

Substation Design Instruction

Holec MD4 12kV switchgear

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Substation Design Instruction

PRIMARY SYSTEMS

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SDI 204 HOLEC MD4 12KV 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 Holec MD4 12kV switchgear.

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of Holec MD4 12kV switchgear installed on Endeavour Energy's network.

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

- Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual for mounting and construction requirements;
- Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test for earthing design, construction and testing;
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment and Mains Design Instruction MDI 0028 – Underground distribution design for general details and minimum design requirements;
- Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems and Division Procedure (Network) GNV 1044 – Commissioning Network Electrical Assets for testing and commissioning;
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment and Substation Maintenance Instruction SMI 212 – HV switch and switch fuse units for ongoing maintenance requirements;
- Standard Asset Data SAD 0001 – Project Drawing Standards for standard drawing requirements; and
- Company Procedure (Procurement and Logistics) GSU 0012 – Selection and Approval of Disposal Method

From January 2011, all new installations and replacement of existing Holec MD4 switchgears shall be of the approved metal clad switchgear.

Holec MD4 shall not be used as a replacement unit in Endeavour Energy's network.

3.0 REFERENCES

Company Policy (Network) 9.2.5 – Network Asset Design

Company Policy (Network) 9.2.10 – Network Asset Ratings

Company Policy (Network) 9.8.3 – Network Operations

Company Policy (Network) 9.9.1 – Network Asset Maintenance

Company Procedure (Procurement & Logistics) GSU 0012 - Selection and Approval of a Disposal Method

Division Procedure (Network) GNV 1026 – Equipment Register

Division Procedure (Network) GNV 1044 – Commissioning Network Electrical Assets

Division Procedure (Network) GNV 1061 – Transmission and High Voltage Distribution Network Switching

Division Procedure (Network) GNV 1062 – Granting Dispensation from Network Standards

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
 Substation Design Instruction SDI 101 – Distribution substations general details and minimum requirements
 Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
 Substation Maintenance Instruction SMI 212 – HV switch and switch fuse units
 Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual
 Mains Design Instruction MDI 0028 – Underground distribution design
 ENA Doc 01-2008 National Electricity Network Safety Code
 Network Management Plan December 2013 Review
 NSW Work Health and Safety Act 2011
 NSW Work Health and Safety Regulation 2011
 Eaton/Holec user manual (HVD0C-013/0) for medium voltage switchgear Magnefix MD4
 Holec short circuit indicator Magnefix (3.6.2)
 Exchanging a short circuit indicator (2991.141)

4.0 DEFINITIONS AND ABBREVIATIONS

Accredited Service Provider (ASP)

An individual or entity accredited by the NSW Government Trade & Investment in accordance with the Electricity Supply (General) Regulation 2001 (NSW).

HV

High voltage

RMS

Root mean square

XLPE

Cross link polyethylene

5.0 ACTIONS

5.1 General

Holec MD4 equipment is cast resin and air insulated HV switchgear. The switches are independent, manually-operated, and switched separately by a removable operating handle. Contact making/breaking is affected by a double break, the speed of this operation being independent of the operator.

Holec MD4 switchboards are not extendable in the field and must be returned to the manufacturer for dismantling, re-assembly to the modified arrangement, testing, and the like. This instruction gives details of the three phase operated switchgear, however, it should be noted that large quantities of single phase operated switchgear are installed in Endeavour Energy's northern area.

5.2 Electrical specification

5.2.1 Insulation level (all equipment)

Rated voltage	12kV
50Hz one (1) min. withstand-	40kV
1.2/50 impulse withstand:	

- phase to phase and phase to earth	95kV
- across switch	95kV
- across fuse holder contacts	95kV
DC 15 min. withstand	45kV
Partial discharge @ 8kV	3pC ¹
Partial discharge @ 13kV	3pC ¹

5.2.2 Switch and busbar

	Nameplate	In padmount
Rated voltage	12kV	
Rated normal current	400A	336A
Rated current of busbars	400A	
Rated one (1) sec withstand current	14.4kA	
Rated peak withstand current	30kA	
Rated peak making capacity	30kA	
Rated breaking capacity:		
- mainly active load at 0.7pf	400A	
- closed loop at 0.3pf	400A ²	
- cable charging	21A	
- line charging	21A	
- transformer off load	6.3A	
- capacitive earth fault	240A	

5.2.3 Fuse carrier

	Nameplate	Padmount/indoor
Rated voltage	12kV	
Rated normal current	200A	52A
Rated peak withstand current	30kA	
Acceptable power	27 watts ³	

Will accommodate current limiting fuse links to the following dimensions :

- overall length	360 +2mm to - 3mm
- overall diameter	88mm max.
- contact ferrule diameter	45 ±1mm

¹ Test limits on new equipment prior to delivery from manufacturer. Higher figures may occur in service.

² A circuit in which both sides of the switch remain live after breaking and in which the voltages appearing across the terminals is substantially less than the system voltage.

³ The power dissipation of the fuse links must not exceed the power acceptability of the fuse-holder. The 27 watts is a calculated (cold) power and is the maximum dissipation figure as it relates to the resistance of the fuse link at 20 deg. C.

- contact ferrule length $34 \pm 1\text{mm}$

Note: The ratings indicated in the right column above (padmount and indoor) are as determined by Endeavour Energy's Testing & Instruments Section for Endeavour Energy's environment.

