

Substation Design Instruction

AREVA 12kV/24kV switchgear: Fluokit - M24

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Substation Design Instruction

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SDI 205 AREVA 12kV/24 kV switchgear: Fluokit - M24

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1.0 PURPOSE

To provide the technical specification to assist with the application and installation of AREVA 12kV/24kV switchgear type Fluokit - M24.

2.0 SCOPE

This instruction provides information to assist in the design and installation of substations that require AREVA switchgear: Fluokit - M24. It deals only with the standard units approved by Endeavour Energy for use on the network. The instruction does not set out the mounting and earthing, for which an appropriate document should be referred. The switchgear complied with the requirements of the now superseded Substation Design Instruction SDI 302 – Distribution indoor and padmount substation 11/22kV switchgear specification (superseded by Equipment Technical Specification ETS 0068 - Distribution indoor and padmount substation 12-24kV switchgear).

Endeavour Energy uses 24kV rated switchgear: Fluokit - M24 units on both 11kV and 22kV systems. Endeavour Energy has approved the following assemblies rated at 24kV for use on the network:

24kV Fluokit M-24 extensible switchgear				
Type	Ref.	Rating	Function	Approval no.
Fluokit	IS	24kV, 16 kA	Load break switch panel	330 050
Fluokit	PFA	24kV, 16 kA	Load break fuse switch panel	330 051
Fluokit	PGC	24kV, 16 kA	Circuit breaker panel with MICOM P124 self-powered protection relay	330 052
Fluokit	LR	24kV, 16 kA	Bus riser panel	330 053

This switchgear is not to be installed in Endeavour Energy's distribution network in the future. Currently, there are 12 indoor distribution substations installed with this switchgear. Areva, the manufacturer of the switchgear, was acquired by Schneider Electric in 2011.

The newer version of this switchgear (FKM24+) supplied by Schneider Electric can be only used as secondary switchgear in zone substations.

3.0 REFERENCES

Internal

- Company Policy (Network) 9.1.7 – Commissioning Network Electrical Assets
- Company Policy (Network) 9.2.2 - Network Protection
- Company Policy (Network) 9.2.5 - Network Asset Design
- Company Policy (Network) 9.7.1 - Network Asset Construction
- Company Policy (Network) 9.8.3 - Network Operations
- Company Policy (Network) 9.9.1 - Network Asset Maintenance
- Company Procedure (Network) GAM 0001 Network standards framework preparation and amendment of network standards
- Company Procedure (Network) GAM 0114 – Granting Dispensations for Engineering Documents
- Company Procedure (Procurement & Logistics) GSU 0012 – Selection and Approval of a Disposal Method
- Earthing Design Instruction EDI 100 – Distribution Earthing Design

- 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
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
- Substation Maintenance Instruction SMI 122 – Use and handling of sulphur hexafluoride (SF₆)
- Drawing no. 297555 - Indoor distribution substation switchgear trench cover plate.

External

- *Work Health and Safety Act 2011 NSW*
- *Work Health and Safety Regulation 2017 NSW*
- ENA National Electricity Network Safety Code (Doc 01-2008)
- AS 1033.2:1988 - High voltage fuses for rated voltages exceeding 1000V – current limiting type.
- AS/NZS 60265.1:2001 - High voltage switches: Switches for rated voltages above 1kV and less than 52kV
- AS 62271.1- 2012 – High voltage switchgear and control gear – common specification
- IEC 60282.1:2009 - High voltage fuses – current limiting fuses
- Fluokit – *M24 Installation, Commissioning, Operation and Maintenance Manual*
- Fluokit – *M24 Technical Specification*

4.0 DEFINITIONS AND ABBREVIATIONS**CB**

Circuit breaker

CT

Current transformer

HRC

high rupturing capacity

HV

high voltage (12kV to 24kV)

LV

low voltage

SF₆

sulphur hexafluoride

5.0 ACTIONS**5.1 General**

AREVA Fluokit - M24 switchgear is a secondary distribution switchgear used in indoor substations, and shall not be used in new designs of Endeavour Energy's HV distribution network.

