribution systems and GNV 1044 - Commissioning Network Electrical Assets
- Ongoing maintenance requirements: SMI 101 - Minimum requirements for maintenance of distribution equipment
- Standard drawing requirements: SAD 0001 - Project drawing standards
- SF6 Management: EMS 0007 – Waste Management
- Disposal: GSU 0012 - Selection and Approval of a Disposal Method

This document should be read in conjunction with the manufacturer's installation instructions:

- Schneider catalogue *SM6 - Aus030701* on SM6 switchgear
- Schneider instruction no. 07896682EN for IM - PM - QM cubicles
- Schneider instruction no. 07896684EN for DM1 cubicles
- Schneider instruction no. 399008EN for VIP300 relay

3.0 REFERENCES

- Company policy 9.1.7 – Commissioning Network Electrical Assets
- Company Policy 9.2.2 - Network Protection
- Company Policy 9.2.5 - Network Asset Design
- Company Policy 9.7.1 - Network Asset Construction
- Company Policy 9.8.3 - Network Operations
- Company Policy 9.9.1 - Network Asset Maintenance
- Company Procedure GSU 0012 - Selection and Approval of a Disposal Method
- Division Procedure GNV 1026 – Equipment Register
- Division Procedure GNV 1044 - Commissioning Network Electrical Assets
- Division Procedure GNV 1061 – Transmission and High Voltage Distribution Network Switching

- Division Procedure GNV 1062 – Granting dispensation from network standards
- Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test
- Environmental Management Standard EMS 0007 – Waste Management
- Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12-24kV switchgear
- Mains Construction Instruction MCI 0006 - Underground distribution: Construction standards manual
- Mains Design Instruction MDI 0028 - Underground distribution network design
- Standard Asset Data SAD 0001 – Project drawing standards
- Substation Design Instruction SDI 101 - Distribution substation general details and minimum requirements
- SDI 120 - Testing and commissioning for distribution systems
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
- SMI 122 – Use and handling of sulphur hexafluoride (SF6)
- Branch Procedure NCB 4415 – Merlin Gerin Type RM6 – 24kV switchgear
- Network Management Plan December 2013 Review
- NSW Work Health and Safety Act 2011
- NSW Work Health and Safety Regulation 2011
- ENA National Electricity Network Safety Code (Doc 01-2008)
- AS 60265.1 - High voltage switch – switches for rated voltages above 1kV & less than 52 kV
- AS 1033.2 - High voltage fuses for rated voltages exceeding 1000V – current limiting type.
- AS 2650 - HV AC switchgear and control gear – common requirements
- IEC 60282.1 - High voltage fuses - current limiting fuses
- Schneider catalogue *SM6 - Aus030701* on SM6 switchgear
- Schneider instruction no. 07896682EN for IM - PM - QM cubicles
- Schneider instruction no. 07896684EN for DM1 cubicles
- Schneider instruction no. 399008EN for VIP300 relay

4.0 DEFINITIONS AND ABBREVIATIONS

ASP

A company or individual accredited by the NSW Government Trade and Investment to undertake contestable service work as defined by the Scheme for Accreditation of Service Providers.

HRC

High rupturing capacity

SF6

sulphur hexafluoride gas

5.0 ACTIONS

5.1 General

Schneider SM6 switchgear is secondary distribution switchgear for use in indoor substations. Merlin Gerin SM6 switchgear shall not be used in new projects.

However, it may be purchased to replace the same switchgear existing in the network that cannot be replaced with switchgear from Endeavour Energy's current switchgear contract.

5.1.1 Product approval

Endeavour Energy has approved the following SM6 switchgears from Schneider Electric, for use in 11kV and 22kV networks.

