

Substation Design Instruction

Eaton (Holec) SVS/08 12/24kV switchgear

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Substation Design Instruction

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SDI 200 Eaton (Holec) SVS/08 12/24kV switchgear

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1.0 PURPOSE

To set out in detail the application and installation of Eaton (Holec) SVS/08 12/24kV switchgear.

Note: This switchgear is no longer approved for assembly into long switchboards but may be assembled into smaller modules as set out in Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12/24kV Switchgear or used for maintenance or single feeder extensions of existing boards.

2.0 SCOPE

The scope includes the technical requirements for electrical, mechanical and operational parameters and details only that equipment purchased and installed on Endeavour Energy's network.

The instruction does not set out in detail the mounting and earthing of the switchgear (refer to Eaton (Holec) SVS/08 user manual, document no. HVDOC 025/2, and Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test)

The switchgear complies with the requirements of Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12/24kV Switchgear.

Endeavour Energy uses only 24kV rated switchgear - SVS/08 switchgear - on both 11kV and 22kV systems. Endeavour Energy has approved the following assemblies rated at 24kV for use on the network:

Type	Reference	Rated volts	Function	Approval no.
SVS/08/08	VSVS/08 14AA-24B1	24kV	Fused load break switch panel	330 001
SVS/08/08	SVS/08 14AA-2406	24kV	Load break switch panel	330 009
SVS/08/08	NVS 14AA-2406	24kV	Circuit breaker panel	330 011
SVS/08/08	SVS/08 14AA-2406	24kV	Bus section panel with load break switch	330 012

3.0 REFERENCES

- Company Policy 9.2.2 - Network Protection
- Company Policy 9.2.5 - Network Asset Design
- Company Policy 9.2.10 - Network Asset Ratings
- 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 GAM 0089 – Authorisations Governance and Management
- Branch procedure – PAE 1004 Product Approval Process
- Earthing Design Instruction - EDI 100 - Distribution earthing design, construct and test
- Equipment Technical Specification ETS 0068 – Distribution indoor and padmount substation 12/24kV switchgear
- Equipment Technical Specification ETS 0071 – Distribution fuses
- Equipment Technical Specification ETS 0072 – Padmount substation plinth and culvert
- Equipment Technical Specification ETS 0077 - Padmount substation cubicles
- Mains Construction Instruction MCI 0006 – Underground Mains Construction Manual
- Mains Design Instruction MDI 0028 - Underground distribution network design

- Substation Design Instruction SDI 101 – Distribution substation general details and minimum requirements
- Network Management Plan December - 2013 Review
- *Electricity Supply Act 1995 (as amended)*
- *Work Health and Safety Act 2011 (NSW)*
- *Work Health and Safety Regulation 2011 (NSW)*
- ENA National Electricity Network Safety Code (Doc 01-2008)
- AS 60265.1 High voltage switch – switches for rated voltages above 1kV and less than 52kV
- 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
- Eaton – SVS/08 – manual

4.0 DEFINITIONS AND ABBREVIATIONS

A full list of definitions is contained in SDI 101.

AUP

A person with technical knowledge or sufficient experience who has been approved and authorised in writing by the Company to perform the function requiring authorisation as described in Schedule 1 of Company Procedure GAM 0089 – Authorisations Governance and Management. This definition is relevant to the terms *authorisation*, *authorise* and *authorised person*.

HV

high voltage

SF6

Sulphur hexafluoride

5.0 ACTIONS

5.1 General

Eaton SVS/08 HV switchgear is an earthed, sheet steel enclosed system with separate modules that can be assembled in any desired sequence. All live primary components are encapsulated in epoxy resin.

The busbars, isolating/earthing switch and cable terminations are electrically coupled and concealed in such a way that a uniform insulation level is maintained over the entire assembly, preventing the development of open arcs.

Detailed description, operation and maintenance instructions on SVS/08 switchgear are given in the instructions provided by the manufacturer. These additional documents should be referenced where necessary.

5.1.1 Vacuum interrupter

The load-break switch panel and the circuit breaker switch panel incorporate three single-phase vacuum interrupter bottles. A specially designed switching mechanism is provided for operation of the vacuum interrupter. The vacuum interrupter/switch connects the isolating/earthing switch to the cable termination point.

