

Substation Design Instruction

ABB SafeRing 12/24kV switchgear

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Document No. SDI 212

Amendment No. **3**

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SUBSTATION DESIGN INSTRUCTION

PRIMARY SYSTEMS	Document no. Amendment no. Approved by Approval date	SDI 212 3 MPS 04 September 2014
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SDI 212 ABB SafeRing 12/24kV switchgear

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1.0 PURPOSE

This standard provides technical and reference information to assist with the safe design, installation, commissioning, operation and decommissioning of ABB SafeRing 12/24kV switchgear.

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of ABB 22kV SafeRing switchgear. This instruction deals only with the standard units approved for use by Endeavour Energy for use in the distribution network as detailed in 5.1.2.

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: refer MCI 0006
- Earthing design, construction and testing: refer EDI 100
- Specification of new equipment: refer ETS 0068
- General details and minimum design requirements: refer SDI 101 and MDI 0028
- Testing and commissioning: refer SDI 120
- Ongoing maintenance requirements: refer SMI 101
- Standard drawing requirements: SAD 0001

This document shall be read in conjunction with the manufacturer's installation instructions available on the Endeavour Energy standards website document numbers NOPOWSR 5976 GB, dated July 2000.

3.0 REFERENCES

- Company Policy 9.2.2 - Network Protection
- Company Policy 9.2.5 - Network Asset Design
- Company Policy 9.7.1 - Network Asset Constructions
- Company Policy 9.8.3 - Network Operations
- Company Policy 9.9.1 - Network Asset Maintenance
- Company Policy 9.2.10 - Network Asset Ratings
- Company Procedure (Supply Management) GSU 0006 - Disposal of surplus goods and materials
- Company Procedure (Health & Safety) GSY 0051 - Health and safety incident management
- Division Procedure (Network) GNV 1062 - Granting dispensation from network standards
- Branch Workplace Instruction (Regional) WRG 0526 - Handling of SF6 (Sulphur Hexafluoride)
- Branch Form FAE 3085 - 12kV and 24kV enclosed switch Product Approval Form
- Network Management Plan December 2013 Review
- Earthing Design Instruction EDI 100 - Distribution earthing design, construction and test
- Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12-24kV switchgear
- ETS 0072 – Padmount substation plinth and culvert
- ETS 0077 – Padmount Substation Cubicles
- Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual
- Mains Design Instruction MDI 0028 – Underground distribution network design

- Substation Design Instruction SDI 101 - Distribution substation general details and minimum requirements
- ENA National Electricity Network safety code (Doc. 01-2008)
- AS ISO 1000 – 1998 - The international system of units (SI)
- equipment
- AS 2067 – 1984 - Switchgear assemblies and ancillaries equipment for alternating equipment for alternating voltages above 1kV
- AS 2264 – 1995 - AC insulation-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 38kV
- AS 2629 – 1983 - Separable insulated connectors for power distribution systems above 1kV
- AS 2650 – 2005 - Common specifications for HV AC switchgear and control gear
- AS 60265 - 2001 - High voltage switches – switches for rated voltages above 1 kV and less than 52 kV
- IEC 60694 – 2000 - Common specifications for high voltage switchgear and control gear
- IEC 60265 – 2000 - High voltage switches for rated voltages above 1 kV and below 52 kV
- IEC 62271 – 2003 - AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and below 52 kV
- ABB operation instruction no. NOPOWSR 5976 GB
- SEG WIC1 – CT powered Protection Relay Manual no. TB WIC1 03.02 E

4.0 DEFINITIONS

For definitions, refer to AS 1852-1988. Also, refer to Substation Design Instruction SDI 101 - Distribution substation general details and minimum requirements, for general definitions.

ASP	Accredited Service Provider
BIL	basic insulation level
HRC	high rupturing capacity
SF ₆	sulphur hexafluoride
TRF	transformer
XLPE	cross-linked polyethylene

5.0 ACTIONS

5.1 General

5.1.1 Introduction

ABB's SafeRing switchgear is secondary distribution switchgear. The switchgear is type tested, factory assembled metal enclosed switchgear for installation in both padmount substations and indoor substations.