Schneider's ref.	Description	Approval no.
24 kV SM6 QM	Load break fuse switch panel	330013
24 kV SM6 DM1S	Circuit breaker panel with VIP300 relay	330014
24 kV SM6 IM	Load break switch panel	330015
24 kV SM6 IMB-GBM	Bus section panel with a load break switch	330016

5.1.2 Technical features

The main technical features are:

- Modular construction - modules can be added at a later date to extend the switchgear.
- SF6 is gas used for interruption.
- Busbars are air insulated.
- Earthing switch has full short circuit making capacity.
- A three-position switch *open-closed-earthed* provides fail-safe interlocks.
- HRC fuses and cable-sealing ends accessible only when the circuit is earthed.
- In case of a single fuse blow out, all the three (3) phases of the switch are opened through striker pin provided on the fuses.
- Self-powered relay for use with circuit breakers.

5.2 Specification

SM6 switchgear is rated at 24kV. The main technical parameters are:

Rated system voltage of use	12kV or 24kV
50Hz 1 minute withstand	50 kV rms
1.2/50 μ s impulse withstands	125kVp
Busbar system	
Rated current	630A
Rated short time withstand current	16 kA/1 sec
Insulation	Air
Load break switch unit – IM	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16kA/1 sec
Rated making current	40kA
Insulation/arc interruption media	SF6 gas
Operating mechanism	Manual - CIT
Load break fuse switch unit – QM	
Rated current	200A
Rated breaking current at 0.7 pf	200A
Rated short time withstand current	16kA/1 sec
Rated making current	40kA
Insulation/arc interruption media	SF6 gas
Operating mechanism	Manual - CI2

HV fuse link, in accordance with		As 1033.2
Circuit breaker unit DM1S		
Breaker type		Fluarc SF1
Rated current		630A
Rated short circuit breaking current		630A
Rated short time withstand current		16kA/1 sec
Rated making current		40kA
Insulation/arc interruption media		SF6 gas
Operating mechanism	Disconnecter	Manual - CS
	Breaker	Manual - RI
Protection relay (self powered)		VIP300
Bus section switch IMB-GMB (load break switch + bus riser)		
Rated current		630A
Rated breaking current at 0.7 pf		630A
Rated short time withstand current		16kA/1 sec
Rated making current		40kA
Insulation/arc interruption media		SF6 gas
Operating mechanism		Manual - CIT
Busbar insulation		Air

5.3 Dimensions and weight

	SM6 - IM	SM6 - QM	SM6 - DM1S	SM6 - IMB-GBM
Width, mm	375	375	750	750
Depth, mm	940	940	1220	940
Height, mm	1600	1600	1600	1600
Weight, kg	120	130	400	240
Weight of SF6	0.21kg	0.21kg	0.558kg	0.21kg

The switchgear is rated for 24kV applications: for use on the 11kV system, an extension fuse link shall be necessary.

5.4 Description

All the modules of SM6 switchgear have following basic compartments:

- Switchgear
- Busbar
- Connection and switchgear (circuit breaker)
- Operating mechanism
- Low voltage (if required)

A brief description of each panel/module approved by Endeavour Energy is given below. For complete details of the switchgear, consult the instructions provided by the manufacturer. These manuals form part of this document.

5.4.1 Load break switch unit IM

The load break switch unit comprises a rotary load break/fault make main switch and integral fault make cable side earthing switch in a permanently filled SF6 enclosure.

The isolating/earthing switch has three positions: *closed*, *open* or *earthed*. The switch operation is manual through a CIT operating mechanism.

This provides fail-safe interlocking between the switch and the earth switch. The two switches cannot be closed simultaneously.

