

Substation Design Instruction

Schneider (Nulec) RL-Series 12/24kV load break switch (LBS)

IMPORTANT DISCLAIMER

As the information contained in this publication is subject to change from time to time, Endeavour Energy gives no warranty that the information is correct or complete or is a definitive statement of procedures. Endeavour Energy reserves the right to vary the content of this publication as and when required. You should make independent inquiries to satisfy yourself as to correctness and currency of the content. Endeavour Energy expressly disclaims all and any liability to any persons whatsoever in respect of anything done or not done by any such person in reliance, whether in whole or in part, on this document.

Document no. SDI 222
Amendment no. 0

51 Huntingwood Drive, Huntingwood NSW 2148

Postal address: PO Box 811 Seven Hills 1730

Phone: 133 718 **Fax:** (02) 9853 6000



SUBSTATION DESIGN INSTRUCTION

PRIMARY SYSTEMS	Document no. Amendment no. Approved by Approval date	SDI 222 0 MPS 03 July 2014
------------------------	---	-------------------------------------

SDI 222 Schneider (Nulec) RL Series 12kV/24kV load break switch

CONTENTS

1.0	PURPOSE.....	3
2.0	SCOPE.....	3
3.0	REFERENCE	3
4.0	DEFINITIONS AND ABBREVIATIONS.....	4
5.0	ACTIONS	5
5.1	General	5
5.1.1	<i>Introduction</i>	<i>5</i>
5.1.2	<i>Product approval number and stock code</i>	<i>5</i>
5.1.3	<i>Technical features.....</i>	<i>6</i>
5.1.4	<i>Technical specifications</i>	<i>7</i>
5.1.5	<i>Gas leak indication.....</i>	<i>7</i>
5.1.6	<i>Internal arc venting</i>	<i>7</i>
5.2	Installation.....	8
5.2.1	<i>General.....</i>	<i>8</i>
5.2.2	<i>Supplied manufacturer items:</i>	<i>9</i>
5.2.3	<i>Control cubicle</i>	<i>9</i>
5.2.3.1	<i>Pole top control cubicle (PTCC).....</i>	<i>9</i>
5.2.3.2	<i>ADVC2.....</i>	<i>10</i>
5.2.4	<i>Auxiliary supply.....</i>	<i>10</i>
5.3	Operation.....	10
5.3.1	<i>Manual Operation</i>	<i>10</i>
5.3.2	<i>Remote operation</i>	<i>11</i>
5.3.3	<i>Switching operations.....</i>	<i>11</i>
5.3.4	<i>Position indicators.....</i>	<i>11</i>
6.0	AUTHORITIES AND RESPONSIBILITIES.....	11
7.0	DOCUMENT CONTROL	11
	Annexure 1: PTCC controller images and block diagram.....	12
	Annexure 2: AVDC2 controller images and block diagram	14

1.0 PURPOSE

To provide technical and reference information to assist with the safe design, installation, commissioning, operation and decommissioning of 22kV load break switch RL Series manufactured and supplied by Schneider Electric (previously known as Nulec Industries).

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of the approved RL series load break switch manufactured and supplied by Schneider Electric (formerly Nulec). This instruction is applicable only with the standard units approved for use by Endeavour Energy for use in the distribution network as set out 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: MCI 0005
- Location of isolation points on the network: MDI 0026
- Earthing design, construction and testing: EDI 100
- Specification for new equipment: ETS 0067
- General details and minimum design requirements: SDI 101 and MDI 0028
- Testing and commissioning: SDI120 and GNV1044
- Ongoing maintenance requirements: SMI101
- Standard drawing requirements: SAD 0001
- SF6 Management: EMS 0007
- Disposal: GSU 0012

This document should be read in conjunction with the manufacturer's installation instructions: Schneider Technical manual – RL Series Load Break Switch / Sectionalizer Version 28 and Schneider Operation manual – ADVC controller range.