The vacuum interrupter consists of a ceramic cylinder that houses a fixed and a moving contact. A bellows fitted to the interrupter's movable contact enables contact movement while maintaining the vacuum. A shield around the contacts prevents deposition of metal vapour on the isolator, which is produced during current interruption. In addition, the shield provides a good potential distribution over the insulator.

A zircon-alloy getter (catcher) is mounted around the fixed contact. The getter (catcher) has an absorptive power for nitrogen and oxygen equal to more than 100 times the volume of the interrupter. Due to this special getter, and the application of reliable vacuum detection technology, the vacuum is guaranteed for more than 20 years, regardless of whether switching takes place or not.

Important features of the vacuum interrupter are:

- No ageing, contact erosion is negligible due to the low arcing time (3-13ms). Hence, the electric endurance equals the mechanical endurance.
- The impedance of the vacuum extinguishing chamber prevents any influence on the remaining insulating medium of the assembly.

5.2 Specification

Eaton switchgear SVS/08 is rated at 24kV. The main technical parameters are:

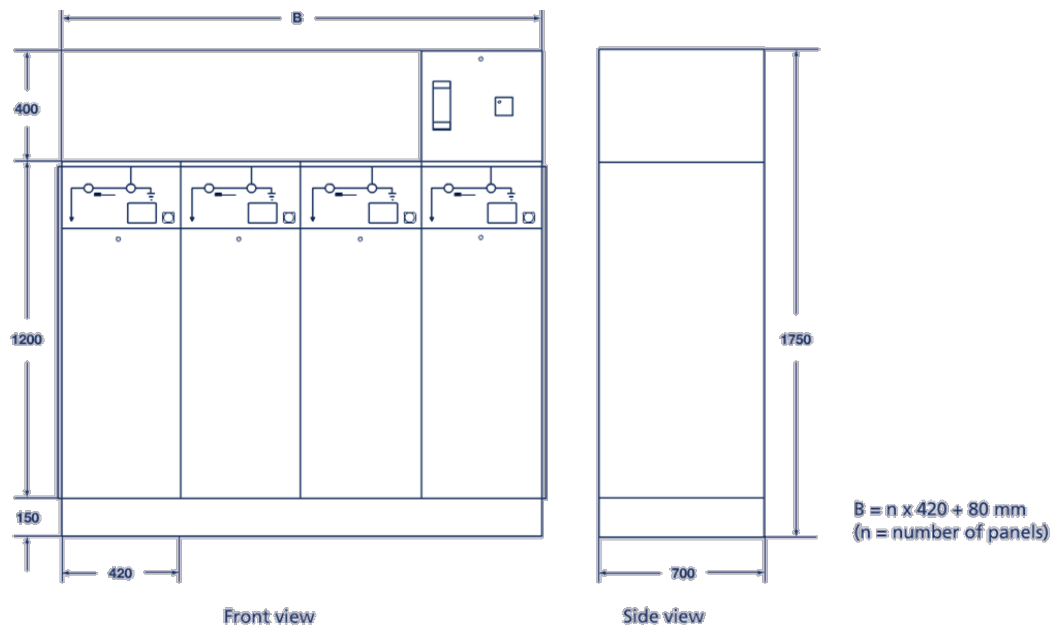
Rated system voltage of use	12kV or 24kV
50Hz 1 minute withstand	50kV rms
1.2/50 μ s impulse withstands	125kVp
Busbar system	
Rated current	800A
Rated short time withstand current	16kA/1sec
Insulation	Epoxy
Load break switch panel	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16kA/1sec
Rated making current	40kA
Arc interruption media	Vacuum
Operating mechanism	Manual
Fuse load break switch panel	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16kA/1sec
Rated making current	40kA
Arc interruption media	Vacuum

Rated system voltage of use	12kV or 24kV
Operating mechanism	Manual
Rated normal current (fuse carrier)*	30A
HV fuse link, in accordance with	AS 1033.2
Circuit breaker panel	
Rated current	630A
Rated short circuit breaking current	16kA
Rated short time withstand current	16kA/1sec
Rated making current	40kA
Arc interruption media	Vacuum
Operating mechanism	Manual
Protection relay (self powered)	WIP
Bus section switch uses break switch, no riser required	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16kA/1sec
Rated making current	40kA
Arc interruption media	Vacuum
Operating mechanism	Manual
Busbar insulation	Epoxy

* 24kV switchgear with adaptor for 12kV fuses has been tested (temperature rise test) for 60A and the requirements of IEC298 were satisfied (refer to KEMA test report no. 2188200 HSL 93-1183 dated 15/06/1993).