5.3 Dimensions

5.3.1 Complete unit dimensions

Figure 1: Switchgear dimensions

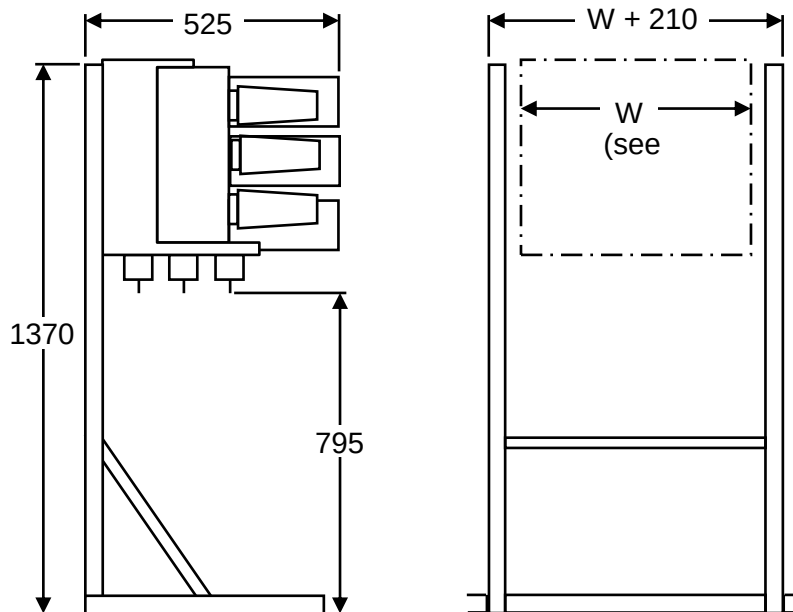


Table 1: Various configurations

Unit type	Manufacturer code	Stock code*	Designation	Width (W)
Transformer unit	MD404	SS14520	A C E	388
2 feeder and transformer unit	MD451	SS19034	A B C A	479
3 feeder and transformer unit	MD490-DX	SS19042	S A A B C A	661
3 feeder switching station	-	SS10487	A A E A	430
4 feeder switching station	-	SS15055	A A E A A	521

* - Obsolete stock codes

Note: S = spacer

Figure 2: Switchgear configuration

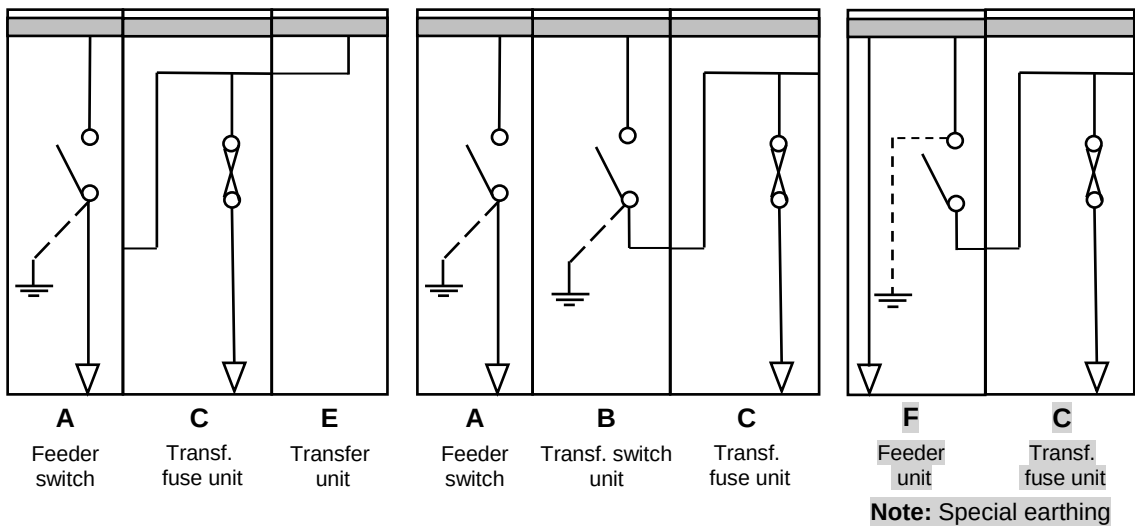


Figure 3: Installed Holec switchgears



Holec - ACE



Holec – AABC



Holec - SAABCA



Holec – AAEEA



Holec – AAEEA



Holec – FC

5.4 Cabling

5.4.1 Transformer

Flexible cables are used to couple the Holec unit to the transformer. They provide fast and efficient connection/disconnection without specialised cable jointing techniques. The technical detail for this cable is shown below:

Type of insulation:	XLPE with PVC cable sheath
Type of screen:	Semi-conductor tape with overlapped copper wire
Voltage rating:	12kV/28kVrms/95kVpeak
Conductor:	16mm ² copper
Overall diameter of cable:	25mm
Length:	2000mm
Minimum bending radius:	200mm

Figure 4: Cable set

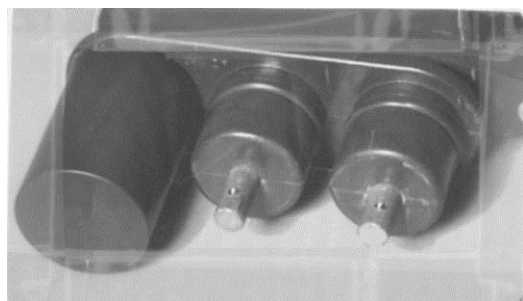


5.4.2 Feeder

Max cross-section each phase 300mm² (refer to Equipment Technical Specification ETS 0068 – Distribution indoor and padmount substation 12-24kV switchgear).

