

Substation Design Instruction

ASEA Brown Boveri RGB12 12kV switchgear

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Substation Design Instruction

PRIMARY SYSTEMS

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SDI 206 ASEA BROWN BOVERI RGB12 12KV 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 ASEA Brown Boveri RGB12 12kV switchgear.

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of ASEA Brown Boveri RGB12 12kV switchgear. This instruction deals only with the standard units that were previously approved for use by Endeavour Energy in the distribution network as detailed in **Error! Reference source not found.**

The scope of this document provides reference to the various lifecycle stages of the switchgear and therefore shall be read in conjunction with the references of section 3.0 and:

- Mounting and construction requirements: refer Mains Construction Instruction MCI 0006 – Underground distribution: Construction standards manual;
- Earthing design, construction and testing: refer Earthing Design Instruction EDI 100 – Distribution earthing design, construction and test;
- Specification of new equipment: refer Equipment Technical Specification ETS 0068 – Distribution indoor and padmount substation 12-24kV switchgear;
- General details and minimum design requirements: refer Substation Design Instruction SDI 101 – Distribution substation general details and minimum requirements and Mains Design Instruction MDI 0028 Underground distribution network design;
- Testing and commissioning: refer Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems;
- Ongoing maintenance requirements: refer Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment; and
- Standard drawing requirements: Standard Asset Data SAD 0001 – Project drawing standards.

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

This switchgear is currently being replaced under Endeavour Energy's Capital Refurbishment program due to its poor reliability.

Extension of this switchgear to cater for new feeders is no longer allowed. If more HV feeders are required, the switchgear shall be replaced or a separate switchboard shall be installed.

All dismantled switchgear that is in good condition is to be tested by Transmission Technologies and, if it passes the tests, is to be kept as spares for fault and emergency work.

Units that do not pass the tests are to be disposed of according to Company Procedure GSU 0006.

3.0 REFERENCES

Company Policy (Network) 9.1.7 – Commissioning Network Electrical Assets
 Company Policy 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 GSU 0006 - Disposal of surplus goods and equipment
 Equipment Technical Specification ETS 0068 – Distribution indoor and padmount substation 12-24kV switchgear
 Equipment Technical Specifications (ETS) ETS 0071 - Distribution fuses
 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
 Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
 Substation Maintenance Instruction SMI 203 - Sheet steel enclosed switch and switch fuse units
 Company Network Management Plan December - 2013 Review
Work Health and Safety Act 2011 (NSW)
 Work Health and Safety Regulation 2011
 Australian Standards AS 2650 - HV AC switchgear and control gear – common requirements
 ENA National Electricity Network Safety Code (Doc. 01-2008)
 AS 1033.2 - High voltage fuses (for rated voltages exceeding 1000V) Current limiting (powder filled) type
 Branch Workplace Instruction WCB 2024 - Brown Boveri Type RGB Switchgear
 Branch Workplace Instruction WRG 3023 - Control of RGB12 switchgear
 Operating Instructions - Type tested metal-enclosed Compact Switchgear Type RGB 12/13.8 for 12 and 13.8kV