5.3 Dimensions and weight

	SVS/08 load break switch	SVS/08 fuse load break switch	SVS/08 circuit breaker	SVS/08 bus section
Width (mm)	420	420	420	420
Depth (mm)	700	700	700	700
Height (mm)	1200	1200	1600	1200
Weight (kg)	150	150	175	150



The 150mm base plate shown above is not used in Endeavour Energy.

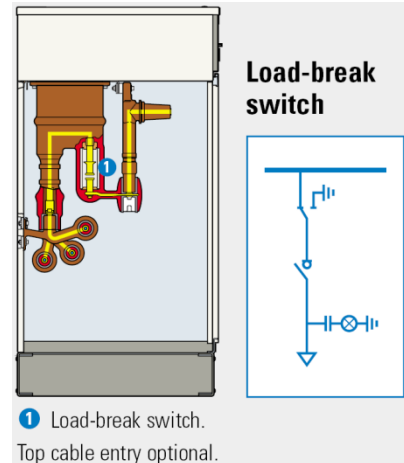
5.4 Description

A brief description of each panel/module approved by Endeavour Energy is given below. For complete details of the switchgear, refer to the instructions in the user manual provided by the manufacturer. The manual forms an integral part of this document.

5.4.1 Load break switch panel

A switch unit comprises a busbar system, an isolating/earthing switch, a vacuum load-break switch and cable terminals. The isolating/earthing switch has two positions, the service position and the earthed position, as explained below:

- Service position - the isolating/earthing switch is connected to the busbar system.
- Earthed position - the isolating/earthing switch is connected to the earth bar.

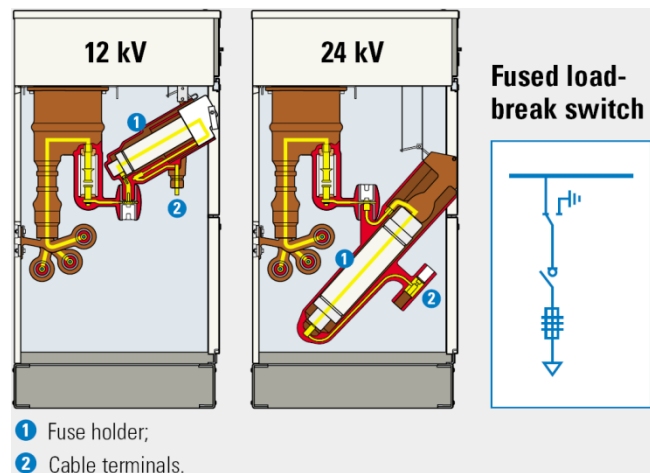


Operation of the isolating/earthing switch is mechanically interlocked with the operation of the vacuum load-break switch. Operation of this switch can take place only with the vacuum load-break switch in the **OPEN** position. The cable is earthed through the switch unit when the isolating/earthing switch is connected to the earth bar and the vacuum load-break switch is in the **CLOSE** position.

5.4.2 Fuse load break switch panel

A fuse-switch combination comprises a busbar system, an isolating/earthing switch, a vacuum load-break switch, epoxy resin insulated HV fuse holders, and terminals for the connection of transformer cables.

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.



The switchgear is rated for 24kV applications and the fuse holder of the fused load break switch panel is suitable for receiving a DIN 43625 24kV fuse. When the 24kV fused load break switch panel is used on an 11kV system, the base contact of the 24kV fuse holder shall be replaced by a 12kV base contact with a spacing tube (refer to clause 6.1.5 of Eaton (Holec) SVS/08 user manual, document no. HVDOC 025/2).

Operation of the isolating/earthing switch and the vacuum load-break switch is the same as for the switch unit, except that operation of the vacuum load-break switch is not possible when the isolating/earthing switch is in the earthed position. This feature therefore inhibits the use of the internal earth-to-earth at a transformer. However, removal of the HV fuse-links and insertion of external earth probes into the HV fuse holders is the means used to earth a transformer.