IM : switch cubicle

- 1 : busbar compartment
- 2 : control cabinet
- 3 : switchgear compartment : switch and earthing switch
- 4 : operating mechanism cabinet
- 5 : cable connection compartment
- A : earth bar connection pad
- B : busbar connection pads
- C : lower field distributor and cable connection
- D : voltage indicator
- E : capacitive divider
- F : front panel
- G : cable connection inspection windows

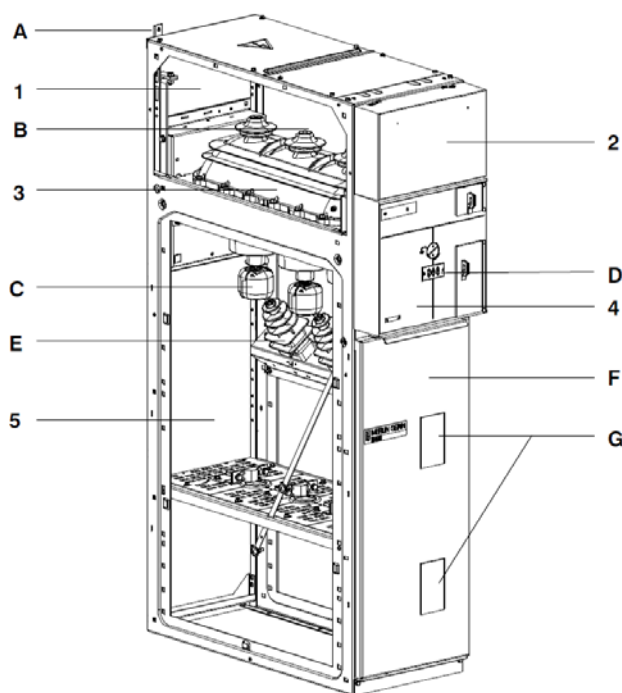


Fig. 1 Description of a switch cubicle

5.4.2 Load break fuse switch unit QM

The load break fuse-switch combination comprises a rotary load break/fault make main switch and integral fault make earthing switch located upstream of the fuse enclosed in a permanently filled SF6 enclosure.

The isolating/earthing switch has three positions: *closed*, *open* or *earthed*. The switch operation is manual through operating mechanism CI2. This provides fail-safe interlocking between the switch and the earth switch.

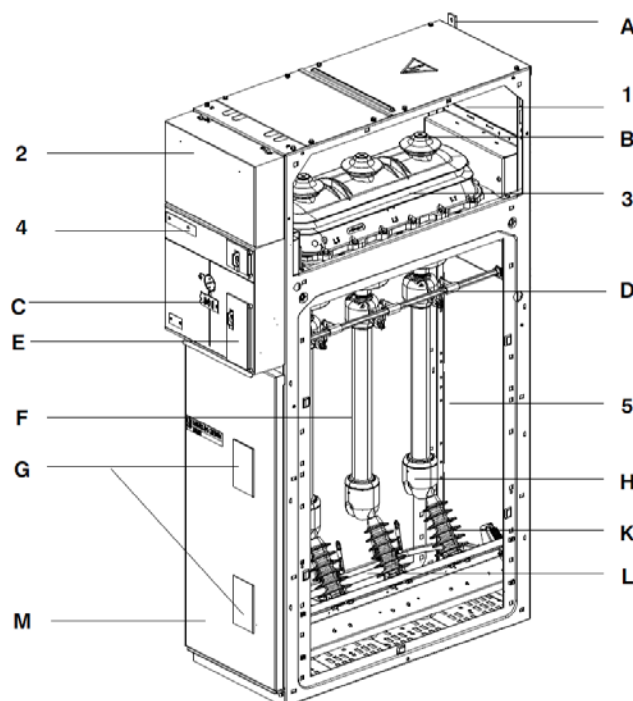
The two switches cannot be closed simultaneously.

The fuse is earthed on both sides. The switchgear is rated for 24kV applications. For use on the 11kV system, an extension fuse link is necessary.

It is not possible to open or remove the fuse unless the switch is in the *open* position and the fuse is earthed on both sides.