The main technical features are:

- Three-pole metal enclosed.
- SF₆ gas is used for insulation and interruption.
- Gas tight, welded stainless steel vessel, with welded in bushing.
- Three-position switch - closed/open/earth. Earth switch is make-proof. No additional interlocks are necessary between the switch to earth.
- HRC fuses and cable-sealing ends are accessible when the circuit is earthed.
- The switchgear used by Endeavour Energy cannot be extended.
- In case of a single fuse operation, all three phases of the switch are opened through striker pins provided on the fuses.

For further description, operation and maintenance instruction on SafeRing switchgear refer to the operating instructions no. NOPOWSR 5976 GB from ABB. These instructions form an integral part of this document.

5.1.2 Product approval and stock codes

Endeavour Energy purchases only 24kV rated switchgear for use on both 11kV and 22kV networks. Endeavour Energy has approved the following assemblies rated at 24kV when fitted with a Sigma F&E 3.0 fault indicator after 2013.

The following ring main units are approved to be used in Endeavour Energy's network:

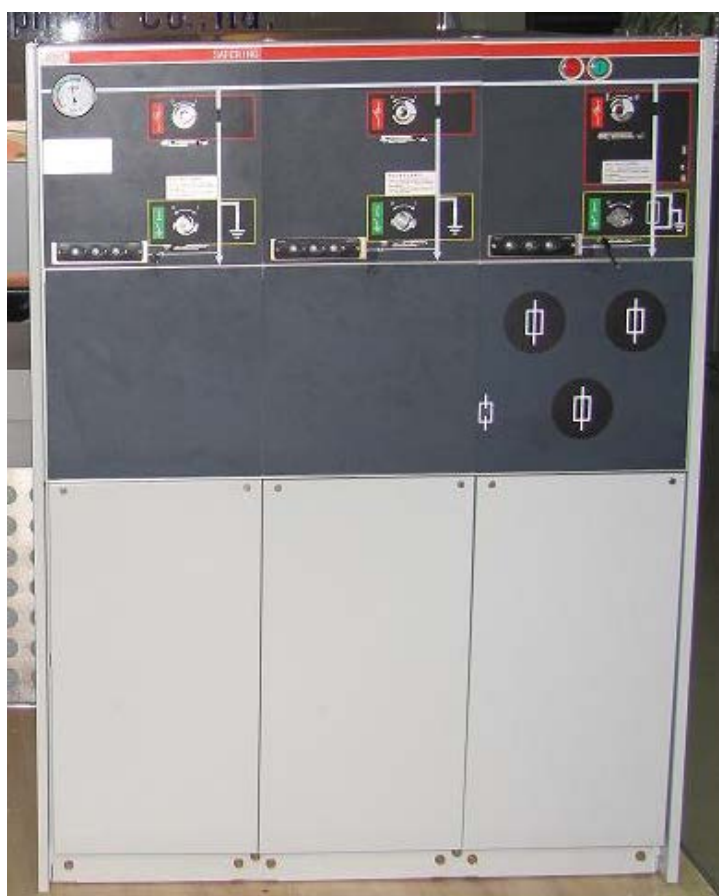
Product App. No.	Manuf. Ref. No.	Item Description
330 035	SafeRing -DF	One switch fuse unit with incoming cable earth switch
330 036	SafeRing -CCF	Two load break feeder switches and one switch fuse
Not approved	SafeRing –CCV **	Three load break switches and one circuit breaker unit *
330 038	SafeRing –CCC	Three load break switches
530272	SafeRing –CCCC	Four load break switches (Indoor use only)

* With relay WIC1-2 of SEG

**** Note:** SafeRing - CCV has been removed from the approved equipment list until further notice. References to the CB unit has been retained as there is a unit installed and in service (Sub DS24824). No new CB units shall be installed in Endeavour Energy's network.

