

Substation Design Instruction

Areva FBX-C/24-20/ C-C-T1 ring main unit

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SUBSTATION DESIGN INSTRUCTION

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SDI 216 Areva FBX-C/24-20/C-C-T1 ring main unit

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PURPOSE

This standard provides technical and reference information to assist with the safe design, installation, commissioning, operation and decommissioning of Areva FBX C SF₆ gas insulated 24kV switchgear.

1.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of Areva FBX C switchgear.

Areva ring main unit FBX-C/24-20/C-C-T1 is approved for use in Endeavour Energy's 22kV distribution network. Areva, the manufacturer of the switchgear, was acquired by Schneider Electric in 2011. Schneider has indicated that they will not be offering this switchgear anymore (after 2014) and would offer alternative switchgear to meet Endeavour Energy's specifications.

Note: This switchgear is no longer approved for use in new installations on Endeavour Energy's network. This instruction is for reference purposes only.

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 - Underground distribution: construction standards manual
- Earthing design, construction and testing: refer EDI 100 - Distribution earthing design, construction and test
- Specification of new equipment: refer ETS 0068 - Distribution indoor and padmount substation 12-24kV switchgear
- General details and minimum design requirements: refer SDI 101 - Distribution substation general details and minimum requirements and MDI 0028 - Underground distribution network design
- Testing and commissioning: refer SDI 120 - Testing and commissioning for distribution systems
- Ongoing maintenance requirements: refer SMI 101 - Minimum requirements for maintenance of distribution equipment
- Standard drawing requirements: SAD 0001 – Project drawing standards

This document shall be read in conjunction with the manufacturer's operating instruction No 531421 and system configuration instructions available on the Endeavour Energy standards website.

The configuration of the switchgear is as shown in the single line diagram in section 5.7.

2.0 REFERENCES

- 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 Operation
- 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
- 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 0071 – Distribution fuses
- 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
- Standard Asset Data SAD 0001 – Project drawing standards
- Substation Design Instruction SDI 101 - Distribution substation general details and minimum requirements
- Substation Maintenance Instruction SMI 101 - Minimum requirements for maintenance of distribution equipment
- Network Management Plan December - 2013 Review
- ENA National Electricity Network Safety Code (NENS 01-2008)
- *Work Health and Safety Act 2011 (NSW)*
- *Work Health and Safety Regulation 2011 (NSW)*
- AS 1033.2 - High voltage fuses for rated voltages exceeding 1000V - current limiting type
- AS 2024:1991 - High voltage a.c. switchgear and control gear – switch-fuse combinations
- AS 2629:2008 - Separable insulated connectors for power distribution systems above 1kV
- AS 62271.1 -2012 – High voltage switchgear and controlgear-Common specification
- AS 60265.1-2001 - High voltage switch-switches for rated voltages above 1kV and less than 52kV
- IEC 60282.1:2014 - High voltage fuses –current limiting fuses
- FBX Gas insulated medium voltage switchgear up to 24kV - Operating instructions no. 531 421, Edition 03/05
- FBX Gas insulated medium voltage switchgear up to 24kV for secondary distribution - compact or extensible: System configuration:2005

3.0 DEFINITIONS AND ABBREVIATIONS

ASP	Accredited Service Provider - a person authorised to work in the system, and includes external contractors and Endeavour Energy staff.
BIL	basic insulation level
HRC	high rupturing capacity
XLPE	cross linked polyethylene cable
RMU	ring main unit
SF ₆	sulphur hexafluoride

4.0 ACTIONS

4.1 General

4.1.1 Introduction

The Areva FBX C/24-20/C-C-T1 gas insulated ring main unit is secondary distribution switchgear. The switchgear is type tested, factory assembled, and metal enclosed for installation in padmount substations, and in indoor substations. The ring main unit can be retrofitted with a motorised gear for remote operation.

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 and operation instructions on this equipment refer to the additional documentation from Areva. These instructions form an integral part of this document.