Access to the fuse links is possible only if the isolating/earthing switch is connected to the earth bar and the load-break switch is opened by way of the upper compartment door.

5.4.3 Circuit breaker panel

A circuit breaker panel is identical to the load break switch panel unit, as described in clause 5.4.1, except that the vacuum load-break switch is replaced by a vacuum circuit breaker with the addition of an instrument panel.

One of the characteristics of interrupting under vacuum is that a large number of parallel arcs occur between the contacts. This phenomenon, known as diffuse discharge, is characterised by an extremely low arc voltage and a short arc duration, resulting in low arc energy.

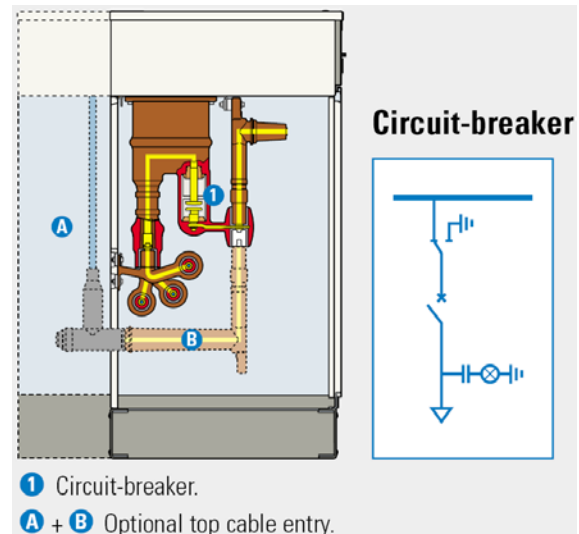
Contact erosion is therefore also negligible. Diffuse discharge normally occurs up to 10kA. By applying an axial magnetic field between the contact surfaces, the diffuse discharge is retained right up to the maximum short-circuit current. This field is produced by fitting horseshoe shaped magnetic iron laminations into the contacts. The resulting contact erosion is kept to an absolute minimum.

5.4.4 Bus section panel

A bus section panel is identical to the load break switch panel unit, as described in clause 5.4.1, but can be equipped with either a vacuum load-break switch or a vacuum circuit breaker. With a circuit breaker, an instrument panel is also provided.

With a busbar sectionaliser, the sectionalising switch or circuit breaker cannot be closed when the isolating/earthing switch is in the earthed position. In this case, the isolating/earthing switch forms an earthed barrier only between the two sections of the busbar assembly. Total insulation between the primary conductors provides minimum distances between the phases, and guarantees a high level of insulation. A further advantage is that a busbar sectionaliser can be fitted in the standard 420mm wide panel.

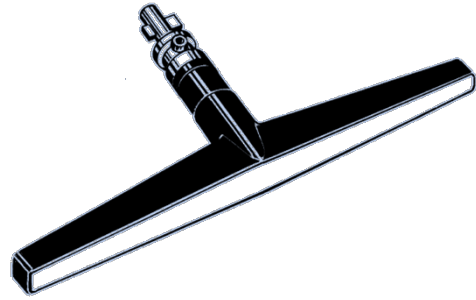
Because of its interlock, the busbar sectionaliser cannot be used to earth either left or right hand side sections.



5.5 Operations

5.5.1 Switching handle

Only approved manufacturer's operating handles should be used for switching purposes.