4.0 DEFINITIONS AND ABBREVIATIONS

A full list of definitions is contained in SDI 101

5.0 ACTIONS

5.1 General

5.1.1 Introduction

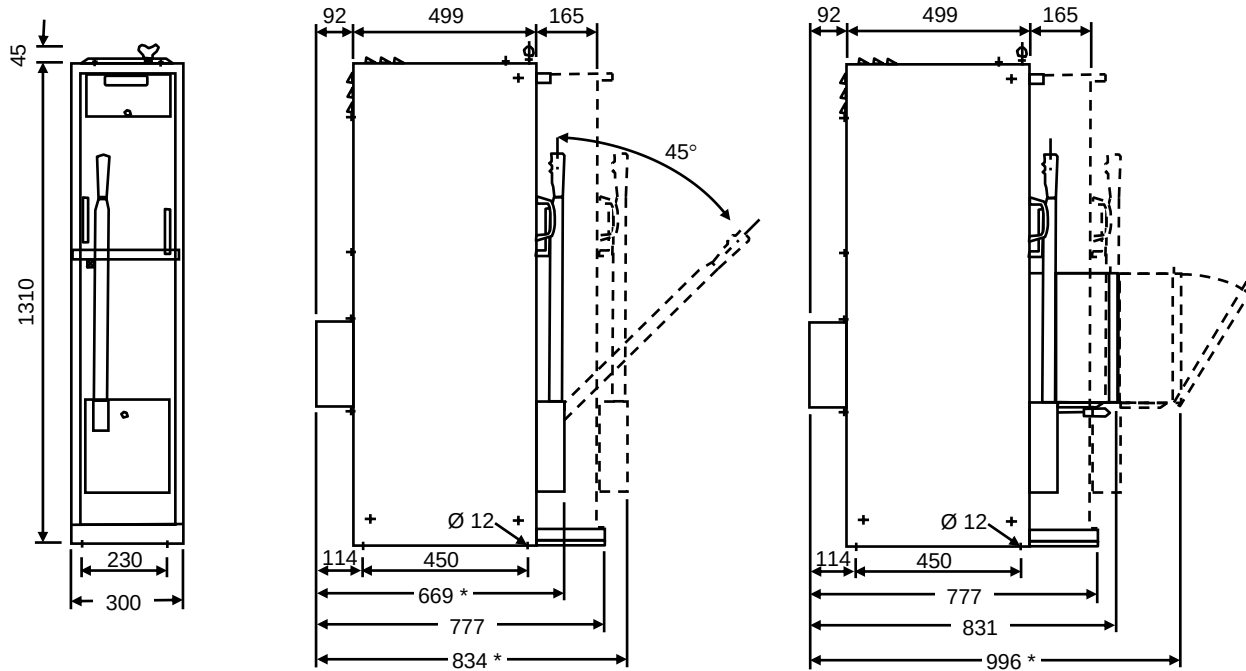
ASEA Brown Boveri RGB12 equipment is cast resin, air and solid insulated, sheet-steel, enclosed indoor HV switchgear. The switches and fuse-switch combinations are stored spring energy, three-phase, gang-operated, and mounted in withdrawable trucks. ASEA Brown Boveri RGB12 switchboards are extendable in the field. It should be noted, however, that extension to the left-hand side of existing switchboards:

- **Is not** possible adjacent to a busbar cabling housing.
- Is possible on all other housings by replacing the left hand end busbar with a left-right extension busbar.

5.1.2 Product approval and stock codes

Endeavour Energy no longer approve or purchase these units.

5.1.3 Dimensions, weight and description



Front view

Switch (manual spring charge)