It is important that all cable lugs are positioned as high up on the cable stem as possible with the locking ring positioned midway down the cable stem. All Unistrut cable clamp mounting rail and feeder cable clamps are to be checked for tightness prior to energising the unit.

Figure 5 – An installed stem cap



5.4.3 Spare units

Any unit without a cable connected to its connection stems shall be fitted with a set of stem caps (refer Drawing no. 073667).

5.5 Installation in an indoor substation

Installation in an indoor substation may require the following modifications to the switchgear. The two (2) types of indoor substations (basement and cable trench) require different mounting arrangements. A basement substation is provided with a penetration which the switchgear sits over. The switchgear is then bolted to the floor using dynabolts or an equivalent.

A cable trench substation requires the switchgear to be mounted on a support plinth, which is in turn mounted in the 900mm wide trench. The support plinth is available as stock code SP1707 and is set out in Drawing no. 050650.

A perspex dust cover is to be installed on the top of the frame when the switchgear is installed in an indoor substation.

5.6 Anti-condensation heaters

Anti-condensation heaters should be installed in areas where past problems have been experienced (typically in switching stations where there is no transformer). Where required an anti-condensation heater and thermostat shall be fitted to the switchgear frame (refer to Drawing no 078559 for details of installation).

5.7 Accessories

5.7.1 Earthing

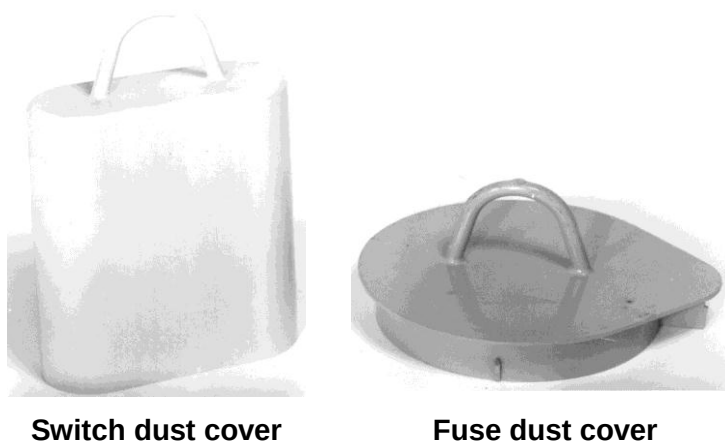
There are two (2) earthing devices, feeder cable earthing and transformer cable earthing. The earthing devices are suitable only for the earthing of cables. Busbar earthing is not possible. Earths cannot be applied without the removal of the respective switch caps for feeder cable earthing, or fuse and caps for transformer cable earthing.

Note: Earthing and switching functions can be carried out only by authorised employees (refer System Control Branch).

5.7.2 Dust cover

Fit dust covers whenever a switch or fuse is removed.

Figure 6 – Switch and fuse dust covers



5.7.3 Manual short circuit indicators

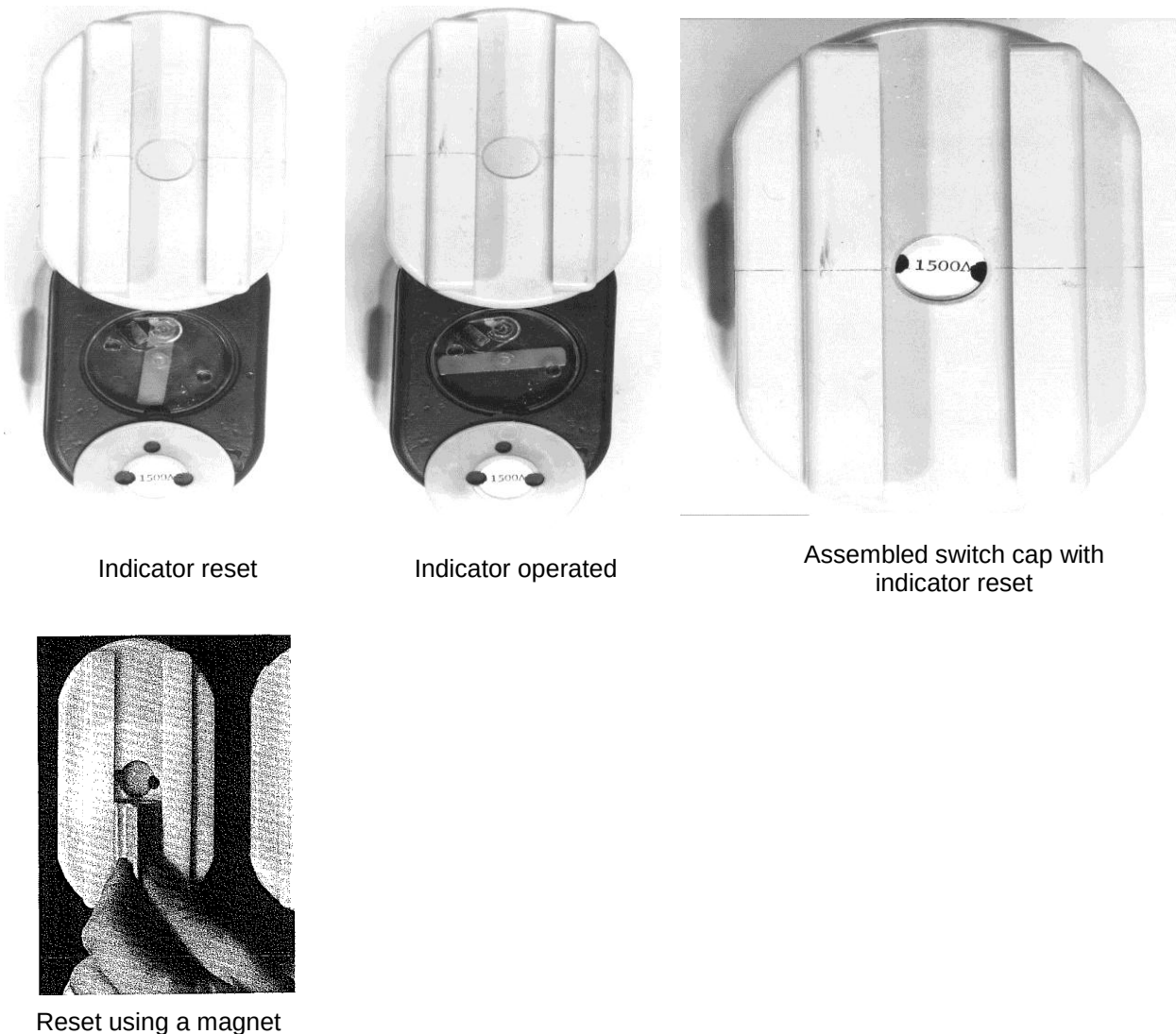
Indicators will be fitted at the discretion of the System Control Branch. On the front side of the switch caps, a short circuit indicator can be fitted to indicate whether or not a short circuit current has passed the respective switch.