Single line diagrams are shown in section 5.1.5.

5.1.3 Dimensions, weight and description



SafeRing CCF

SafeRing	DF	CCF	CCV	CCC
Width, mm	696	1021	1021	1021
Depth, mm	765	765	765	765
Height, mm	1345	1345	1345	1345
Weight, kg	260	320	313	300

C = Switch F = Transformer V = Circuit Breaker D = Cable - no switch

5.1.4 Technical specification

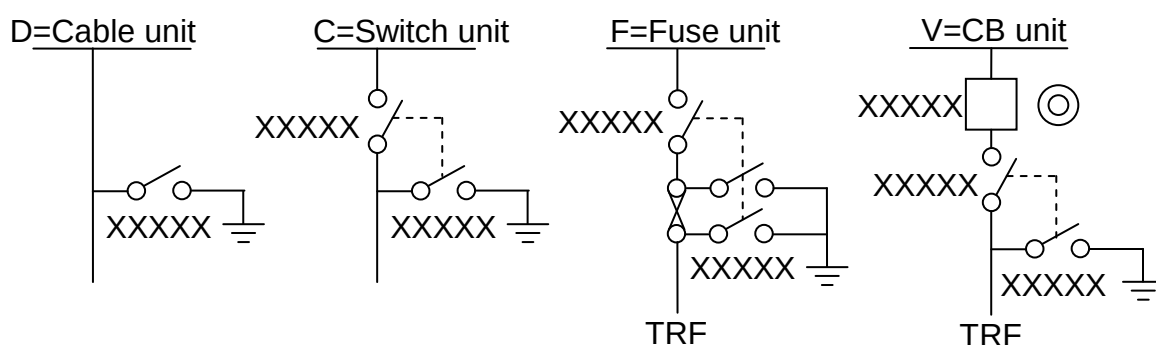
SafeRing switchgear is rated at 24kV. The same switchgear can be used for 12kV applications. The specifications at 12kV and 24kV for 8DJH are:

Rated voltage of use	12kV	24kV
50Hz one (1) minute power frequency withstand Ph to E	28 kV rms	50 kV rms
1.2/50 μ s lightning impulse withstand (BIL) Ph to Earth	95 kVp	125 kVp
Rated current of busbars	630 A	630 A
Rated current of cable feeders	630 A	630 A
Rated current of transformer fused feeders	200 A *	200 A *
Rated current of transformer circuit breaker feeders	200A	200A
Rated short time withstand current for one (1) second	21kA	16 kA
Rated peak withstand and making current	52kA	40kA
Internal arc fault classification	AFL 16kA 1 s	AFL 16kA 1 s

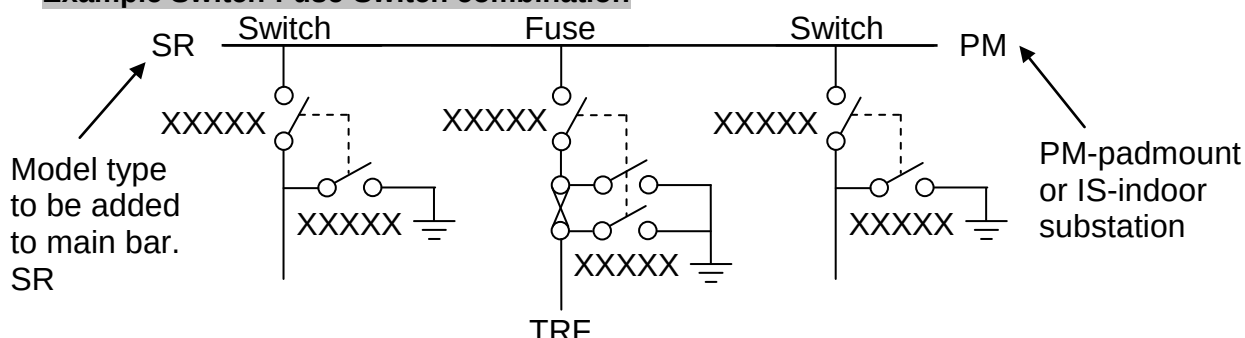
* Depending on the current rating of the fuse