4.1.2 Product approval and stock codes

Endeavour Energy purchased only 24kV rated switchgear for use on both 11kV and 22kV networks. Endeavour Energy had approved the following assemblies rated at 24kV.

The following ring main unit was approved to be used in Endeavour Energy's network but is no longer approved for new purchases/installs:

NOTE	Old App. No.	Manuf. Ref. No.	Item Description
No longer approved	A20024A	Areva FBX-C/24-20/C-C-T1	Two load break feeder switches and one switch fuse

Areva FBX C /24-20/C-C-T1 ring main unit

Single line diagrams are shown in section 5.1.5.

4.1.3 Dimensions, weight and description

Areva FBX-C	SSF
Width, mm	1000
Depth, mm	720
Height, mm	1380
Weight, kg	330

S = C = Switch F = T1 = Transformer

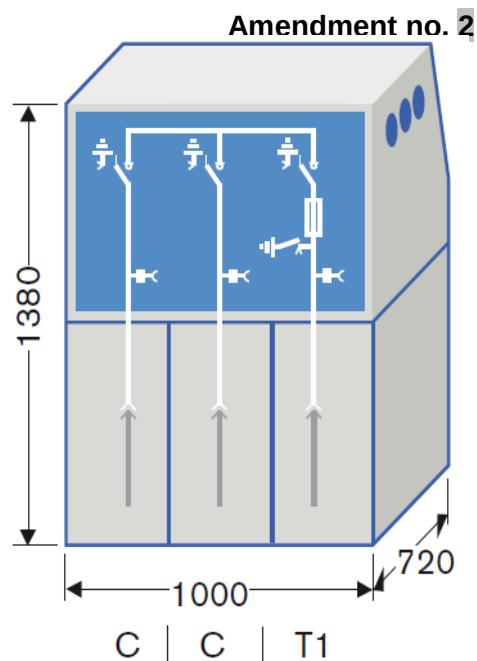


Figure 1 - Switchgear basic dimensions

4.1.4 Technical specification

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

Rated voltage of use	12/24KV
50Hz one minute power frequency withstand Ph to E	50 kV rms
1.2/50 μ s lightning impulse withstand (BIL) Ph to Earth	125 kVp
Rated current of busbars	630 A
Rated current of cable feeders	630 A
Rated current of transformer fused feeders	200 A *
Rated short time withstand current for one second	16 kA
Rated peak withstand and making current	40kA
Internal arc fault classification	AFL 20kA 1 s
SF ₆ gas used for insulation and interruption	2.45kg

* Depending on the current rating of the fuse

Designation of the Areva **FBX-C/24-20/C-C-T1** ring main unit is:

FBX: ring main unit.
C: version - compact (not expandable).
24: rated voltage - (24kV).
20: rated fault current - 20kA/3 sec.
C-C: two (2) outgoing feeder cables with switchgear disc connectors.
T1 transformer outgoing feeder with switch-fuse combination.

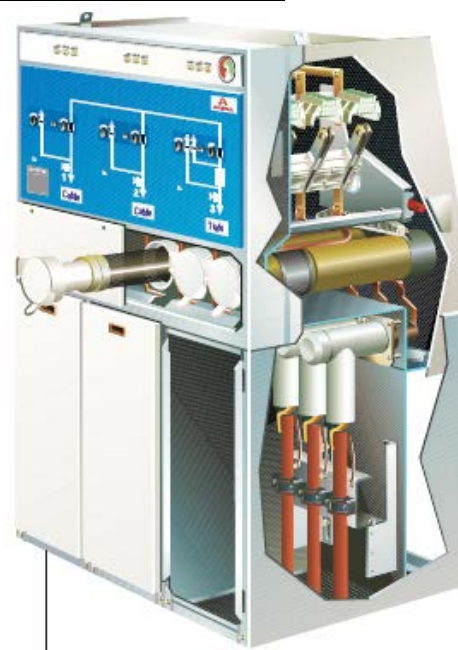
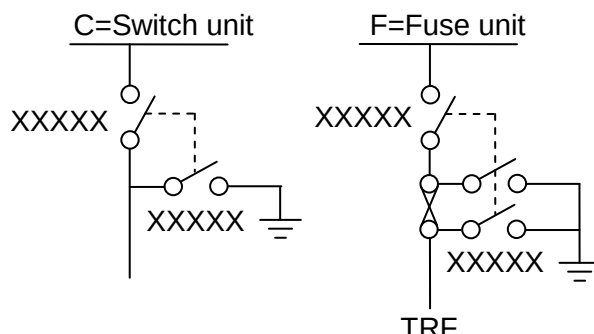