The indicator consists of a permanent magnet with a rotatable flag. In both the reset position and the operated position, the flag is kept in place by the magnet so that the indicator is insensitive to mechanical vibrations or shocks.

When a short circuit current passes the switch cap, the magnetic field created causes the flag to turn to a position opposite two (2) openings in front of the switch cap. To enable this indication to be more clearly observed, the flag has been made of a reflecting material.

The flag indicator can be reset by means of a permanent magnet. The response value is factory set at 1500A RMS symmetrical. No adjustment can be implemented on site.

Figure 7 – Operation of manual short circuit indicator



5.7.4 Electronic short circuit indicators

Effective May 2012, electronic short circuit indicators (eSCI) will be installed on feeders identified by Systems Control. The eSCI is supplied by Eaton Industries Pty Ltd. The eSCI has no battery but uses the energy of the electrical field around the Magnefix cap. When the current exceeds the set value, the movable flap with a permanent magnet will turn and the fluorescent orange side of the flap will be visible.

The eSCI is self-resetting as it will reset in five (5) minutes (a black flap will be visible) after the supply is restored. Setting currents of 1000A and 450A are used by Endeavour Energy.

- When the eSCI is reset, it will show a black indication.
- When installing an eSCI, a white insulating cap shall be used.
- Refer to document no. 2991.142 Exchanging a short circuit indicator for the installation instructions.
- Refer to the document no. 3.6.2 Holec Short circuit indicator Magnefix, for further information of the eSCI.

Figure 8 – Front and back view of an eSCI



Figure 9 – White insulating cap



Figure 10 – An installed eSCI

5.7.5 Stock codes

Stock codes for accessories that is required for operation and maintenance are listed in the table below.

Table 2: Stock codes

No.	Stock code	Product description	Part no.
1.	1547173	Spring plate for 1-phase switch cap	3048.031
2.	1547181	Spring plate for 3-phase switch cap	3048.548
3.	1547199	Plastic clip spring holder for switch cap	3681.520
4.	1547207	Protective cap (white) for switch cap	2685.157
5.	1547215	Fixed main contact	2682.486
6.	SC10015	Fuse cover c/w O ring	SD/A/0041/C
7.	SC14266	Switch cap	2683-497
8.	SC15572	Fuse cap complete	2683-274
9.	SD 11490	Dust protective top	432-2006
10.	SD 11512	Dust protective side cover	432-0001
11.	SP13349	Cable plate support	904-0001
12.	SK 10460	Jumper cable transformer end	502-0024
13.	SH10336	Single switch operating handle	3681-074
14.	1551720	3 phase conversion kit	913.1010
15.	1553445	Cable box 16 -300mm ² , universal for use with PILC cables	3683.304
16.	1553452	Large O ring for cable box	3027.396

17.	1553460	Small O ring for cable box	3027.428
18.	1553478	Sealing plug for cable box	3681.900
19.	1553486	Nylon stopper for cable box	3681.901
20.	TBA	Set of 1000A electronic short circuit indicator (3 units)	MD4_ELEC_SCI000
21.	TBA	Set of 450A electronic short circuit indicator (3 units)	MD4_ELEC_SCI450
22.	TBA	White insulating cap to suit short circuit indicator	2685.155

5.8 Principles of construction and operation

Figure 11 – Switch isolator fully closed (main contacts and arcing contacts closed)