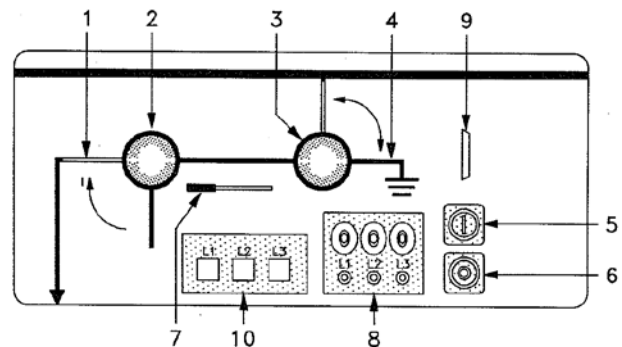


5.5.2 Switching operations

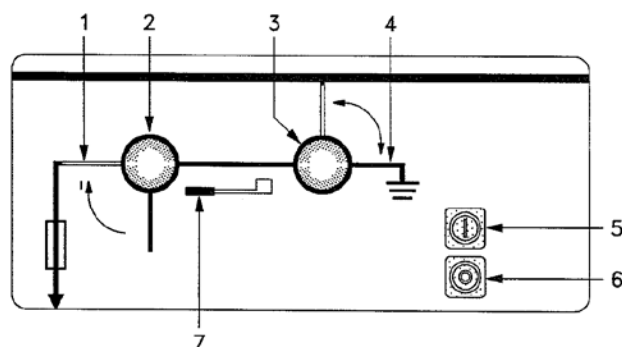
It is important that only authorised personnel carry out any switching operations.

Control panel layout.

1. Position indicator of load-break switch or CB.
2. Operating shaft for load-break switch or CB.
3. Operating shaft for change over switch.
4. Position indicator of change over switch.
5. Closing button for load-break switch or CB (optional).
6. Opening button for load-break switch or CB.
7. Selector.
8. Voltage indicator.
9. Strip for padlock interlock.
10. Automatic resetting overcurrent indicator (optional).



Control panel- Load-break switch or CB



Control panel- Fused load-break switch

5.5.3 Circuit breakers

The circuit breakers are suitable for use on 22kV and 11kV systems without modifications. The circuit breaker uses a self-powered over current and earth fault protection relay, WIP or WEG. The relay's setting must be checked with the Protection Group before being put in to service.

5.5.4 Mimic diagrams

The switchgear status indicators are placed directly on the moving contact assembly-operating shaft. They give an indication of the position of the switchgear. For details, refer to the documentation provided by the manufacturer.

5.5.5 Interlocks

The following safety interlocks are provided on all new panels/switchboards:

- The load-break switch or circuit breaker can be closed when the isolating/earthing switch is in either the service or earthed position.
- The isolating/earthing switch can be operated only when the load-break switch or circuit breaker is open.
- Access to the fuse holders is possible only when the isolating/earthing switch is in the earthed position and the load-break switch is open.¹
- The load-break switch on a fuse-switch combination cannot be operated when the isolating/earthing switch is in the earthed position (the load-break switch will be in the open position).
- The selector switch or operating shafts can be locked with padlocks.
- The operating handle is held captive until the tripping springs are charged through the operation of the operating handle on the fuse-switch combination only.
- Inter-panel barriers are provided to prevent inadvertent approach to the adjacent panel, which might be live.²

Notes

^{1, 2} These facilities may not be available on switchgear panels commissioned before September 2005.

5.5.6 Retrofitting of padlocks and inter-panel safety barriers

It is recommended that for the existing switchgear, where some of the interlocks (refer clause 5.9.4) are not available, the following retrofit kits must be installed whenever the switchgear is under a planned shutdown. These kits are held as a stock item by Endeavour Energy or can be ordered on Eaton Electric Systems Pty Ltd. Any assistance required may be sought from Eaton Electric Systems Pty Ltd.

5.5.7 Padlocking bracket

All existing switchgear panels shall be fitted with a padlocking bracket.

Eaton (Holec) part no. 485.1033

Fitting instructions

- Step 1:** Open vacuum interrupter and apply earths.
- Step 2:** Open cable compartment door.
- Step 3:** Remove captive nut from the internal facing side of the lock device.
- Step 4:** Withdraw lock from door.
- Step 5:** Fit padlocking device so that it is sandwiched between the outside face of the door and the locking device.
- Step 6:** Replace the retaining nut.
- Step 7:** Replace the cable compartment cover.
- Step 8:** Fit an approved padlock.

5.5.8 Inter-panel barriers

Inter-panel barriers shall be retrofitted to all panels. These barriers are fabricated from Macralon (plastic sheets) and are designed to prevent an inadvertent approach to the adjacent panel, which may be live. Two types of barriers are provided:

- Triangular barrier for use on fuse load break switch panels.
- Rectangular barrier for use on load break switch, circuit breaker and bus-section panels.

The number of barriers required for a switchboard depends on the switchgear configuration and panel sequence. Requirements for some of the common configurations are given below. Requirements of any other types should be assessed.