The main technical features are:

- Modular construction. Modules can be added at a later date to extend the switchgear.
- SF₆ gas used for interruption.
- Air insulated busbars.
- 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 three (3) phases of the switch are opened through a striker pin provided on the fuses.
- Self-powered relay for use with circuit breakers

Detailed description, operation and maintenance instructions on Fluokit – M24 switchgear are given in manuals provided by the manufacturer. These manuals form part of this document

5.2 Specification

The main technical parameters are:

General	
Rated system voltage of use	24kV
50Hz 1 minute withstand	50 kV rms
1.2/50 μ s impulse withstands	125 kVp
Busbar system	
Rated current	630A
Rated short time withstand current	16 kA/1sec
Insulation	Air
Load break switch unit – IS	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16 kA/1sec
Rated making current	40 kAp
Insulation/arc interruption media	SF6 gas (0.1kg)
Operating mechanism	Manual – C10
Load break fuse switch unit – PFA	
Rated current	200A
Rated breaking current at 0.7 pf	200A
Rated short time withstand current	16 kA/1sec
Rated making current	40 kAp
Insulation/arc interruption media	SF6 gas (0.1kg)
Operating mechanism	Manual – C12
HV fuse link, in accordance with	AS 1033.2

Circuit breaker unit - PGC	
Breaker type	ORTHOFLUOR FP
Rated current	630A
Rated short circuit breaking current	16kA
Rated short time withstand current	16 kA/1sec
Rated making current	40 kAp
Insulation/arc interruption media	SF6 gas (2.5kg)
Operating mechanism	Manual – BLR
Protection relay (self powered)	MICOM P124

Bus section switch type IS + LR (load break switch + bus riser)	
Rated current	630A
Rated breaking current at 0.7 pf	630A
Rated short time withstand current	16 kA/1sec
Rated making current	40 kAp
Insulation/arc interruption media	SF6 gas (0.2kg)
Operating mechanism	Manual – C10
Busbar insulation	Air

5.3 Dimensions and weight

Measurements	Fluokit – M24 IS	Fluokit – M24 PFA	Fluokit – M24 PGC	Fluokit – M24 IS + LR
Width (mm)	375	375	750	750
Depth (mm)	1030	1030	1240	1030
Height (mm)	1550	1550	1550	1550
Weight (kg)	100	110	350	160

5.4 Description

All the modules of Fluokit – M24 switchgear have the following basic compartments:

- Switchgear
- busbar
- cable (connection to switchgear)
- 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, refer to the manuals/technical specifications provided by the manufacturer. These manuals form part of this document.

5.4.1 Load break switch unit, type IS

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 C10 operating mechanism. This provides fail-safe interlocking between the switch and the earth switch.

The two (2) switches cannot be closed simultaneously.

5.4.2 Load break fuse-switch unit, type PFA

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 a C12 operating mechanism. 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, as described above. The switchgear is rated for 24kV applications.

The 11kV fuse link is shorter in length to fit into the space between the upper and lower sockets of the 24kV fuse holder.

Hence, an extension to the 11kV fuse link is required when the 24kV fuse - switch unit is used on the 11kV system. 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 the sides.

5.4.3 Circuit breaker unit – PGC

The circuit breaker unit comprises:

- An isolation switch with an in-built earthing switch similar to unit IS. The unit comprises a circuit breaker in a permanently filled SF₆ enclosure, rotary switch with integral fault make, and a dual earthing switch. The isolating/earthing switch has three positions: *closed*, *open* or *earthed*. The switch operation is manual through operating a C10 mechanism. This provides fail-safe interlocking between the switch and the earth switch. The two switches cannot be closed simultaneously.
- Circuit breaker ORTHOFLUOR FP comprises of three separate poles mounted on a supporting 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, MICOM P124, 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.