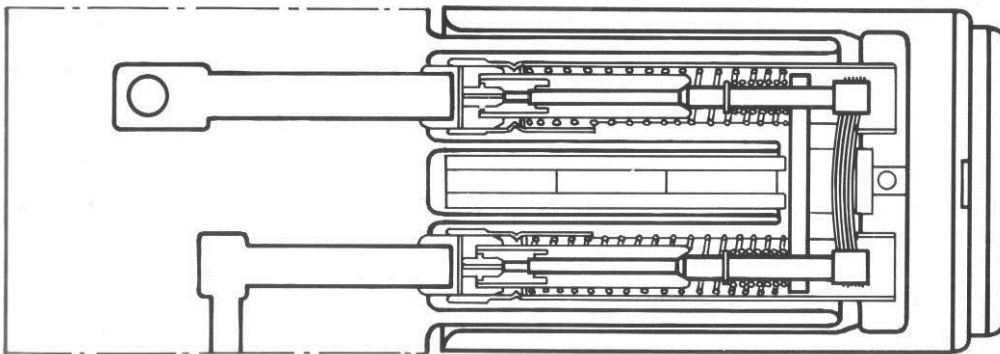
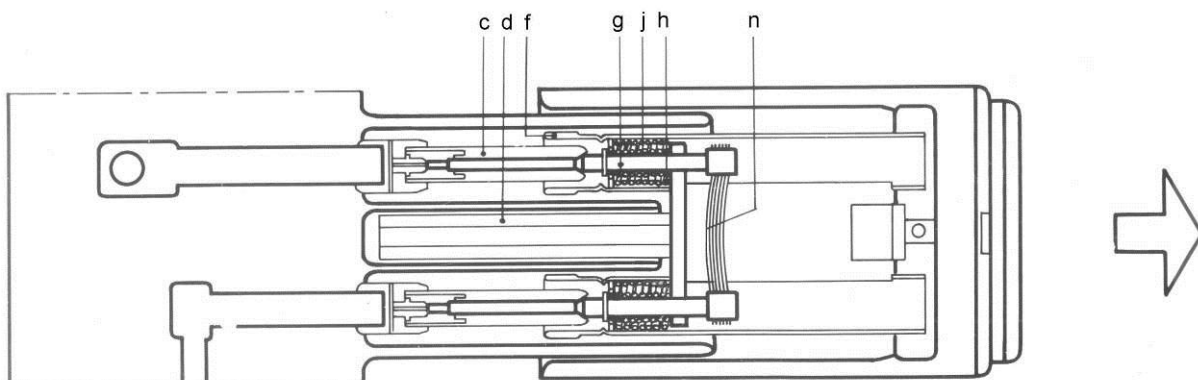


Figure 12 – Switch isolator opening (main contacts opened and arcing contacts closed)

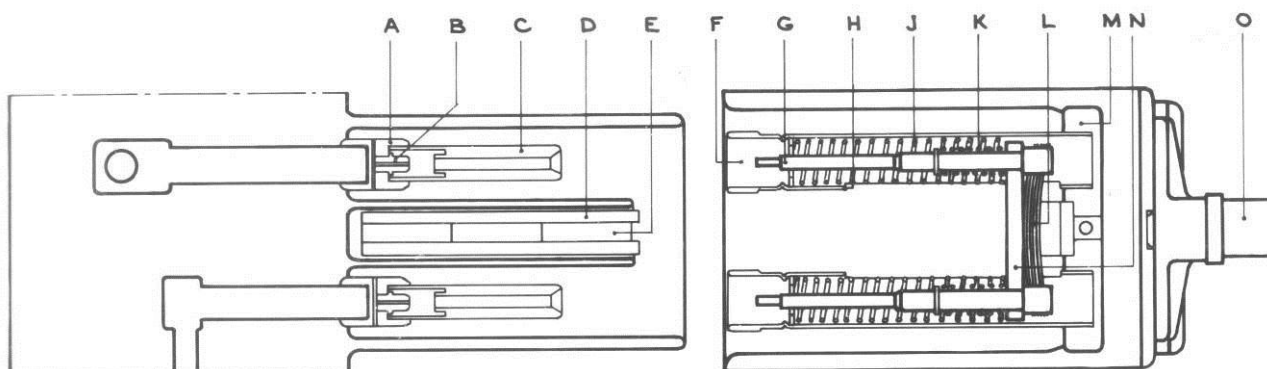


When opening:

- 1) The switch cap with main contacts (f) is pulled back by way of the operating handle, charging interrupter springs (j).
- 2) Arcing contacts (g) remain closed since the ferromagnetic plate (n) holds these contacts in their position.
- 3) When the switch cap is pulled back further, the ferromagnetic plate is finally pulled through two (2) stops on the main contacts (h) and off pole plates (d).
- 4) Interrupter springs discharge and the arcing contacts are pulled out of the arcing chambers (c) with the required speed, independent of the operator.

Note: Since the switch cap is completely removed during opening, a clearly visible separation of the contacts is implied.

Figure 13 – Switch isolator fully opened (main contacts and arcing contacts opened)



Fixed portion

- A - Fixed main contacts
- B - Fixed arcing contacts
- C - Arcing chamber
- D - Pole plates
- E - Ferroxdur magnets

Switch cap

- F - Moving main contacts
- G - Moving arcing contacts
- H - Stops
- J - Interrupter springs
- K - Springs for contact pressure