Switchgear configuration and panel sequence	No. of inter-panel barriers required	
	Triangular	Rectangular
Sw – fuse	1	-
Sw – fuse – sw	2	
Sw – fuse – b/s – fuse – sw	4	-
Sw – sw – fuse – b/s – fuse – sw – sw	4	2
Sw – sw – fuse	1	1
Sw – CB	-	1
Sw – CB – sw	-	2
Sw – sw – CB – b/s – CB – sw – sw	-	6
Sw – CB – b/s – CB – sw	-	4
Sw – CB – b/s – fuse – sw	2	2
Where sw = switch panel; CB = circuit breaker panel/s; b/s = bus section panel; fuse = fuse switch panel.		

5.5.9 Triangular barrier for fuse load break switch panels

Fitting instructions

Eaton (Holec) part no. 107860

Kit contains:

- 1 x FLBS Macralon fitting instruction
- 1 x triangular Macralon piece
- 3 x self-threading screws
- 3 x retaining brackets and fitting hardware
- 1 x reference drawing A1-AT01.011 Rev C
- Step 1 :** Open vacuum interrupter and apply earths.
- Step 2 :** Fit brackets and hardware, position 130-131, 80-81 and 52-53.
- Step 3 :** Fix Macralon sheet to brackets installed in step 2 above.
- Step 4 :** Replace cable compartment door.

5.5.10 Rectangular barrier for load break switch and circuit breaker panels

Fitting instructions

Eaton (Holec) part no. 485B.0126

Kit contains:

- 1 x LBS-CB Macralon fitting instruction
- 1 x rectangular Macralon piece
- 4 x self-threading short screws
- 4 x self-threading long screws

- Step 1 :** Open vacuum interrupter and apply earths.
Step 2 : Whilst making sure that the square block at the top rear of the Macralon sheet aligns in the space between the panels, position Macralon with pre-drilled holes on vertical posts.
Step 3 : Insert self-threading screws in alignment with the pre-drilled holes.
Step 4 : Replace cable compartment door.

5.6 Installation

It is preferred that the switchgear configuration is provided to the manufacturer prior to manufacture. This will allow pre-assembling and testing at the manufacturer's works. SVS/08 can be assembled on site in accordance with the manufacturer's recommendations using the assembly kits provided with each unit.

The length of the pre-assembled board will be restricted by the site handling or transport limitations. The manufacturer must be contacted and given these details.

The switchgear is suitable for installation over 600mm wide floor penetrations (cable basement substations) and cable trenches (cable trench substations). For further details, refer to the user manual provided by the manufacturer.

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 given in Mains Design Instruction MDI 0028 - Underground distribution network design.

5.7 Cabling

5.7.1 Fused load break switch connection

The cable connection to the switchgear shall comply with Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12/24kV switchgear. A cable termination kit is supplied with every SVS fuse-switch combination unit.

The cable specification shall be provided to the switchgear manufacturer in order to obtain the suitable cable termination kit. However, when used with SVS switchgear, the cables require a special cable core connector for the termination at switchgear end (terminal core connectors shall be obtained from the switchgear manufacturer along with the cable termination kit).

The termination of these cables requires a special technique and shall be installed strictly according to the instructions provided in the user manual for the switchgear.

5.7.2 Load break switch/circuit breaker connection

Eaton switchgear SVS/08 provides 630 Amp profile bushings for the connection of power cables using plug-in type elbows and tees. Other termination options are available. The cable connection to the switchgear shall comply with Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12/24kV switchgear.

5.7.3 Termination height

- Using cable-termination adaptor block, 11kV cable connection, 710mm (add 150mm for steel support plinth).
 - Using plug-in type elbows and tees, 835mm (add 150mm for steel support plinth).

5.7.4 Configurations

- 11kV - one) conductor for each phase; cable-termination adaptor block.
- two conductors for each phase; 630A 11kV plug in elbow/tee connectors.
- 22kV - one or two conductors for each phase; 630A 22kV plug-in elbow/tee connectors.

Note: When installing two conductors for each phase, the cable connection compartment will require a compartment extension to allow the installation of the second cable.

Reference should be made to the underground cable jointing instructions/manuals provided by the manufacturer. Elbows and tees manufactured by Elastimold 400TB, Raychem RICS 5743 and 5147 are approved for use on this switchgear.