3.0 REFERENCE

- Company Policy 9.1.7 - Commissioning Network Electrical Assets
- 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 Operations
- Company Policy 9.9.1 - Network Asset Maintenance
- Company Procedure GSU 0012 - Selection and Approval of a Disposal Method.
- Division Procedure GNV 1026 – Equipment Register
- Division Procedure GNV 1044 - Commissioning Network Electrical Assets
- Division Procedure GNV 1061 – Transmission and High Voltage Distribution Network Switching
- Division Procedure GNV 1062 – Granting dispensation from network standards
- Branch Workplace Instruction (Regional) WRG 0526 – Handling of SF6 (Sulphur Hexafluoride)
- Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test
- Equipment Technical Specification ETS 0067 - 11kV and 22kV enclosed load break switches
- Mains Construction Instruction MCI 0005 - Overhead distribution construction standards manual

- Mains Design Instruction MDI 0026 - Location of isolation points on the high voltage distribution network
- Protection Design Instruction PDI 4001 - Protection design principles
- Substation Design Instruction SDI 120 - Testing and commissioning for distribution systems
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
- Network Management Plan December 2013 Review
- ENA Doc 001-2008 National Electricity Network Safety Code
- *NSW Work Health and Safety Act 2011*
- *NSW Work Health and Safety Regulation 2011*
- AS/NZS 60265.1: 2001 - Switches for rated voltages above 1kV and less than 52kV
- Schneider Technical manual – RL Series Load Break Switch / Sectionalizer Version 28
- Schneider Operation manual – ADVC controller range
- Drawing no. 332021 – Overhead 11/22kV construction no. HLBS termination to load break switch with or without remote control

4.0 DEFINITIONS AND ABBREVIATIONS

ASP	Accredited Service Provider - Accredited Service Provider – a person authorised to work in the system and includes authorised external contractors and Endeavour Energy staff.
BIL	Basic Impulse Level – Insulation level designed to withstand surge voltage
CCT	covered conductor thick – Insulated overhead conductor
CT	current transformer
LBS	load break switch
LV	low voltage - A voltage normally exceeding 50 volts alternating current (a.c) or 120 volts direct current (d.c), but not normally exceeding 1,000 volts alternating (a.c) or 1,500 volts direct current (d.c).
HV	11kV or 22kV
PTCC	Pole top control cubicle
reasonably practicable	In relation to a duty to verify health and safety, means that which are, or were at a particular time, reasonably able to be done in relation to ensuring health and safety, taking into account and weighing up all relevant matters.
RMS	root mean square
SCADA	Supervisory control and data acquisition
SF ₆	sulphur hexafluoride – A greenhouse gas which commonly used as a dielectric medium
VT	voltage transformer
XLPE	cross linked polyethylene

5.0 ACTIONS

5.1 General

5.1.1 Introduction

The Schneider RL series load break switches (LBSs) are used in the distribution network to meet the network isolation policy cost effectively and improve power supply reliability. They are designed for use on overhead distribution lines operated at 11kV or 22kV. The LBS can be used as either a manual or remote controlled switch. The automated LBS have sectionalising capability.

Switching operations can be carried out manually by way of a hook-stick, and using automated control from either the on-site control panel or remotely by way of SCADA. Each automated LBS unit is supplied with either 11kV or 22kV voltage transformer (VT) for providing 28V auxiliary supply to the control cubicle.

5.1.2 Product approval number and stock code

The following LBSs from Schneider Electric have been approved for use in Endeavour Energy's 11kV and 22kV network as shown in Table 1. All units supplied after 15 December 2010 are rated at 27/16/150(kV/kA/BIL). Units provided previously were 27/12/150(kV/kA/BIL).