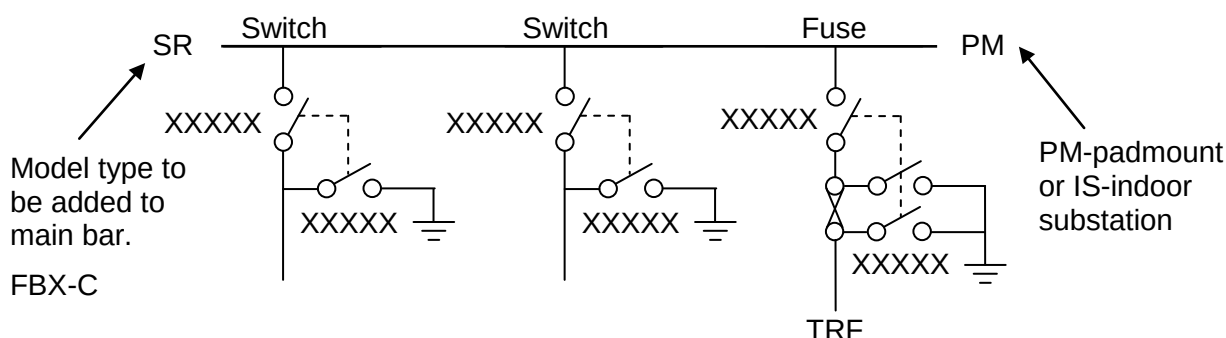
Figure 2 - Areva FBX-C

4.1.5 Single line diagrams - operating diagram symbol

The operating diagram symbols to be shown on projects drawings for the 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 SAD 0001.



Example Switch-switch-fuse combination



4.1.6 Gas indicator

The switchgear 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 relating to the temperature in the direct vicinity of the switchgear prior to operation.

At 20°C, the rated filling pressure is 0.03MPa.

There is approximately 2.45kg of SF6 gas in a SSF unit at the above pressure.

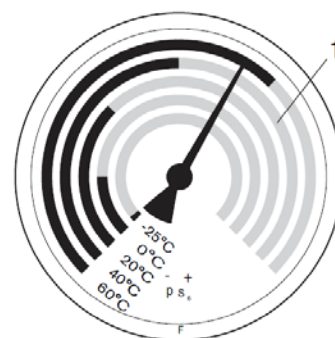


Figure 3 - Pressure gauge

4.1.7 Accessories

4.1.7.1 Short circuit indicators

Horstmann ALPHA E short circuit indicators were installed on the units purchased up until 2014.



Figure 4 - Short circuit indicators

The CTs required to power the Short circuit indicators should be bushing mount design. Some early units were supplied with cable mounted CT.

4.1.7.2 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. These test points shall be kept closed using the plugs supplied, or with indicating lamps plugged in to these test points.

4.1.7.3 Fuse and fuse adaptor details

This 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 the manufacturer as a kit.