Fuse switch combination

Switch (motor spring charge)
Add 200mm to dimensions shown *

Figure 1 - Dimensions

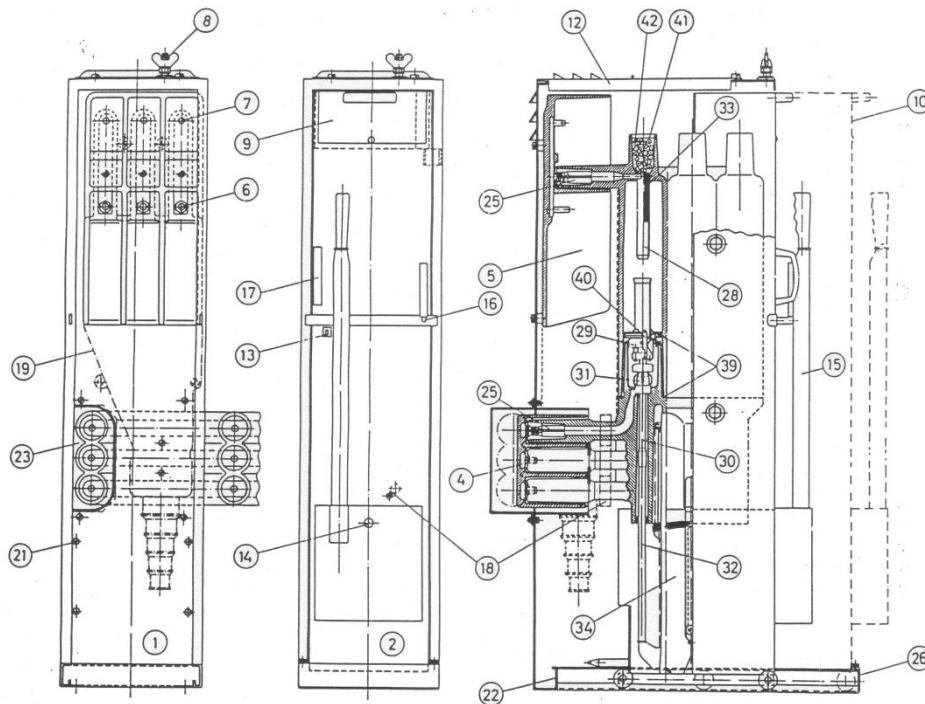


Figure 2 - Switch unit

1	Fixed housing
2	Switch truck
3	Fuse switch combination truck
4	Busbar
5	Cable terminal board
6	Cable terminals
7	Cable earthing stud
8	Direct earthing terminal
9	Earthing access shutter
10	Isolated position
11	Fuse links and tripping device
12	Pressure relief cover
13	Position indicator
14	Manual trip knob
15	Spring charge operating handle
16	Interlock handle
17	Truck withdrawal handle
18	Short circuit indicator (if fitted)
19	Cable terminal box (not Endeavour Energy standard)
21	Cable sealing end fixing holes (not Endeavour Energy standard)
22	Cable support bracket
23	Busbar contacts
24	Hinged cover interlocking knob
25	Upper (cable) and lower (busbar) tulip contacts
26	Cross link (remove to fully withdraw truck)
27	Sliding earth contact
28	Main fixed contact tube
29	Movable main tulip contact
30	Movable contact rod
31	Fixed sliding contact
32	Insulating rod
33	Helical gas cooler
34	Operating mechanism

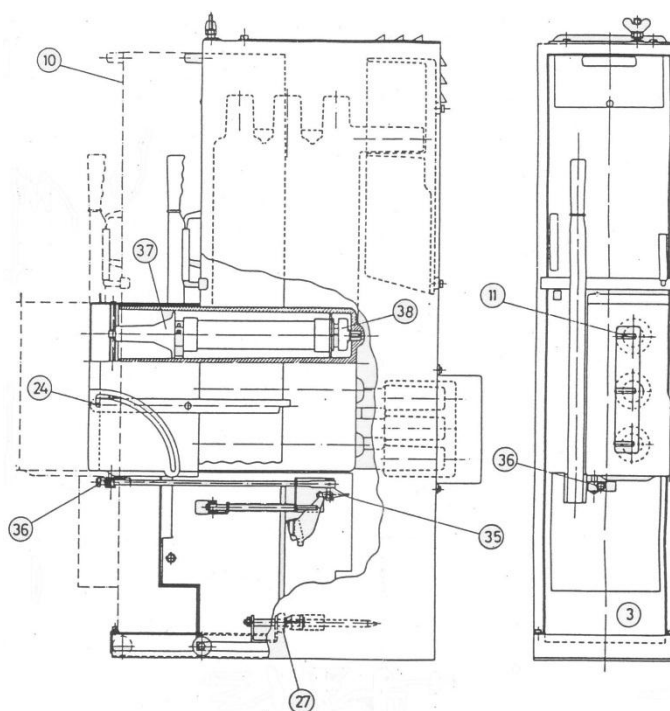


Figure 3 - Fuse unit

35	Spring operated tripping device
36	Automatic tripping device
37	Fuse handle and clamp contact
38	Tulip contact (fuse)
39	O rings (lower insulation block and pistons)
40	Centre pin (main tulip contact)
41	Perforated washer
42	Steatite coolers