Table 1: Approved LBSs from Schneider Electric

Endeavour Energy Stock code	Rating (kV/kA/BIL)	Schneider part number	Description	Approval no.
1554757	27/16/150	420300200A (8800163100 - controller)	11kV network, automated load break switch with control box, cable leads, bushing covers, auxiliary supply VT 11kV/28V and controller	O20047A
1554765	27/16/150	420300200B (8800163100 - controller)	22kV network, automated load break switch with control box, cable leads, bushing covers, auxiliary supply VT 22kV/28V and controller	O20048A
1550342	27/16/150	400300200	11/22kV network, manual operated load break switch	O20049A

BIL = Basic Impulse Level, kV

The following LBSs with 12.5kA short circuit rating as shown in Table 2 were previously procured for use in the network but are not approved for future use.

Table 2: Previous LBSs supplied by Schneider Electric

Type/Part number	Rating (kV/kA/BIL)	Period of supply	Description	Total no. of units installed
Auto LBS/ RL27-LBS-FA-SF6- 27-12-150	27/12/150	Jan 2008 to Nov 2010	27kV auto operated enclosed switch	124
Manual LBS/ RL27-LBS-MR+- SF6-27-12-150	27/12/150	Aug 2010 to Nov 2010	27kV manually operated enclosed switch	77

5.1.3 Technical features

A summary of the main technical features of the Schneider RL series enclosed switch are:

- Tank made from 316 stainless steel and powder coated finish.
- SF₆ gas used as insulation and interruption medium.
- Uses a puffer interruption system.
- SF₆ gas tank is sealed for life.
- Operated manually by a hook stick for manual LBS or electrically by a DC motor through the controller for Automated LBS.
- Pole mounted control cubicle provides remote control and monitoring capability for Auto LBS.
- Equipped with automatic sectionalising logic for Automated LBS.
- Mechanical locking of LBS using manual lock which can be padlocked.
- Operations counter mounted behind the motor pack.
- Open and closed position is indicated by reflective green and red indicators, respectively.
- Low gas below safe working pressure locks the switch and prevents further operation.
- Low gas pressure warning flag is visible from the ground.
- Silicon rubber bushing boots are provided.

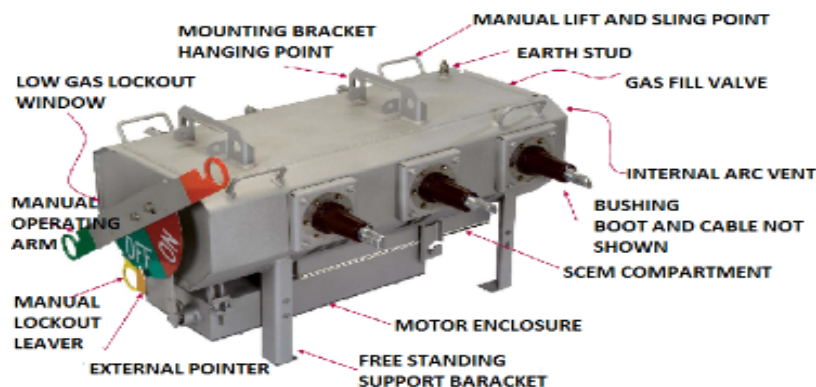


Figure 1: Schneider RL series LBS

Further description, operation and maintenance instructions on the LBSs are set out in manuals, guides and instructions provided by Schneider (Nulec). This instructions form an integral part of this document.

5.1.4 Technical specifications

The technical specification for RL27 LBS's approved for use on Endeavour Energy's network both previous and current approved units is as follows:

Table 3: RL 27 LBS specifications

Fault current rated unit	Previously supplied units (12.5kA unit)	Current units (16kA unit)
Applicable standards	AS/NZS 60265.1:2001	
Name plate RL-LBS - ## -SF6-####/####	27/12/150	27/16/150
Rated maximum voltage	27kV	
Rated continuous current (rms)	630A	
Fault make capacity (rms)	12.5kA	16kA
Fault make capacity (peak)	31.5kA	40kA
Mainly active load breaking capacity	630A	
No load mechanical operations	3,000	
Rated full load operations	600	
Short time current withstand (rms)	12.5kA / 4sec	16kA / 4 sec
Transformer magnetising current	22A	
Cable charging breaking current	25A	
Line charging breaking current	10A	
Power frequency withstand phase to earth (rms)	60kV	
Power frequency withstand across open contacts (rms)	60kV	
Impulse withstand phase to earth and phase to phase	150kV	
Impulse withstand across open contacts	170kV	
Insulation medium	SF ₆ gas	
SF6 nominal operating gas pressure @ 25 deg. C	105kPa Gauge	
Bushings	Silicone rubber	
Creepage distance	700 mm min.	
Maximum operating temperature	50° C	
Humidity	0-100%	
Altitude	1000m	
Weight of the tank	95kg	
Weight of controller	35kg	

5.1.5 Gas leak indication

The normal operating pressure of the SF₆ gas is 105 kPa Gauge at 25°C

A low gas pressure of 65kPa Gauge at 25°C in the switch tank will automatically inhibit operation of the switch. Low gas pressure is indicated by a mechanical indicator. A reflective red disc will be visible from ground level. An electronic low gas pressure alarm is available for all automated units.

5.1.6 Internal arc venting

If an internal arc fault condition occurs, a vent at the rear of the LBS tank ruptures to vent the over pressure, as shown in Figure 2.

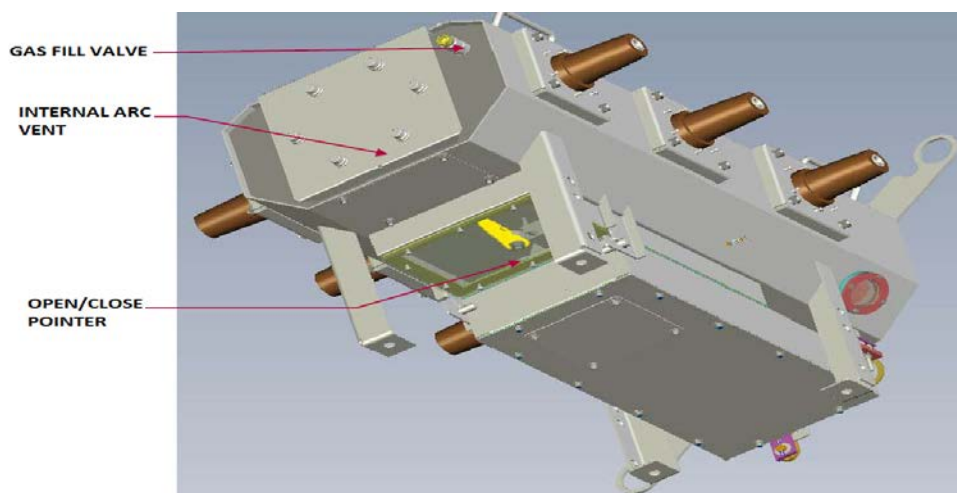


Figure 2: Internal arc vent

If a LBS has failed and all the SF₆ gas has been depleted, and is beyond repair, the LBS shall be disposed through the normal disposal methods in accordance with Company Procedure GSU 0012 – Selection and Approval of a Disposal Method. Where the SF₆ gas is still intact, the SF₆ gas must be removed prior to disposal in accordance with Branch Workplace Instruction WRG 0526 – Handling of SF₆ (Sulphur Hexafluoride).

5.2 Installation

5.2.1 General

Schneider RL series LBS's are designed for pole mounted installation in accordance with Mains Construction Instruction MCI 0005 – Overhead distribution construction standards manual and Drawing no. 332021. The LBS is built in accordance with Equipment Technical Specification ETS 0067 – 11kV and 22kV enclosed load break switches. Earthing of the LBS shall be performed in accordance with Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test, and commissioning performed in accordance with Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems.

Installation should be performed safely with all relevant authorisations, training, safe work method statements and all relevant Safe Work and WorkCover codes of practice.