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

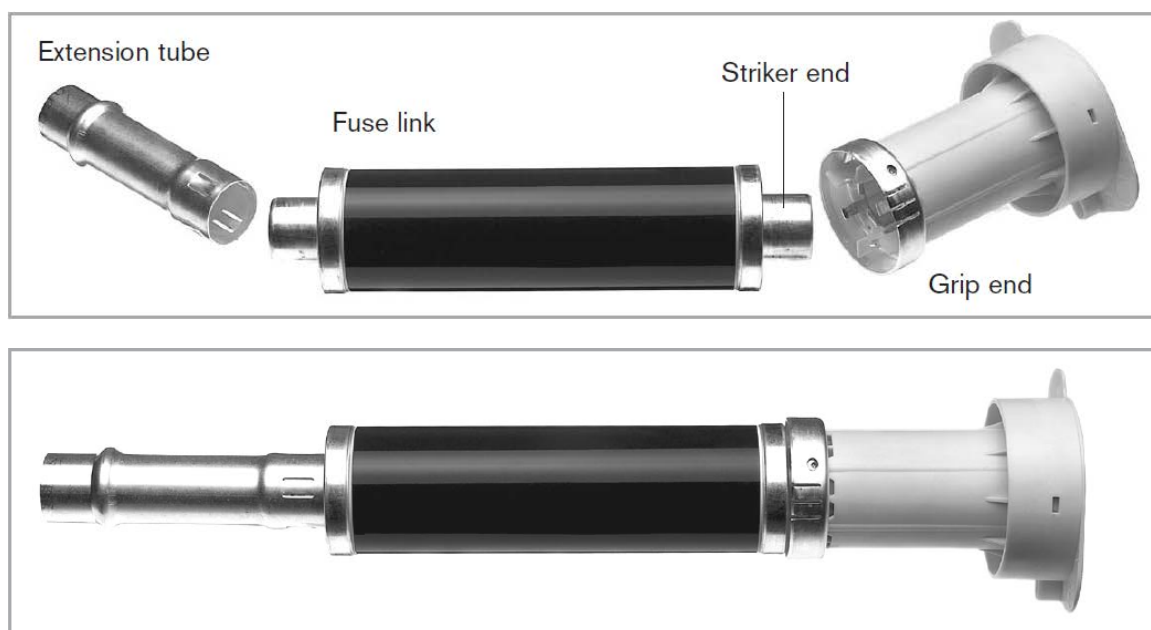


Figure 5 - Fuse extension fitment

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

In the case of a single fuse blow out, all the three phases of the switch are opened through a striker pin provided on the fuse.

4.1.7.4 Operating handle

Two (2) operating handles are provided with each unit and should remain with the unit.

The black handle is for operating the main switch and the second handle (either Red or Green) is used to operate the earth switch.



Figure 6 - Operating handle example

4.2 Installation

4.2.1 General

This 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 operation. For further details, refer to the System configuration:2005 document.



Figure 7 - Example of unit installed in a padmount

4.2.2 Cabling

4.2.2.1 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
F&G/NKT	CB 24/630	XLPE insulated 300 sq mm

24kV screened cable terminations/elbows are to be used in all cases, including when used on 11kV.

4.2.2.2 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

22kV screened elbow connectors are to be used in all a cases, including when used on 11kV areas.



Figure 8 - Cable clamping arrangement

4.3 Operation and switching

4.3.1 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 cable and fuse 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.

A fuse blown indication is also provided in the mimic diagram. In the case of a single fuse blow out, all the three phases of the switch are opened through a striker pin provided on the fuse.

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 upon approval of Network Substation Manager.