5.4.4 *Bus section switch - IS + LR*

The bus section switch comprises two panels, as follows:

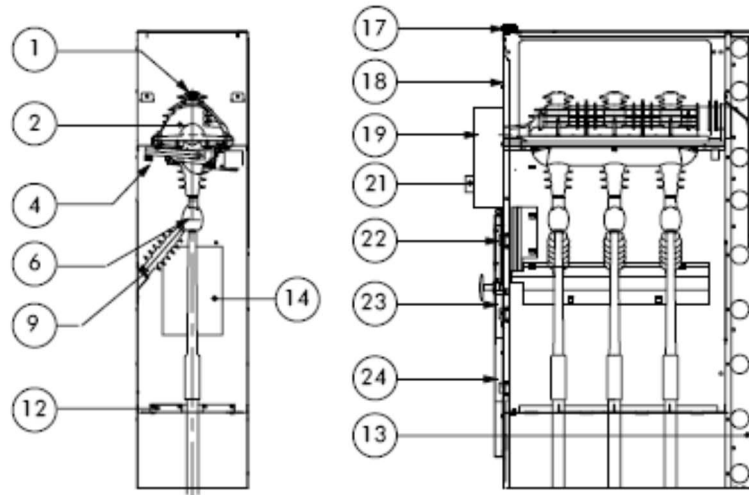
- a load break switch panel, IS. No earth switch is provided. The connection to the adjacent panel is through busbars. No facility exists for cable connection
- bus riser panel (LR).

5.4.5 Basic functional unit of an IS and PF switch

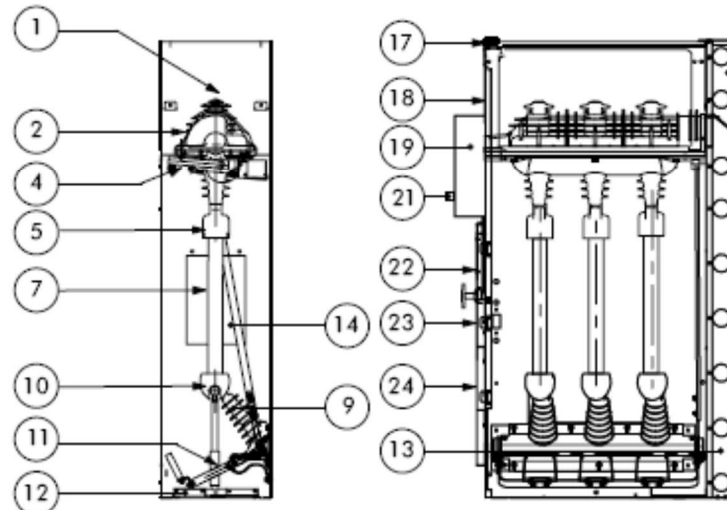
Légend

- 1 Busbars connection plate
- 2 Load-break switch ISR
- 3 Main isolator SR
- 4 Earthing switch on supply side (open position)
- 5 Fuse holder upper shell
- 6 Cable connection shell
- 7 HV fuse
- 8 ORTHOFLUOR FP (SF6) Circuit-breaker
- 9 VIGIA capacitive voltage divider
- 10 Fuse holder lower shell
- 11 Earthing switch on load side of fuses open position PF/PFA
- 12 Bottom plate made of 4 elements
- 13 Evacuation duct
- 14 Overpressure valve
- 15 Current transformers
- 16 Voltage transformers (TM)
- 17 Unit earthing bar
- 18 Busbars access panel
- 19 Load break switch ISR control
- 20 Main isolator SR control
- 21 Voltage presence indicator lamps
- 22 Position check window for earthing switch or main isolator
- 23 Test pin for installing the earthing block
- 24 Access panel to HV cable compartment (IS – PF – PFA), or to fuse and voltage transformers compartment (TM), or to circuit breaker and current transformer compartment (PGB)
- 25 Circuit-breaker control

IS Functional unit (Switch disconnect)