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 General accessories

The following accessories shall be ordered from the supplier (Eaton) with the type of board purchased:

- cable connection adaptor block for 11kV cable terminations for every board;
- selector switch padlocking facility (excluding fuse-switch combination) for every board;
- set of three earthing probes each with an earthing pin and an earthing clamp for every fused load break switch panel; and,
- cable compartment extension when two cables for each phase is installed using insulated elbow termination for circuit breaker panels.

5.8.2 Remote operation

Any switch unit, including bus sectionaliser, can be retrofitted to provide motorised operation of the unit. If it is known that motor/remote operation will be required, units can be ordered with the necessary equipment to avoid retrofitting.

Operating mechanism type: Motor tumbler

Voltage: 24 or 110V DC

Rating: 200W

Operating time: Close < 5 sec

Open < 5 sec

5.8.3 Anti-condensation heater

A 150W, 240V 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.

5.8.4 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.

5.8.5 Phase concordance unit

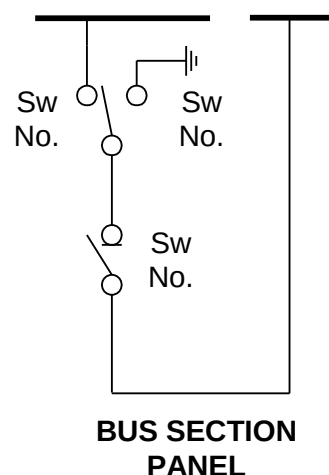
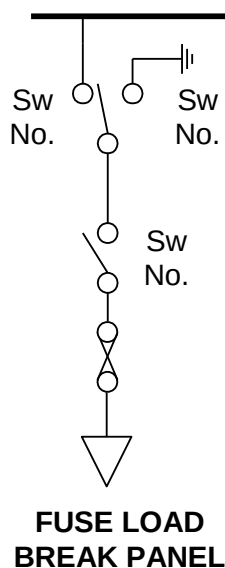
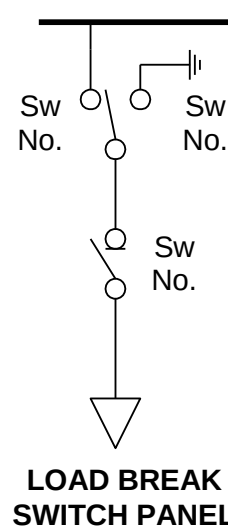
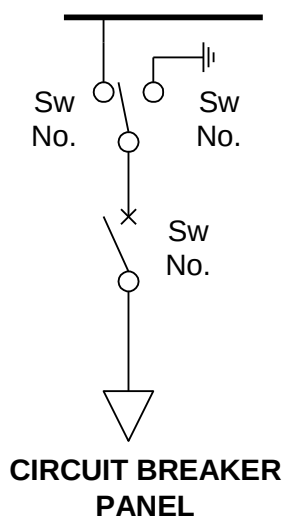
The phase concordance unit can be used with the voltage indicator lamps supplied as standard on all ring main units to Endeavour Energy. The unit can be purchased directly from Eaton Pty Ltd.

5.8.6 Reference drawings

The following Endeavour Energy drawings form a part of this instruction.

Drawing no.	Amendment	Title
297547	A	Indoor distribution substation floor penetration and trench details for HV and LV switchgear
297555	B	Indoor distribution substation standard switchgear trench cover plate and support angle fabrication with installation details
297556	C	Indoor distribution substation standard 11/22kV switchgear trench mounting support bracket fabrication details

5.9 Single line diagrams



These diagrams are for individual modules of the SVS/08 switchgear. The modules for projects shall be selected to match the single line diagram of each project.

6.0 AUTHORITIES AND RESPONSIBILITIES

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

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

Network Substations Manager, Primary Systems has the authority and responsibility for revising and updating this instruction in accordance with Company Policy and Procedures.

Regional Managers have the authority and responsibility for:

- appointing a Responsible Officer to any project when required by this procedure; and,
- developing a process for implementing the requirements of this instruction.

Manager Network Connections has the authority and responsibility for confirming that the network installations made by external employees or organisations are checked and tested in accordance with this Standard.

Accredited Service Providers have the authority and responsibility for confirming that their employees have available and use the latest issue of this instruction and other related Standards.

7.0 DOCUMENT CONTROL

Documentation content coordinator Network Substation Manager

Documentation process coordinator Standards Process Coordinator