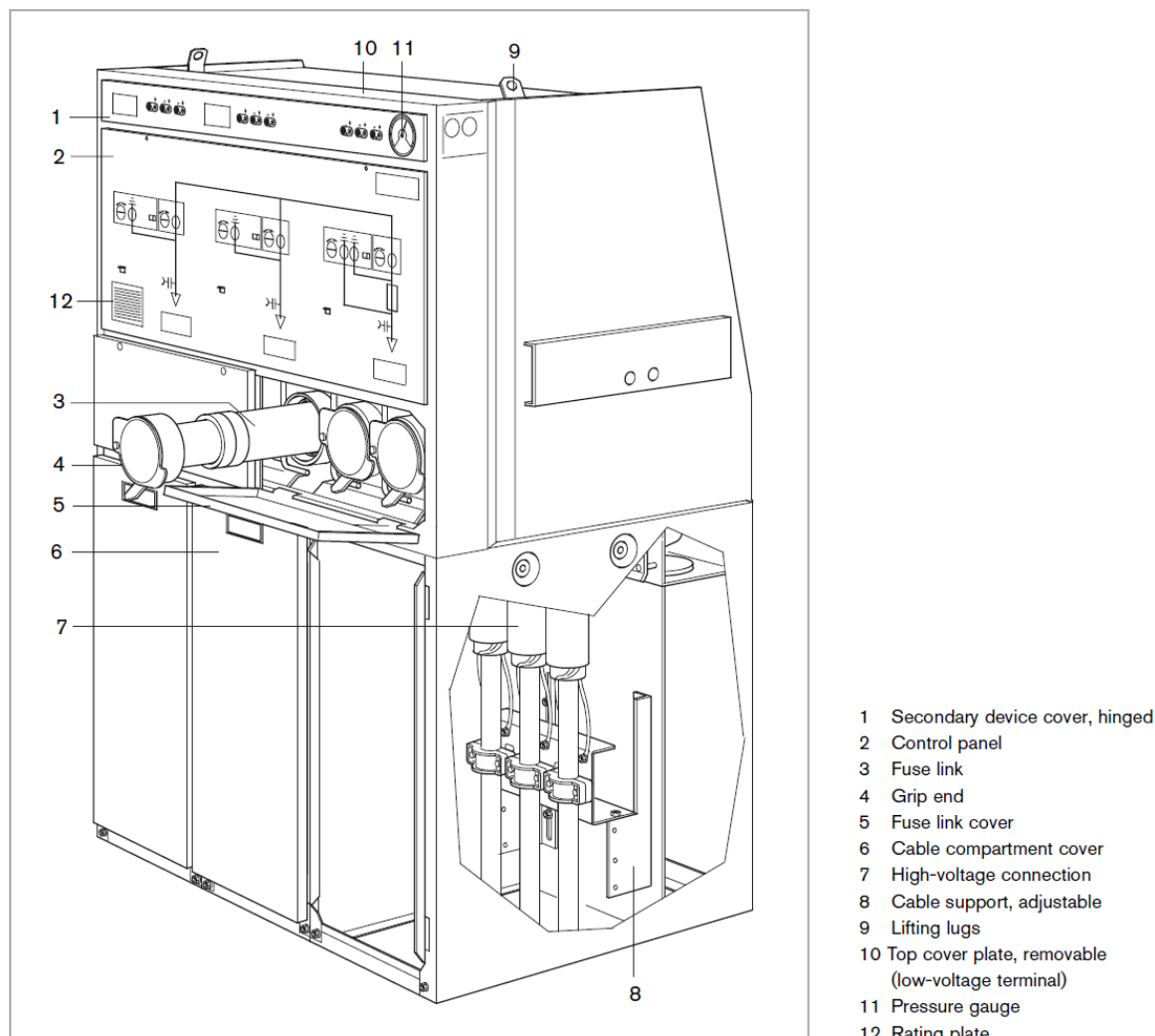


Figure 9 - Main parts of an FBX-C-CCT1

4.3.2 Switch operation

The switchgear may be operated only if the gas pressure is in the green range of the scale on the pressure gauge. Where the gas pressure is below this range, the switchgear must not be operated.

Only authorised personnel may carry out switching operations.

The green operating handle is provided for the operation of the earth switch, and the black operating handle is provided for the operation of the switch disconnector.

The switchgear is clearly marked with the direction of operation.

The driving mechanism of the fuse disconnector must be charged with the control lever before closing, as indicated in the mimic diagram.