5.1.4 Technical specification

Insulation level (all equipment)		
Rated voltage		12/13.8kV
50Hz one (1) minute power frequency withstand	Phase to earth	45kV rms
	Across isolating distance	60kV rms
1.2/50 μ s lightning impulse withstand (BIL)	Phase to earth	95 kVp
	Across isolating distance	110 kVp
DC 15 min. withstand		25 Kv
Partial discharge @ 8kV		5pC 1
Partial discharge @ 13kV		10pC 1
Switch and busbar		
Rated normal current		400 A 2
Rated current of busbars		500 A
Rated short time withstand current for one (1) second		25 kA 2
Rated peak withstand current		70 kA 2
Rated short circuit making current - cable feeder		50 kA
Rated breaking capacity		
- Mainly active load at 0.7pf		800 A
- Closed loop at 0.3pf		400 A ³
- Cable charging		25 A
- Transformer off load		16 A
- Max load breaking capacity @ 0.3pf		240 A
Motor spring charge detail		
- Voltage		110V DC
- Motor current rating		2.1 A
- Spring charge operating time		22 seconds
- Operating time to open		70 m/s
Fuse carrier		
Rated normal current		100 A
Rated peak withstand current		70 kA
Acceptable power		75 Watts ⁴
Will accommodate fuse links to the following dimensions :		
- Overall length		360 +2mm to - 3mm
- Overall diameter		88mm max.
- Contact ferrule diameter		45 $\pm$ 1mm
- Contact ferrule length		34 $\pm$ 1mm
Will accommodate current limiting fuse links to:-		AS 1033.2 - fuse link type I

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

² These values are for switches and relate only to fuse switch combinations when they are fitted with solid links. When fitted with fuse links, the fuse characteristics would apply.

³ A circuit in which both sides of the switch remain live after breaking, and in which the voltage appearing across the terminals is substantially less than the system voltage.

⁴ The power dissipation of the fuse links must not exceed the power acceptability of the fuse-holder. The 75 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.

5.1.5 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 SAD0001.