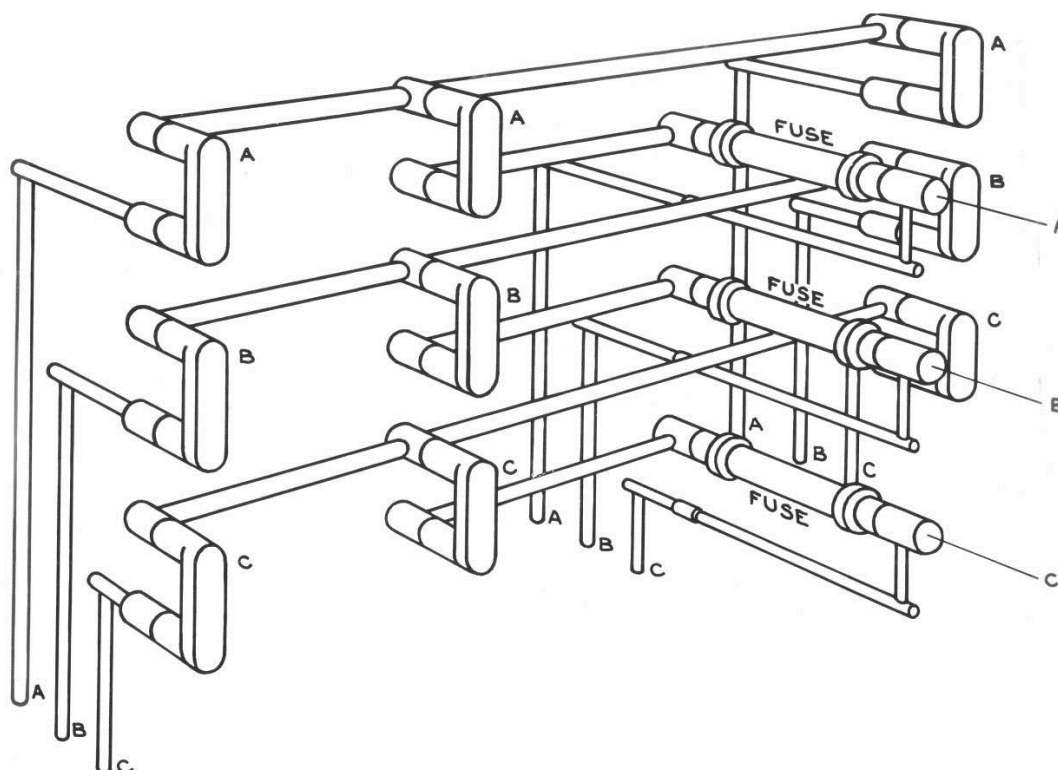
Switch cap

- L - Flexible conn. between arcing contacts
- M - Conn. block between main contacts
- N - Ferromagnetic plate
- O - Operating handle (removable)

5.8.1 Arrangement of busbars (ring main unit – MD451)

Letters A, B and C indicate phase identification.