5.1.5 Single line diagrams - Operating diagram symbol

The operating diagram symbols to be shown on projects drawings for the SafeRing switchgear shall be a combination, in accordance and aligned with the switchgear configuration, of the following basic types as shown below. More detail on the actual mechanism is provided in installation and operating instructions. Project drawing standards shall be in accordance with SAD0001



Example Switch-Fuse-Switch combination



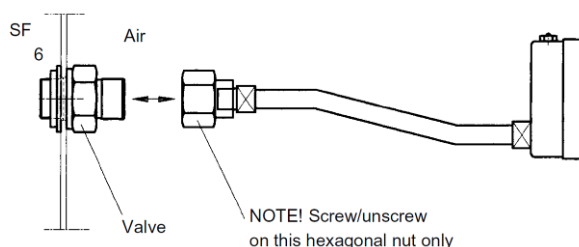
5.1.6 Gas indicator

SafeRing is a pressure-sealed system that normally does not require special inspections. However the gas pressure on the manometer should always be checked to be in the green region prior to operation.

The gas density gauge differs from a simple pressure indicator in that it is temperature compensated. A temperature-compensated device that emits an electrical signal to indicate

lower pressure can be supplied on request.

All units are tested for gas tightness during production to ensure any gas leakage rate is less than 0.1% per annum (maximum 3×10^6 mbarl/s using helium).



Gas filling is through a valve at the front of the unit using a gas filling / sampling kit.

There is approximately 3.24kg of SF6 gas in a CCF unit.

5.1.7 Accessories

5.1.7.1 Short circuit indicators

Horstmann ALPHA E short circuit indicators were initially installed on the SafeRing units but future units (after 2013) shall only be supplied with the Horstmann Sigma F&E 3.0 installed.

Sigma F&E 3.0 indicates both short circuit and earth faults.



The CTs required to power the Sigma F&E relays are larger than the Alpha E fitted around the bushing not the cables as shown below.



5.1.7.2 Phase concordance unit

The phase concordance unit can be used with the voltage indicator lamps supplied standard on all units to Endeavour Energy. The unit can be purchased directly from the manufacturers.

5.1.7.3 Capacitive voltage indicator

Capacitive voltage dividers check the presence of voltage on each phase. Sockets for the connection of an indicator are located on the front plate. Before starting the test remove the earthing links and refit them immediately after disconnecting the tester.

5.1.7.4 Phase balance indicator

A phase balance indicator is available and uses the same capacitive test points as the capacitive voltage indicator.

5.1.7.5 Fuse and fuse adaptor details

ABB SafeRing switchgear is designed for 12kV and 24kV operation. When used on a 12kV system, an extension fuse link is required so that it will accept standard 12kV 292mm long DIN fuses. Information and the parts for the fuse extension are available from ABB as a kit.