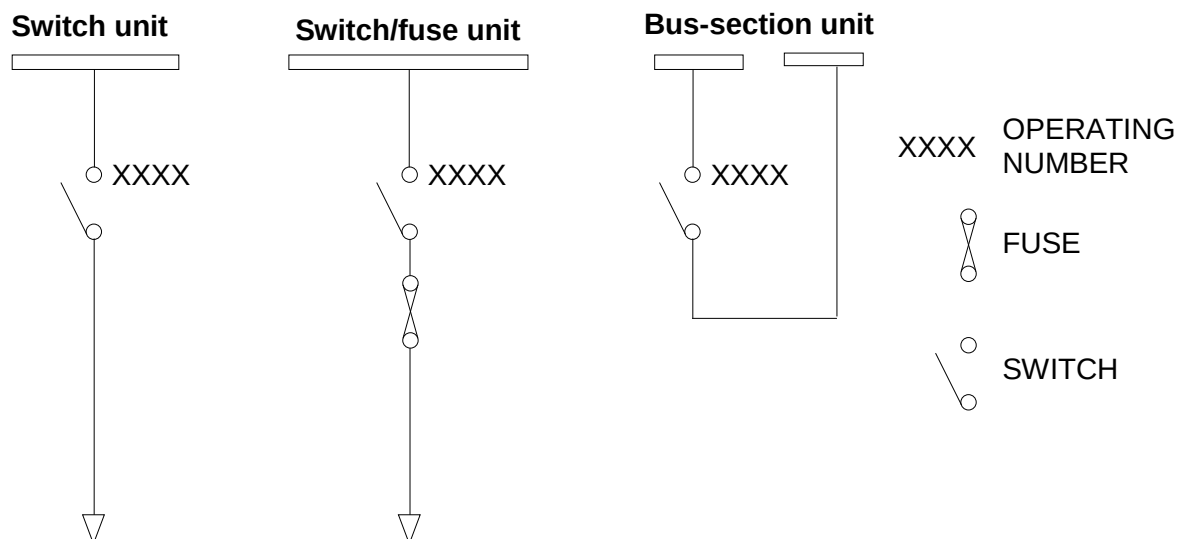


Figure 4 - Single line diagram

5.1.6 Gas indicator

There is no gas in this switchgear it is cast resin, air and solid insulated in a sheet-steel enclosure.

5.1.7 Accessories

5.1.7.1 Earthing device

Earthing of the cable is done by means of a special earthing device (see Figure 5 - Earthing leads) which is connected to the earthing terminal on the top of the cable termination block.

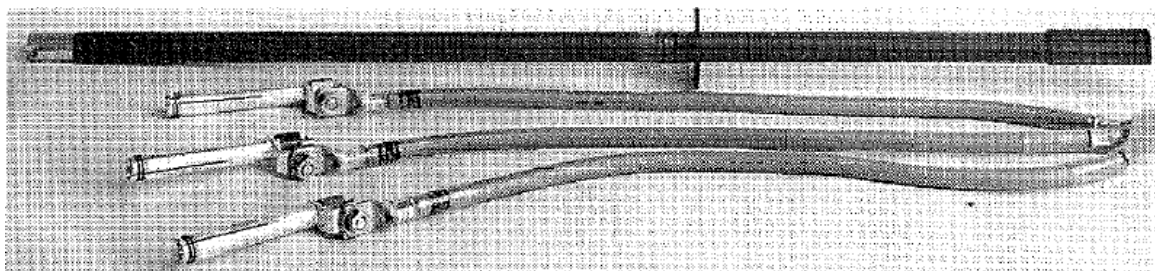


Figure 5 - Earthing leads

5.2 Installation

5.2.1 General

RGB12 switchgear is designed for installation in an indoor substation/switching station. Anti-condensation heaters should be installed. Problems have occurred in the past from condensation and tracking where heaters were not fitted. A thermostat shall also be fitted to the switchgear.

Three (3) basic withdrawable trucks are purchased: a manual spring charge switch, a manual fuse-switch combination, and a motor spring charge switch.

5.2.2 Switch (manual spring charge)

The switch consists of three (3) single air break poles, which are gang operated by closing and opening springs. The poles are mounted in line, one behind the other, and are fully epoxy insulated.

5.2.3 Fuse-switch combination

In addition to the three (3) pole switch described in clause 5.2.2, the units are fitted with epoxy insulated fuse carriers.

Fuse carriers are housed in a metal enclosure fitted to the front of the truck; access to the fuses is gained by a hinged metal cover, which is fitted with a Perspex window. The hinged cover is interlocked so it cannot be opened until the switch is withdrawn into the isolated position.

The carrier will accommodate fuses as specified in clause 5.1.4, which must be complete with striker pins, as the fuse-switch combination is designed to trip all three (3) poles should one or more fuse links rupture.

5.2.4 Switch (motor spring charged)

The switch is as described in clause 5.2.2, but with the addition of a motor and gearbox to automatically charge the operating springs and solenoids to allow remote closing and opening.

Refer to 5.1.4 for details of voltages and times.

When the truck is plugged into the service position, the circuit is arranged such that the motor will immediately charge the springs while the 110V DC control voltage is available (a warning label should state this on the front of the truck). Once charged, the springs have sufficient energy to close and open the switch, but reclosing cannot occur until after 22 seconds, which is the time required for the motor to re-charge the springs.

5.2.5 Fixed housings

There are two basic housings:

- Switch or fuse-switch combination (fitted with cable terminal board).
- Bus section or busbar cabling.