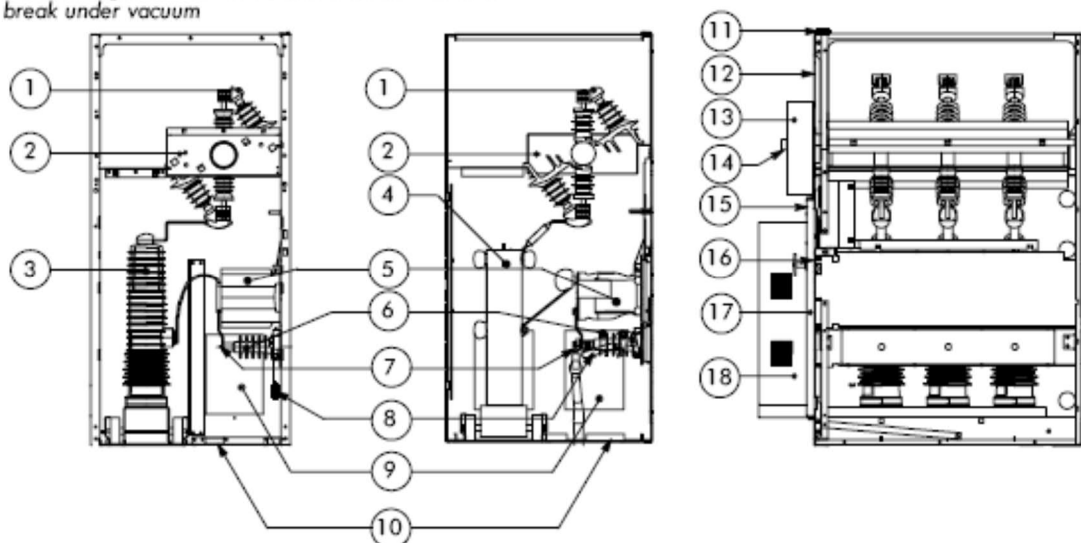


PF – PFA Functional unit (Fuse protection – Fuse Combination Unit)



5.4.6 Basic functional unit of a PGC SF6 gas circuit breaker

PGC Functional Unit (Cables overall protection) with ORTHOFLUOR FP Circuit-breaker with load break under SF6 gas or with VBL Circuit-breaker with load break under vacuum



Légend

- | | | |
|---|---------------------------------------|--|
| - 1 Busbars connecting plate | - 8 Earthing switch | - 15 Position check window for main isolator |
| - 2 Main isolator SR | - 9 Overpressure valve | - 16 Test pin for installing the earthing block |
| - 3 ORTHOFLUOR FP Circuit-breaker with load break under SF6 gas | - 10 Cable fastening plate | - 17 Cable compartment access panel |
| - 4 VBL Circuit-breaker with load break under vacuum | - 11 Unit earthing bar | - 18 Circuit-breaker control: BLR/M for ORTHOFLUOR FP Circuit-breaker, CRR1 or CRR 1000 for VBL Circuit-breaker. |
| - 5 Current transformer | - 12 Busbars access panel | |
| - 6 Capacitive voltage divider | - 13 Main isolator control | |
| - 7 Cables connection plate | - 14 Voltage presence indicator lamps | |

5.5 Operation

5.5.1 Switching operations

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

5.5.2 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, MICOM P124. The relay's setting must be checked with the Protection section before being put in to service.

5.5.3 Mimic diagrams

The switchgear status indicators are placed directly on the moving contact assembly-operating shaft. They indicate the position of the switchgear.

5.5.4 Interlocks

Fluokit - M24 is fitted with interlocks, which 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; and,
- the switch must be open and the earth switch applied before the front cover can be removed.

The switchgear is fitted with a mimic diagram, which 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

Fluokit – M24 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 at 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 will 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.



Figure 1: Installed IS/PFA/IS unit in an indoor substation

5.7 Cabling

5.7.1 General

Refer to the relevant mains instructions.

5.7.2 Cable sizes

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

Panel type	Maximum cable size
Load break switch type IS	3 x 1 core 300 sq. mm
Load break fuse switch type PFA	3 x 1 core 95 sq. mm
Circuit breaker type PGC	3 x 1 core 240 sq. mm

When a three-core cable is to be used, the cable shall be trifurcated outside of the switchgear in the trench. For further details, refer to the documents provided by AREVA.