QM : fuse switch combination cubicle

- 1 : busbar compartment
 2 : control cabinet
 3 : switchgear compartment : switch and earthing switch
 4 : operating mechanism cabinet
 5 : cable connection and fuse compartment
 A : earth bar connection pad
 B : busbar connection pads
 C : voltage indicator
 D : mechanism used to open switch when fuse blows (QM)
 E : indication of switch opening by blown fuse (QM)
 F : fuses
 G : inspection windows for fuses and downstream earthing switch
 H : lower field distributor and cable connection
 K : capacitive divider
 L : downstream earthing switch
 M : front panel

**Fig. 2 Description of a fuse switch cubicle****5.4.3 Circuit breaker unit DM1S**

The circuit breaker unit comprises:

- An isolation switch with an in-built earthing switch, similar to unit IM. The switch comprises a rotary switch with integral fault make and a dual earthing switch in a permanently filled SF6 enclosure. The isolating/earthing switch has three positions: *closed*, *open* or *earthed*. The switch operation is manual through a CS operating mechanism. This provides fail-safe interlocking between the switch and the earth switch. The two switches cannot be closed simultaneously.
- A circuit breaker, Fluarc SF1, made up of three separate poles mounted on a support structure. Each pole unit houses all the active elements in an insulating enclosure filled with SF6 gas to a relative pressure of 0.5 bars. The circuit breaker is provided with a manual operating mechanism.
- A self powered relay, VIP 300, with CTs to trip the circuit breaker in the event of a fault. The relay provides a range of protection characteristics to suit different requirements.

DM1 : circuit breaker cubicle

- 1 : upper busbar compartment
- 2 : low voltage compartment
- 3 : switchgear compartment:
line disconnect
- 4 : operating mechanism
compartment
- 5 : lower busbar or cable
connection compartment
- A : earth bar connection pad
- B : upper busbar connection
pads
- C : inspection windows
- D : SF1 or SFset type MV
circuit breaker
- E : front panel

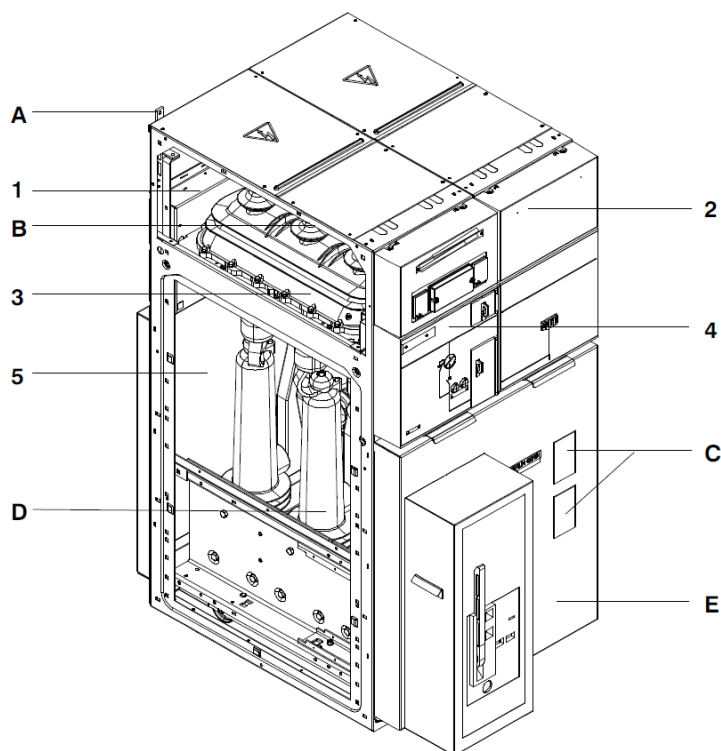


Fig. 3 Description of a circuit breaker cubicle

5.4.4 Bus section switch IMB + GBM

The bus section switch comprises of two panels, as follows:

- A load break switch panel, IMB. This is similar to the load break switch unit IM, except that the earth switch is not provided. The connection to the adjacent panel is done by way of busbars. No facilities exist for cable connection.
- Bus riser panel.