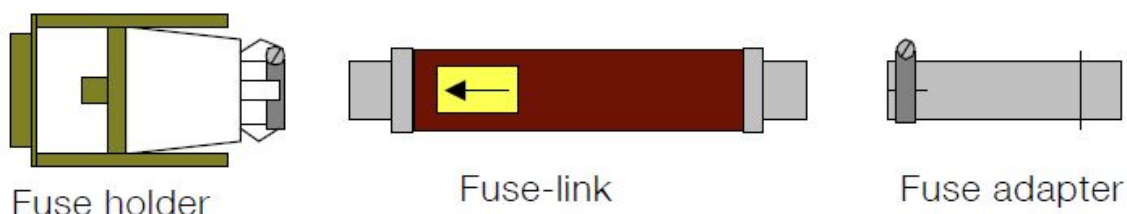
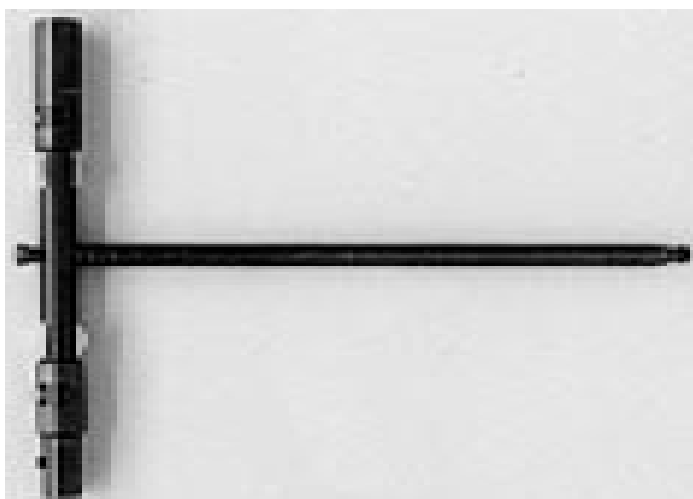


ABB SafeRing switchgear will accept standard 22kV 442mm long DIN fuses. No modification is required for this purpose.

Warning: Make sure the striker is in the direction of the fuse cap.

5.1.7.6 Operating handle

An operating handle is provided with each unit and should remain with the unit.