5.2.6 Switchboard assembly

The switchgear is to be assembled on a support plinth (refer Drawing no. 044473 for trench access, or Drawing no. 049739 for floor penetration access).

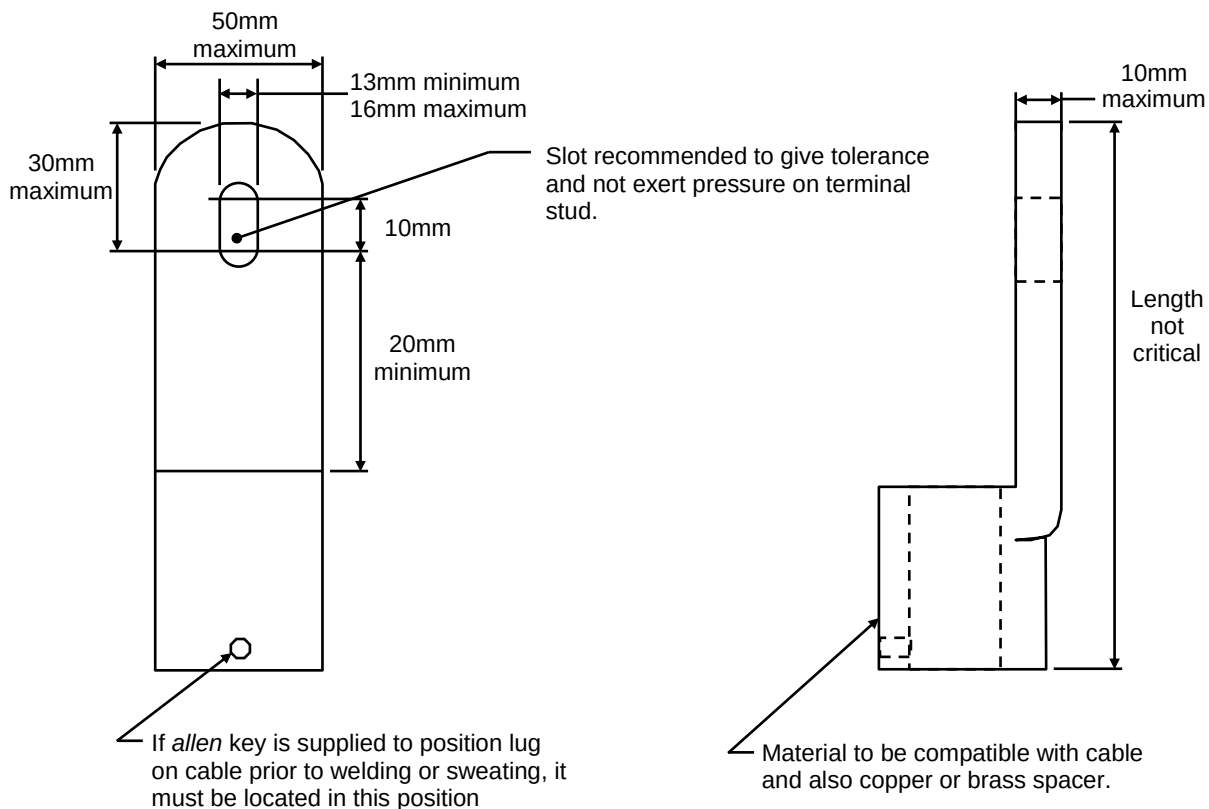
5.2.7 Cabling

5.2.7.1 Feeder

Max cross-section each phase 300mm²
Refer Drawing no. 015058.

5.2.7.2 Termination hardware (cable lugs)

To ensure that cable lugs are suitable for terminating on RGB12 cable terminal board, they are to comply with the following limiting dimensions:



Note: Torque setting to be used when connecting cables to the 12mm cable termination studs is a minimum of 52Nm (38ft/lb) and a maximum of 57Nm (42ft/lb).