5.5 Operations

5.5.1 Switching operations

It is important that only authorised personnel carry out any switching operations. For detailed operating procedures, refer to Branch Procedure NCB 4415 - Merlin Gerin Type RM6 – 24kV switchgear.

5.5.2 Circuit breakers

The circuit breakers are suitable for use on 22kV and 11kV distribution network without modification. The circuit breaker uses a self-powered over current and earth fault protection relay, VIP 300. The relay's setting must be checked with the Protection section of Endeavour Energy before being put into service.

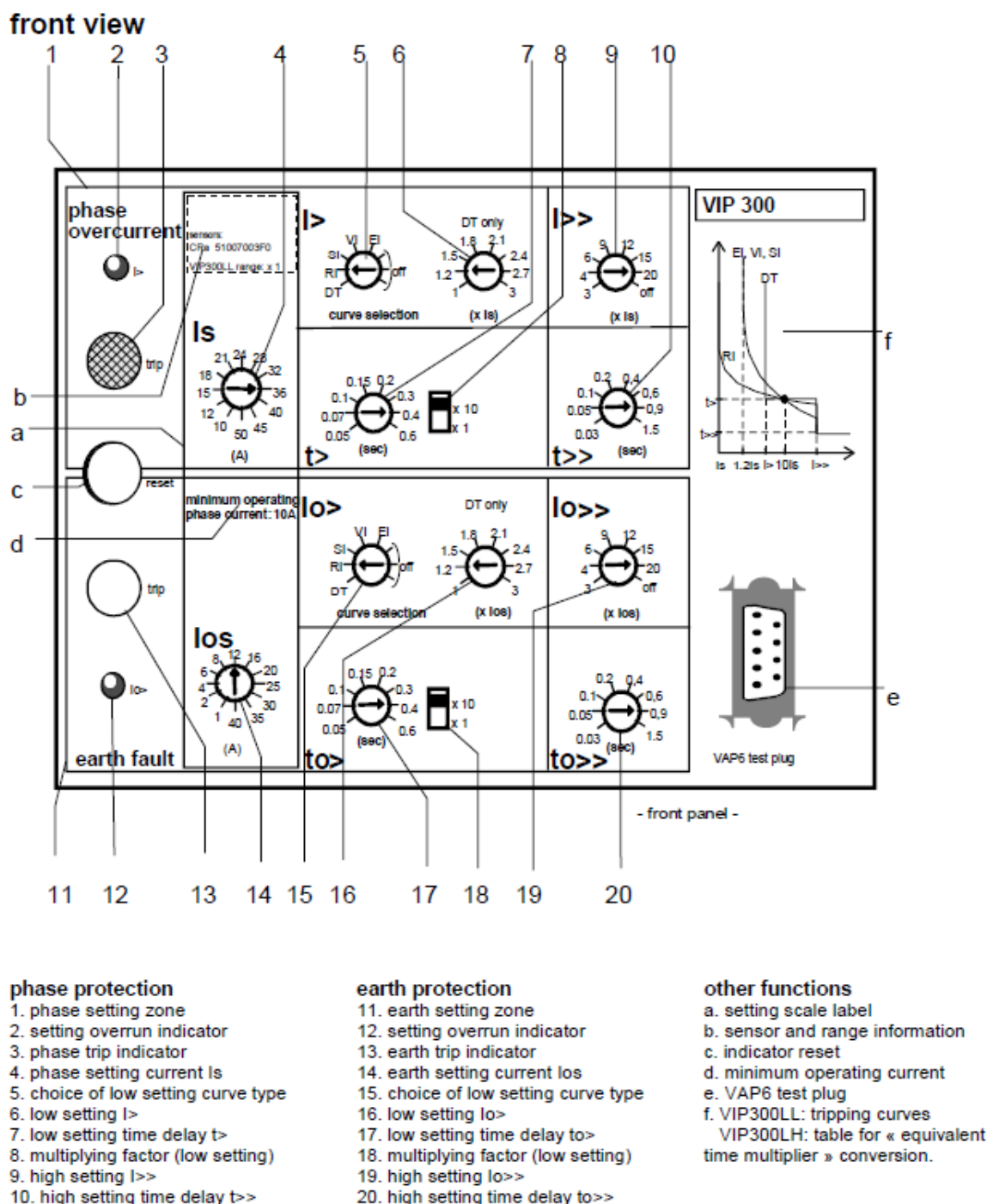


Fig. 4 Front view of a VIP 300 relay

5.5.3 Mimic diagrams

The switchgear status indicators are placed directly on the moving contact assembly-operating shaft. They give an accurate indication of the position of the switchgear.

5.5.4 Interlocks

Merlin Gerin SM6 is fitted with interlocks that prevent the following switching operations:

- Closing the main switch when the earth switch is applied.
- Application of the earth switch when the main switch is in the closed position.
- Removal of the front cover without closing the earth switch.

The switchgear is fitted with mimic diagram that indicates the status of each switch.

The fuse holders are designed to accept 12kV and 24kV fuse links, which must be complete with striker pins as the fuse-switch combination is designed to trip all three phases should one or more fuse links rupture.

5.6 Installation

Merlin Gerin SM6 switchgear is to be assembled on site in accordance with the manufacturer's recommendations, using the assembly kits provided with each unit.

The switchgear can be supplied pre-assembled from the manufacturer's works, provided the board configuration is defined at the time of order. The length of the pre-assembled board will be restricted by the site handling or transport limitations.

The switchgear is suitable for installation over 600mm wide floor penetrations (cable basement substations) and cable trenches (cable trench substations).

When switchgear is used over cable trenches it is to be mounted on suitable supporting brackets that allow the switchgear to overhang the trench to enable cables to be laid in from the front. These brackets will fit into the *Unistrut* rails set in the trench.