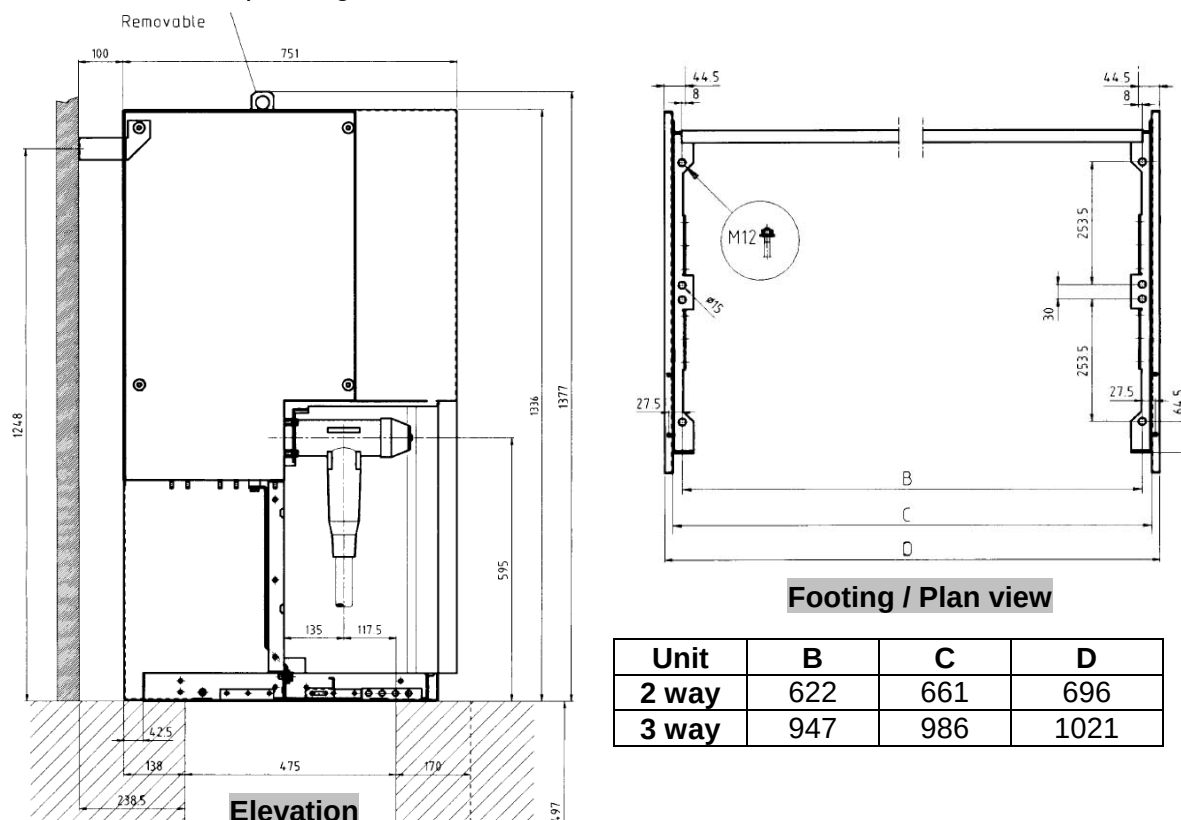


5.2 Installation

5.2.1 General

ABB SafeRing switchgear is designed for installation in padmount substations or indoor substations, as mentioned previously. The switchgear is suitable for installation on the standard plinth, as set out in MCI 0006 - **Underground distribution: Construction standards manual**.

The switchgear does not require the installation of space heaters for operations. For further details, refer to operating instructions no. NOPOWSR 5976 GB.



5.2.2 Cabling

5.2.2.1 Load break switch unit

The load break switch units are provided with 630A bolt-on bushings, which comply with DIN 47636T1 (similar in content to AS 2629). These bushings use M16 bolts for connection of cable lugs.

Dead break elbow terminations are recommended for termination of XLPE cables. These bushings are capable of accepting a range of elbow terminations including:

Manufacturer	Termination boot type	Max. cable size
ABB Kabledon	SOC 630	XLPE insulated 240 sq mm
Elastimold	K430TB18-300-EE01 or K400TB	XLPE insulated 300 sq mm
Pirelli	FMCTs 400	
Raychem	RCAB – 4120	XLPE 35 - 400 sq mm
3M electrical products	92 – EE 615-1 (cold shrink)	XLPE 50 - 300 sq mm

24kV screened cable terminations/elbows are to be used in all cases, including when used on 11kV. Refer to ABB's instruction no. NOPOWSR 5976 GB for complete details of acceptable terminations. A *Unistrut* is provided for clamping of feeder cables.

5.2.2.2 Circuit breaker unit

**** Note:** SafeRing - CCV (and all other CB units) have been removed from the approved equipment list until further notice. References to the CB unit has been retained as there is a unit installed and in service. No new CB units shall not be installed in Endeavour Energy's network.

Each circuit breaker unit is fitted with 200 Amp plug-in bushings, manufactured in accordance with standard no. DIN 47636T1 (similar in content to AS 2629). Dead break 200A elbows connectors are recommended for use with the bushings. Minimum cable size will be 70 mm² copper conductor XLPE insulated. These bushings are capable of accepting the following plug-in elbow connectors:

Manufacturer	Type reference
ABB Kabledon	SOC 250
Elastimold	K158LR
F&G/NKT	EASW 20-250

Pre-made leads are available for connection to either 11kV or 22kV transformers. 22kV screened elbow connectors are to be used in all a cases, including when used on 11kV areas. Refer to ABB's instruction no. NOPOWSR 5976 GB for complete details of acceptable terminations. A *Unistrut* is provided for clamping of feeder cables.

5.2.2.3 Fuse switch unit

Each fuse switch unit is fitted with 200 Amp plug in bushings manufactured in accordance with standard no. DIN 47636T1 (similar in content to AS 2629). Dead break 200A elbows connectors are recommended for use with the bushings. Minimum cable size will be 25mm² copper conductor XLPE insulated. These bushings are capable of accepting the following plug-in elbow connectors:

Manufacturer	Type reference
ABB Kabledon	SOC 250
Elastimold	K158LR
F&G/NKT	EASW 20-250

Pre-made leads are available for connection to either 11kV or 22kV transformers. 22kV screened elbow connectors are to be used in all a cases, including when used on 11kV areas. Refer to ABB's instruction no. NOPOWSR 5976 GB for complete details of acceptable terminations. A *Unistrut* is provided for clamping of feeder cables.