5.2.7.3 Transformer

Flexible cable is used to couple the switchgear to the transformer. The cable provides fast and efficient connection/disconnection without specialised cable jointing techniques. The technical detail for this cable is:

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:	4000mm
Minimum bending radius:	200mm

5.3 Operation

5.3.1 Interlocks

5.3.1.1 General

The following interlocks should be provided to prevent incorrect operation and injury to personnel:

- Truck can only be withdrawn from, or enter into, housing with switch in the OPEN position.
- Truck must be withdrawn to the ISOLATED position before the fuse housing cover can be opened.
-

5.3.1.2 Earthing shutter

- Truck must be withdrawn to the ISOLATED position before the earthing access shutter can be lowered.
- Earthing access shutter cannot be removed with truck in isolated position (refer Drawing no. 044054).
- Earthing access shutter to be suitable for a padlock (refer Drawing no's 044049, 044053).

5.3.1.3 Handle to be suitable for a padlock (refer Drawing no's 044055, 044056)

- Springs cannot be charged with a tripping impulse on.
- Trucks will enter other housings of same type truck (refer Drawing no. 042402).
- Truck will not enter other housings of alternate type truck (refer Drawing no.042402).

5.3.2 Operation

5.3.2.1 Switch unit - Manual spring charge

- **Closing** Switches are closed by pulling the spring charge operating handle four (4) times. When the lever is pushed back after the last pull, the switch closes.
- **Opening** Pushing the manual trip knob releases a spring-operated tripping device.

5.3.2.2 Switch unit - Motorised spring charge

Electrical operation - can be local or remote.

Mechanical operation – (in an emergency). In an emergency, the springs can be manually charged with an operating handle. However, the following should be noted:

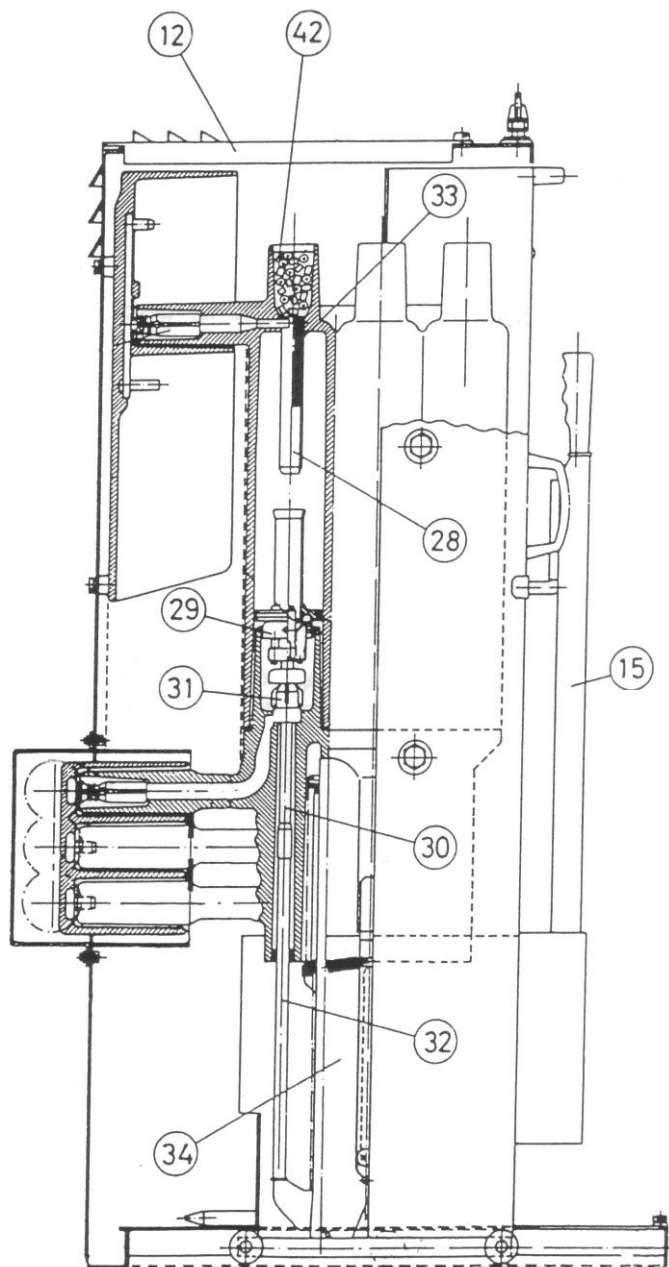
- The supply to motor should be isolated.
- The linkage pin must be removed and linkage arm swung clear of charging mechanism to avoid damaging the gearbox (this can be done without removing the cover).
- Manually charging can be carried out as in clause 5.2.2, but closing is not automatic. The manual close button must be operated.
- When re-connecting gearbox linkages, the cover may have to be removed.
- Supply to the motor should not be re-installed until linkages are connected.