Figure 14 – Arrangement of busbars



5.9 Operating notes

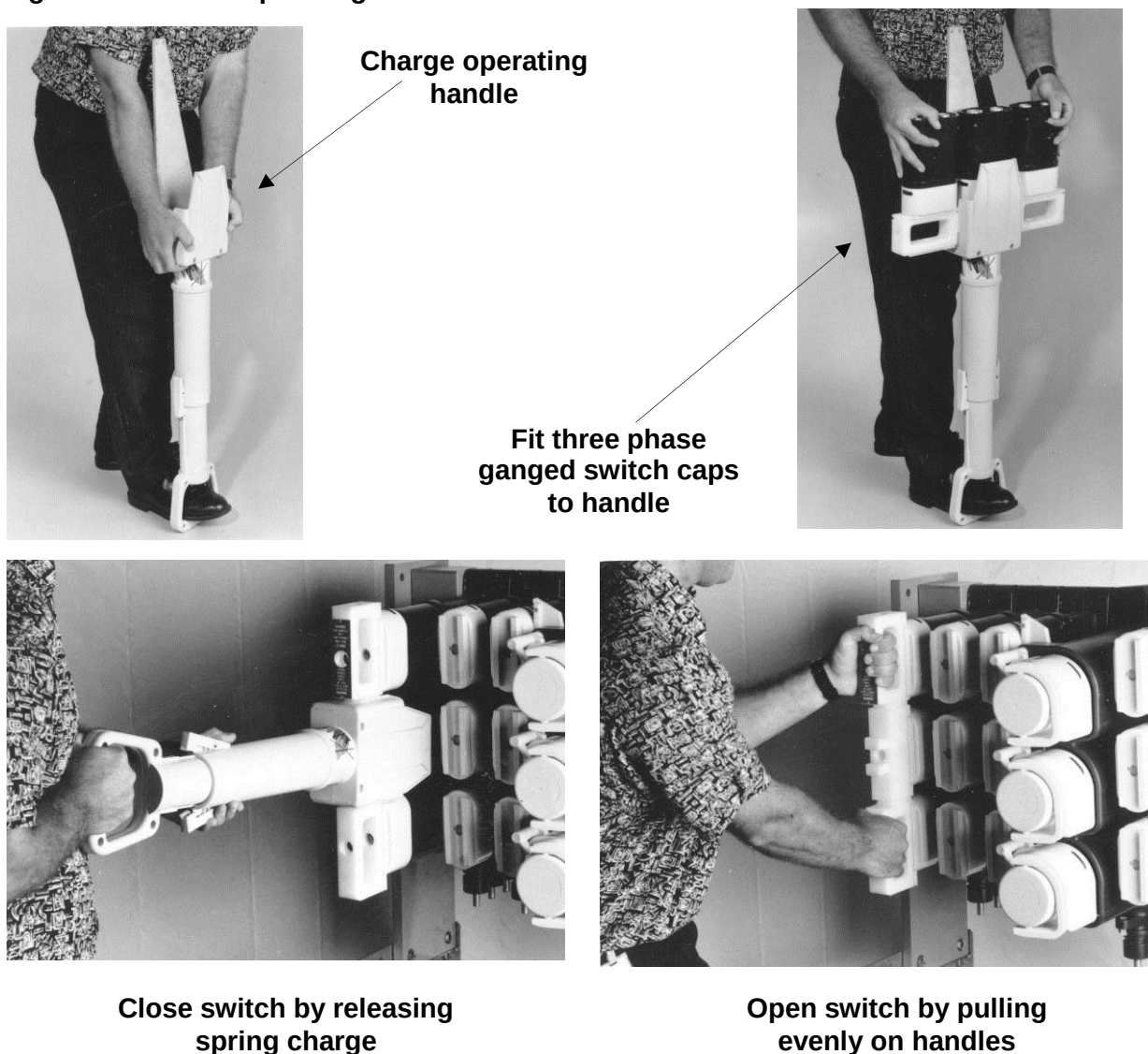
5.9.1 Switching

Switching operations must be carried out by authorised personnel only. Refer to Division Procedure (Network) GNV 1061 – Transmission and High Voltage Distribution Network Switching.

Switches can be single phase (older style) or are ganged together for three phase operation using the bridging piece shown in the following photos. This is supplied with each switchboard.

Switches can be removed by applying suitable force. Closing must be carried out using the spring loaded three phase operating handle.

Figure 15 - Use of operating handle



5.9.2 Insertion of fuse links

In a transformer unit (consisting of a switch unit and fuse holder unit) an interlock ensures that the caps of the fuse holders can be fitted or removed only when the corresponding switch caps have been removed. The section below sets out the sequence for removal of fuse links.

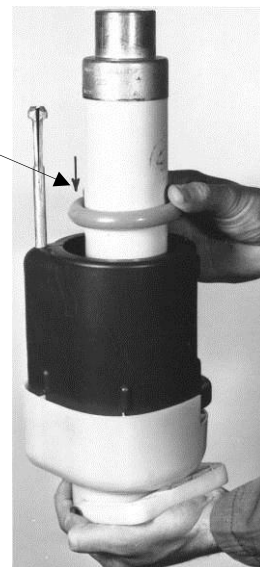
Note: It is not necessary for the operation of the switchgear to use striker fuse links and, therefore, indicator type should be used whenever stock permits.

- 1) Remove the switch caps from the corresponding switch.
- 2) Turn the Interlock to the left.
- 3) Remove the caps from the fuse holders.
- 4) Insert the fuse links without using pressure, that is, against a wall or floor. If GEC fuse links are used (small diameter) fit spacer ring so that ring is just inside the open end of the fuse holder cap.

Figure 16 – Inserting a fuse link



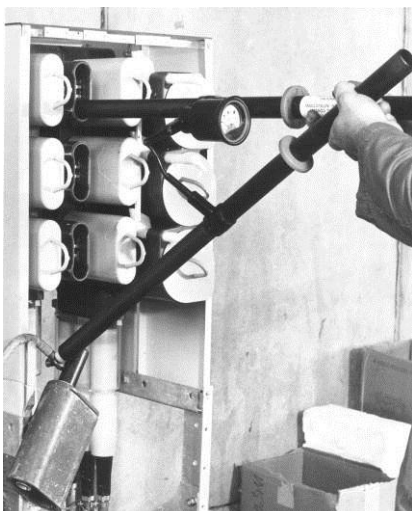
Spacer ring



5.9.3 Testing if live

The manufacturer's special indicating probes should be used to test if live.

Figure 17: Using special indicating probes for testing



5.9.4 Earthing

Earthing should be carried out only with the manufacturer's approved earthing equipment.