5.3 Operation and switching

5.3.1 Interlocks and mimic diagram

This switchgear is fitted with a switch in the main circuit, with three-positions, closed-opened-earthed. This arrangement prevents the closing of the switch when the earth switch is applied.

This switchgear is equipped with interlocks to prevent opening of the upper or lower compartments unless the respective switch or switch fuse is in the earthed position.

The mimic diagram is provided on the front plate of the switchgear. The mimic shows the

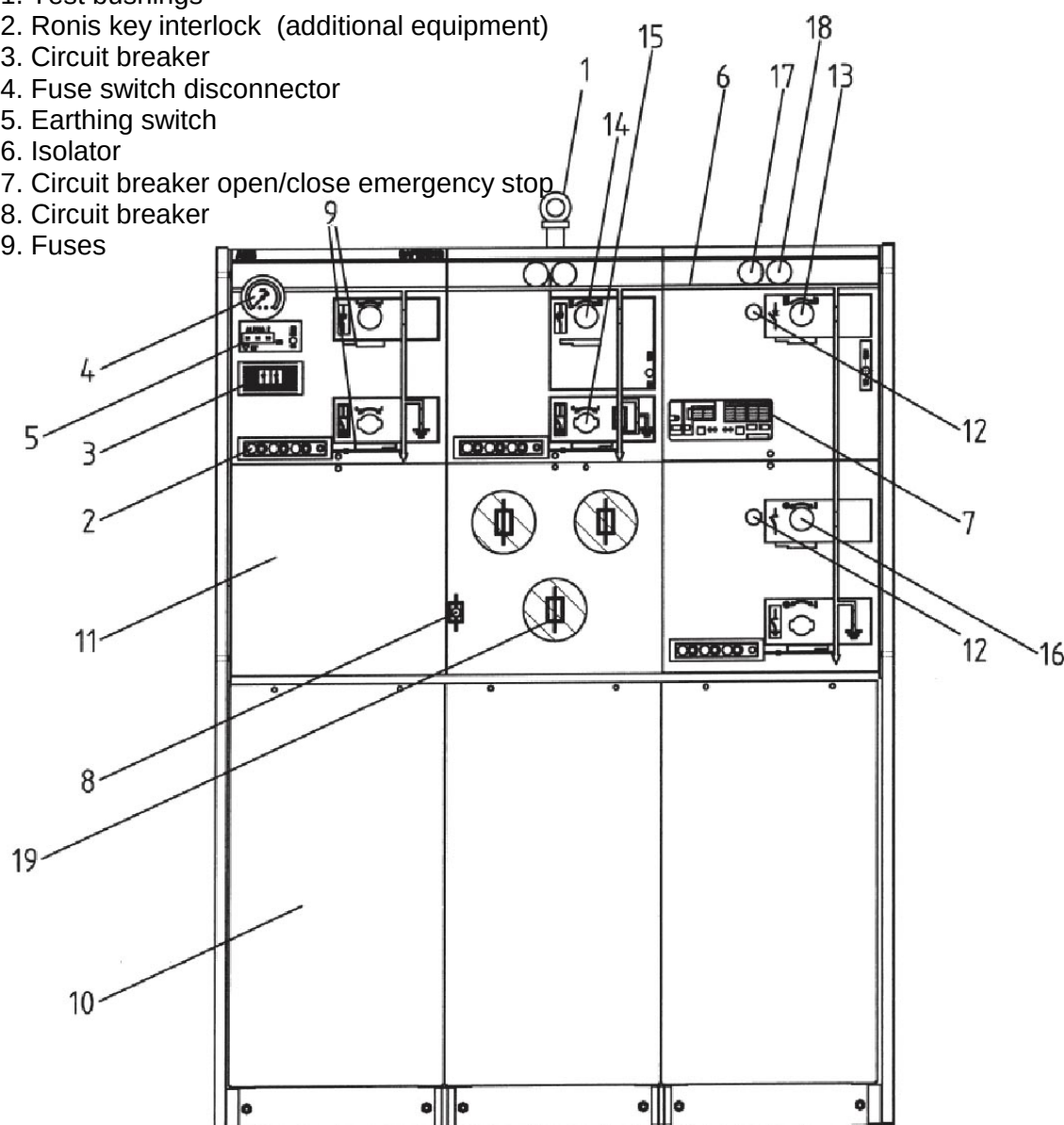
position of the switch, that is, in closed, open or earth position.