5.3.3 Principles of operation

The arc-extinguishing mechanism is fitted with a contact system consisting of a main fixed contact tube (28), and a movable main tulip contact (29), fitted with a gas evolving nozzle. Both main contacts are fitted with copper-wolfram tips.

The main tulip contact with nozzle is fixed to the end of the movable contact rod (30), which is guided by the fixed sliding contact (31), and is attached to the operating mechanism through the insulating rod (32). The length of travel is 200mm.

During the opening movement of the switch, the piston part of the nozzle compresses the air in the lower part of the switch chamber. The air blast escapes through the movable main contact, the gas evolving nozzle, and the fixed main contact tube, to the top of the switch. The ionised exhaust from the arc quenching is cooled by means of a cooling system (33), in the switch exhaust outlets, before it is let out in open-air via steatite cooler (42), at the top of the cubicle (12).



The operating mechanism (34) has separate operating springs for opening and closing of switch. Both operating springs are charged at the same time:

- a) by the operating lever (15), which is pulled four times (through an angle of approximately 45°). When the lever is pushed back after the last pull, the switch closes; or,
- b) automatically, in the case of motor-operated version.

The switch closes when the electrical or manual close button is operated.

The switch is opened by pushing the manual trip knob or electrical trip button (in the case of motor-operated version), which releases a spring-operated tripping device. The operating mechanism is interlocked from being charged while a tripping command exists, and when the interlocking device of the truck is disengaged.

Both types of switches (with and without fuses) have identical arc-extinguishing chambers and operating mechanisms.

5.4 Drawings

The following drawings form part of this instruction:

Drawing	Amend.	Title
015058	D	6.35/11kV paper insulated multi-core metallic sheathed cable
042402	C	RGB12 truck interlock and stop bracket fabrication detail
044049	A	RGB12 cable earthing padlock detail
044053	A	RGB12 padlock tongue
044054	A	RGB12 extra drill removal stop earthing cover
044055	A	RGB12 assembly detail for padlocking
044056	A	RGB12 padlock tag detail
044473	F	RGB12 plinth trench type fabrication/installation detail
049739	D	RGB12 plinth recessed floor type fabrication and installation detail

6.0 AUTHORITIES AND RESPONSIBILITIES

General Manager Asset Management has the authority and responsibility for:

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

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

- endorsing this instruction; and
- recommending changes and revisions to this instruction.

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

Network Substations Manager has the authority and responsibility for revising and updating this instruction in accordance with Endeavour Energy's Policies and Procedures.

Regional managers have the authority and responsibility for checking that all designs carried out by regional employees conform to the requirements of this instruction.

Level 3 Accredited Service Providers have the authority and responsibility checking 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 and application of this standard.

7.0 DOCUMENT CONTROL

Documentation Content Coordinator : Network Substations Manager

Documentation Distribution Coordinator : Branch Process Coordinator