The access point for the detachable actuator operating levers can be closed and padlocked to prevent unauthorised operation.

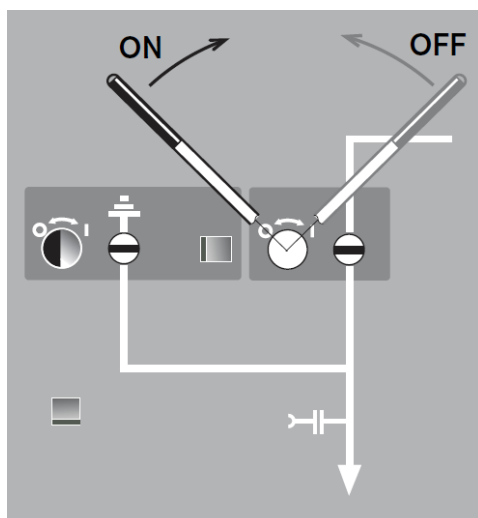


Figure 10 - Feeder main switch operation

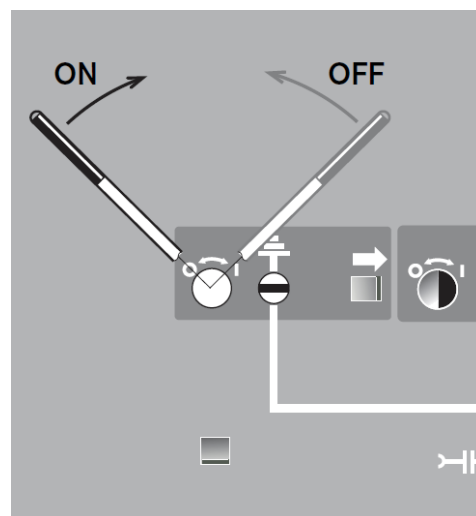


Figure 11 - Feeder earth switch operation

4.3.3 Fuse switch unit

To open the fuse compartment the transformer main switch must be open and the earth switch in the closed position.

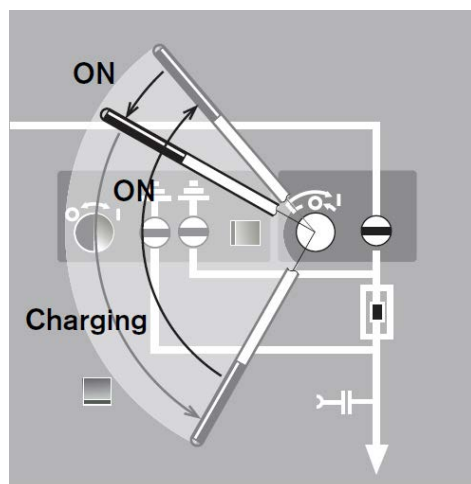


Figure 13 - Transformer main switch operation

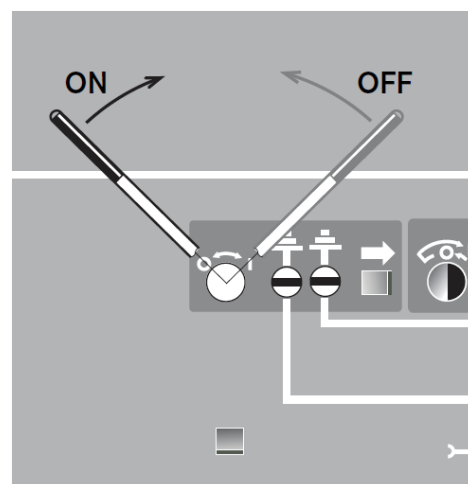


Figure 12 - Transformer earth switch operation



Unlock the top of the fuse cover and tilt cover down to expose the fuse canisters.



Grab the ears of the fuse caps and pull ,do not turn/rotate the grip surfaces.



Remove the fuse carefully.

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

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.

6.0 DOCUMENT CONTROL

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