Figure 18 – Earthing equipment accessories

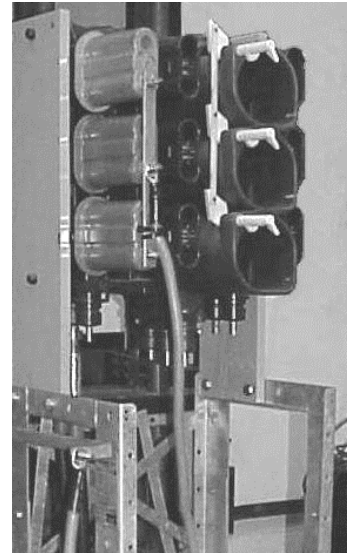


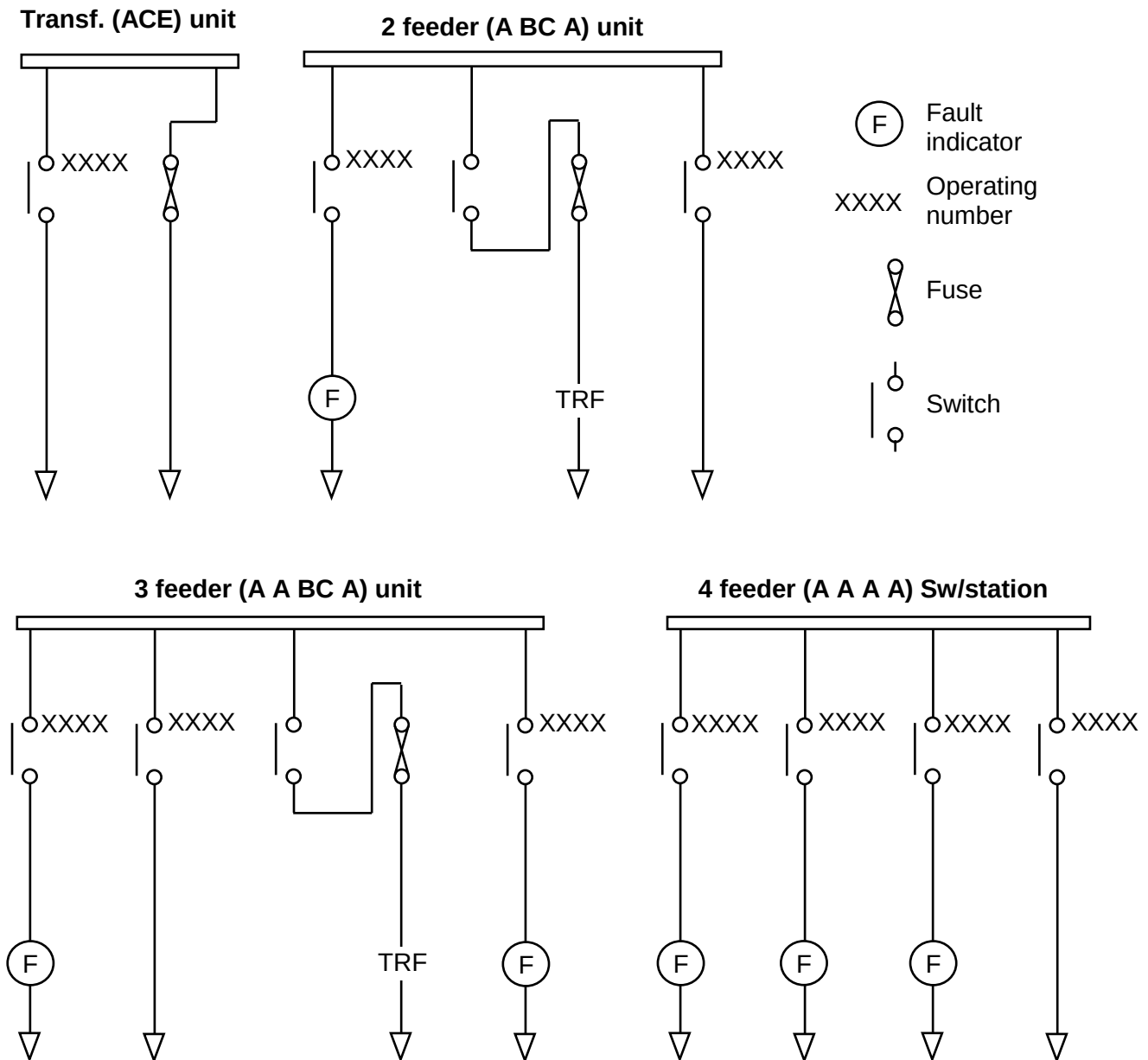
Figure 19 - Earth applied on switchgear

Note: If striker pins are fitted, links should be inserted so that the pin is at the opposite end to the cap.

- 1) Push the cap and fuse link into the fixed portion **gently**, as an impact could unknowingly fracture the internal fuse elements.
- 2) Turn the interlocks to the right.
- 3) Replace switch caps.

5.10 Operating single line diagrams

Figure 20 - Single line diagrams



Note: A 3 feeder switching station would be the same as a four (4) feeder unit but with one (1) less switch and fault indicator.

5.11 Maintenance

Substation Maintenance Instruction SMI 212 – HV switch and switch fuse units for the detailed maintenance procedure of Holec MD4 12kV switchgear.

5.12 Disposal

Refer to Company Procedure (Procurement & Logistics) GSU 0012 – Selection and Approval of a Disposal Method when disposing dismantled or failed switchgear.

5.13 Drawings

The following drawings form part of this instruction:

Drawing	Amend.	Title
050650	G	Indoor sub Holec switchgear trench mounted plinth fabrication and installation detail
063608	B	Holec switchgear base support angle fabrication detail
073667	C	Cap for installation on spare cable stems fabrication detail
076348	C	Padmount substation Holec switchgear mounting plinth
076349	F	Padmount substation switchgear and toe clamp layout
078559	B	Heater & Thermostat For Krone Switchgear (Holec also)
079664	B	Indoor sub Holec switchgear trench cover plate fabrication and installation detail

6.0 AUTHORITIES AND RESPONSIBILITIES

Chief Engineer has the authority and responsibility for:

- approving this instruction; and
- approving variations from the requirements of this instruction.

Manager Primary Systems has the authority and responsibility for:

- endorsing this Substation Design Instruction; and
- recommending changes and revisions to this Substation Design Instruction.

Network Substations Manager has the authority and responsibility for revising and updating this Substation Design Instruction in accordance with company policy and procedures.

Regional managers have the authority and responsibility for **confirming** that all designs carried out by regional employees conform to the requirements of this Substation Design Instruction.

Manager Network Connections has the authority and responsibility for **confirming** that all designs carried out by Level 3 Accredited Service Providers (ASP) conform to the requirements of this Substation Design Instruction.

Accredited Service Providers have the authority and responsibility for **determining** the latest issue of any instruction or drawing relevant to or listed in this manual and that it is available and used during the design of any project.

7.0 DOCUMENT CONTROL

Documentation Content Coordinator : **Network Substations Manager**

Documentation Distribution Coordinator : **Branch Process Coordinator**