The civil construction requirements for installation of the switchboard are set out in MCI 0006 - Underground distribution: Construction standards manual and MDI 0028 - Underground distribution design.



Fig. 5 Photo of installed SM6 switchgear

5.7 Cabling

5.7.1 General

Refer to the relevant mains instructions.

5.7.2 Cable sizes

Connection pads are provided for termination of cables. The maximum size of cables that can be terminated on each switchgear panel is:

Panel	Maximum cable size
Load break switch (IM)	3 x 1 core 240 sq. mm or 300 sq. mm
Load break fuse switch (QM)	3 x 1 core 95 sq. mm
Circuit breaker (DM1S)	3 x 1 core 240 sq. mm

Where a three-core cable is to be used, the cable shall be trifurcated outside of the switchgear in the trench.

5.7.3 Cable connections

Suitable single hole cable lugs with a width not exceeding 38mm should be used. Cable lugs are to be connected to switchgear using the bolts provided, tensioned to 50Nm.

5.7.4 Cable termination height

Panel	Cable termination height
Load break switch IM	950mm
Load break fuse switch QM	400mm
Circuit breaker DM1S	430mm

5.7.5 Cable clamping

Suitable cable clamps are to be used to secure cables to the base plate *Unistrut* provided on each unit. Cable gland plates shall be used, where available.

5.8 Accessories

5.8.1 Remote operation

Motor operation can be fitted to any switch unit or bus sectionaliser, as required. If it is known that motor/remote operation will be required, units can be supplied motorised to avoid retrofitting.

Operating mechanism type	motor tumbler
Voltage	24 or 110V DC
Rating	200W
Operating time	close <5 sec open <5 sec

5.8.2 Anti condensation heater

A 150W, 240 V, anti-condensation heater is provided and fitted as standard to each unit, and is wired to the low voltage compartment on each panel. This feature is to be implemented on all units.

5.8.3 Short circuit indicators

Horstmann ALPHA E short circuit indicators are provided and fitted on all load break switch units (SM6 – IM) by the manufacturer. The short circuit indicators fit around each individual phase and should be on the front of the panel for easy viewing.