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.

For further details, refer to the information provided in the AREVA technical specification FLUOKIT M24-TEC/eng/MVB/02/03/FR/4115 under the heading MV cable connection:

5.7.4 Cable termination height

Panel type	Cable termination height
Load break switch type IS	908mm
Load break fuse switch type PFA	365mm
Circuit breaker type PGC	370mm

For further details, refer to the documents provided by AREVA.

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.

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, motorised units can be supplied to avoid retrofitting.

Operating mechanism	Motor tumbler
Voltage	24V or 110V DC
Rating	200W
Operating time	Close <5 sec
	Open <5 sec

5.8.2 *Short circuit indicators*

The current transformers for short circuit indicators fit around each individual phase and the indicators should be on the front of the panel for easy viewing.

5.8.3 *Voltage presence indicators*

Three voltage presence indicator lamps (one for each phase) are provided on the front panel of the control mechanism. The phase identity of the feeders can be verified by connecting an external voltage measuring or voltage indicating device to the socket above the voltage indicator lamps.

More information is provided in the Installation/commissioning/operation maintenance manual NT003 A AMT-12/99, which forms an integral part of this document. The external voltage indication device can be purchased directly from **Schneider Electric**.

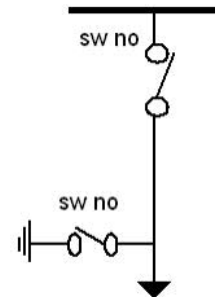
5.8.4 *Reference drawings*

The switchgear trench, cover plate and support arrangement is similar to the arrangement shown in Drawing no. 297555.am C.

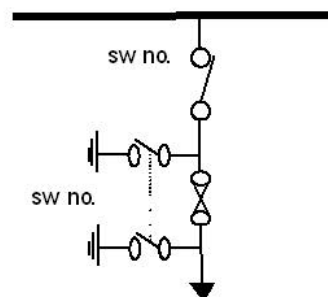
5.9 Single line diagrams

The single line diagrams shown below are for individual modules of the Fluokit - M24 switchgear. The single line diagram of the board is to be prepared for each project using these modules.

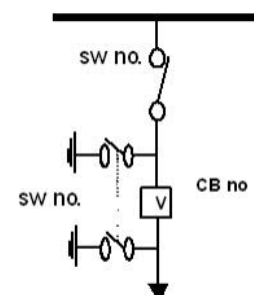
FLUOKIT – M24
Load break switch panel **IS**



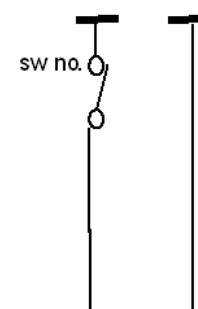
FLUOKIT – M24
Load break switch panel **PFA**



FLUOKIT – M24
Circuit breaker panel **PGC**



FLUOKIT – M24
Bus section panel **IS+LR**



6.0 AUTHORITIES AND RESPONSIBILITIES

Manager Asset Standards & Design has the authority and responsibility for:

- approving technical standards including any variations with GAM0001.

Substation Assets Manager has the authority and responsibility for:

- reviewing and endorsing this standard in accordance with company policies and procedures.

Senior Engineer, Distribution Substation Assets has the authority and responsibility for:

- revising and updating this standard in accordance with company policies and procedures

Regional Managers have the authority and responsibility for:

- allocating appropriate resources to enable compliance for designs carried out by regional employees with this standard.
- determining that all designs carried out by Regional employees conform to the requirements of this standard.

Manager Network Connections has the responsibility for:

- allocating appropriate resources to enable compliance for designs carried out by Level 3 ASPs with this standard.

Accredited Service Providers and Regional Designers have the authority and responsibility for:

- producing all designs in conformance to the requirements of this standard
- confirming that the latest issue of any instruction or drawing relevant to or listed in this standard is available and used during the design of any project.

7.0 DOCUMENT CONTROL

Documentation content coordinator: Substation Assets Manager

Documentation process coordinator: Standards Process Coordinator