The switchgear is designed so that it can be retrofitted for remote operation if required. This shall require the use of a motorisation kit, which can be purchased from the manufacturer. Appropriate modifications can be carried out in the field. Refer to the manufacturer for further details or refer to the attached instruction from ABB, NOPOWSR 5976 GB.

5.3.2 SafeRing operating mechanism

Important: Only authorised employees may carry out switching operations.

1. Lifting lug
2. Capacitive voltage indication
3. Short circuit indicator
4. Pressure indicator
5. Legend plate with serial number
6. Mimic diagram
7. Relay protection
8. Blown fuse indicator
9. Padlock device
10. Cable compartment
11. Test bushings
12. Ronis key interlock (additional equipment)
13. Circuit breaker
14. Fuse switch disconnecter
15. Earthing switch
16. Isolator
17. Circuit breaker open/close emergency stop
18. Circuit breaker
19. Fuses



5.3.3 Switch operation

The switch disconnect and earthing switch are closed by turning the operating handle clockwise. Turning the operating handle anti-clockwise opens the switch.

For closing the switch fuse disconnect / circuit breaker the spring mechanism must be charged. Turning the operating handle clockwise does this. Then the green "on" button must be pressed to close the switch/breaker.

An anti-reflex system, standard on all operating handles, prevents the immediate re-operation of switches.

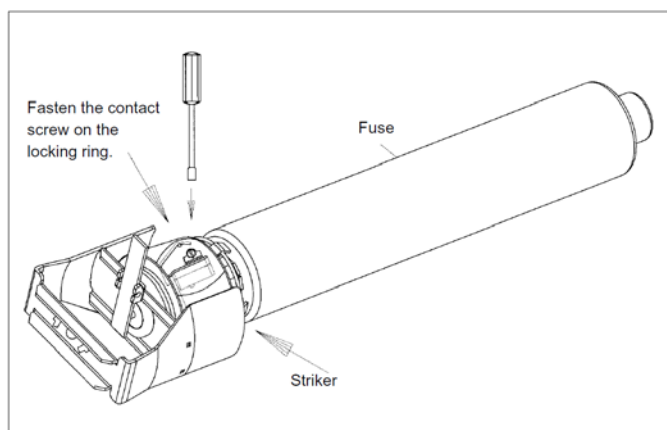


5.3.4 Fuse switch unit

To open the fuse compartment the switch must be in the earthed position. Then remove the screw at the top of the fuse cover and tilt cover down to expose the fuse canisters.



Applying the operating handle and turning anti-clockwise opens the fuse canisters



Fix the fuses to the fuse cover using the contact screw.

The striker must point out from the fuse canister for the fuse to function properly

5.3.5 Circuit breakers

The circuit breakers are rated at 24kV. These can be used at 12kV without modifications. The circuit breaker units are fitted with a self-powered over current and earth fault protection relay type WIC1-2 of SEG. The details of the relay and test procedures are provided in the attached manual no. TB WIC1 03.02 E from SEG. The relays setting must be checked with the Protection Group before being put in to service.

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, 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 to check that all designs carried out by Regional employees conform to the requirements of this instruction.

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

It will be the ASP's responsibility to check that the latest issue of any instruction or drawing relevant to or listed in this manual 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