5.8.4 Phase concordance unit

The phase concordance unit can be used with the voltage indicator lamps supplied as standard on all ring main units to Endeavour Energy. The unit can be purchased directly from Schneider Pty Ltd.

5.8.5 Spares

The following spares are available from Schneider Electric

No.	Part no.	Description
1	FSSPK0011SM6	110 Volt DC Shunt Trip Coil IM / QM Switch / Fuse Switch
2	FSSPK0011SM6	110 Volt DC Close Release Coil IM / QM Switch / Fuse Switch
3	FS997934	110 Volt DC Spring Charge Motor Operator for IM/QM Fuse Switch
4	P/N VPI62407	VPIS LED Block for IM/QM/DM1-A for 11KV system
5	P/N VPI62408-	VPIS LED Block for IM/QM/DM1-A for 22KV system
6	FS889705BE	110 Volt DC Shunt Trip DM1-A CB
7	FS889705AD	110 Volt DC Close Release DM1-A CB
8	FS51072122C1	110 volt DC Motor Operator DM1-A CB
9	FSRXM2AB1FD	110 Volt DC Anti-Pump Relay DM1-A CB

5.8.6 Reference drawings

The following drawings form a part of this instruction:

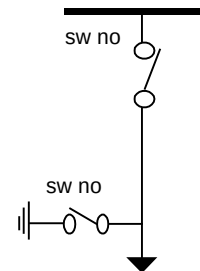
Drawing no.	Amendment	Title
078193	A	Indoor Sub Merlin Gerin SM6 Trench Support Detail
078194	B	Indoor Sub Switchgear installation details
078301	A	Indoor Sub Merlin Gerin SM6 Floor penetration and trench detail

5.9 Single line diagrams

These diagrams are for individual modules of the SM6 switchgear. The single line diagram of the board is to be prepared for each project using these modules.

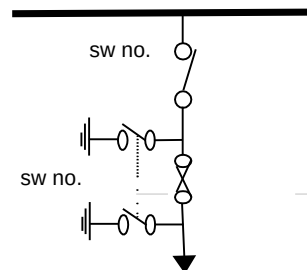
SM6 – IM

Load break switch panel



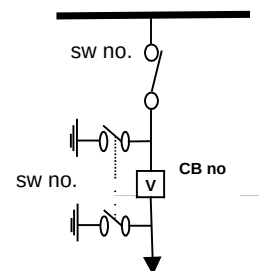
SM6 – QM

Load break switch panel



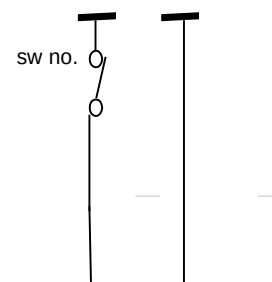
SM6 – DM1S

Circuit breaker panel



SM6 – IMB-GBM

Bus section panel



6.0 AUTHORITIES AND RESPONSIBILITIES

The **Chief Engineer** has the authority and responsibility for approving this instruction and approving variations to the requirements of this instruction.

The **Manager Primary Systems** has the authority and responsibility for endorsing and recommending changes and revisions to this instruction.

The **Network Substations Manager** has the responsibility for revising and updating this instruction in accordance with Company Policy and Procedures.

Regional Managers have the responsibility for **determining** that all designs carried out by Regional employees conform to the requirements of this instruction.

The **Manager Network Connections** has the responsibility for **determining** that all designs carried out by Level 3 ASPs conform to the requirements of this instruction.

It will be the ASP's responsibility to **determine** that the latest issue of any instruction or drawing relevant to or listed in this instruction is available and used during the design of any project.

7.0 DOCUMENT CONTROL

Documentation content coordinator:	Network Substations Manager
Documentation process coordinator:	Standards Process Coordinator