Figure 3: Automated Schneider RL LBS

5.2.2 Supplied manufacturer items:

The items supplied with the RL series LBS are as per the tables below:

Table 4: Items included with automated LBS (Stock codes: 1554765 and 1554757)

Description	Qty
RL series-LBS in a stainless steel (316) tank with six (6) terminals, motor pack and 7m control cable.	1
Pole mounting bracket for enclosed switch	1
Silicon rubber bushing covers	6
11kV XLPE-CCT cable 19/3.5, 185 sq. mm in three (3) meter length one end lugged and connected to the palm of each bushing	6
Surge arrester bracket	2
PTCC (supplied prior to September 2013) or ADVC2 (supplied since September 2013)	1
Pole mount voltage transformer (22kV/27V or 11kV/27V)	1
Earthing stirrups (stock code: 1509462) connected to palm of the each bushing	6

Table 5: Items for the manual LBS (Stock code: 1550342)

Description	Qty
RL series LBS in a stainless steel (316) tank with six (6) terminals	1
Pole mounting bracket for enclosed switch	1
Silicon rubber bushing covers	6
11kV XLPE-CCT cable 19/3.5, 185 sq. mm in three (3) metre length one end lugged and connected to the palm of each bushing	6
Surge arrester bracket	2
Earthing stirrups (stock code: 1509462) connected to palm of the each bushing	6

Reference shall be made to Mains Construction Instruction MCI 0005 – Overhead distribution construction standards manual, for complete list of materials required for construction of pole mounted LBS. Refer to Drawing no. 332021 for termination to LBS.

Additional items not included in the stock item but required for construction of pole mounted LBS are:

- HV connectors for connection of enclosed switch to aerial conductors.
- Surge arresters with earth lead disconnect device, including HV connections and hardware.
- Earthing conductor from surge arresters to tank and to earth rods.

5.2.3 Control cubicle

The automated LBS is supplied with the ADVC2 controller since September 2013. Prior to September 2013, the automated LBS was supplied with PTCC controller.

5.2.3.1 Pole top control cubicle (PTCC)

The automated LBS supplied with a PTCC (prior to Sept 2013) can be mounted on a pole, and has the following conditions:

- The PTCC is suitable for ambient temperature -10⁰ C to 50⁰ C.
- The mains compartment houses LV mains transformer, MCCB for batteries and auxiliary supply.
- The electronic compartment houses control and protection modules (CAPM) version 5 and operator panel sub-system
- The battery compartment houses two (2) 12V batteries.
- Radio mounting tray is used for mounting communication equipment.

- The control cable entry module (CCEM) provides termination and filtering for the control cable.

Refer Annexure 1 for images and block diagram.

Refer to Schneider Technical manual – RL Series Load Break Switch / Sectionalizer Version 28 for further information.

5.2.3.2 ADVC2

Automated LBS supplied with the ADVC2 controller (since September 2013) has the following conditions:

- Cubicle is constructed of 316 stainless steel
- An electronic switchgear controller (CAPE) that monitors the switchgear and provides protection and communications functions. The CAPE module contains the Protection and communication submodule board, Power supply and switchgear module board and trip/close capacitors.
- An operator interface mounted on the CAPE.
- Power supply unit module.
- Two (2) 12V batteries.
- Compartment to house communication equipment.

Refer Annexure 2 for images and block diagram.

Refer to Schneider Operation manual – ADVC controller range, for further information.

5.2.4 Auxiliary supply

The auxiliary supply is used to maintain a charge on the sealed lead acid batteries that provide standby power when auxiliary power is lost. The lead acid batteries need to be replaced every 5 years.

Auxiliary supply can be from LV overhead mains or from the VT fitted on to the LBS pole. There are two (2) types of voltage transformers 22kV/27V and 11kV/27V and both are rated 50VA. The stock codes are 1559087 and 1559079 respectively.

5.3 Operation

5.3.1 Manual Operation

The enclosed switch is manually operated from ground level using an extended insulated hook stick. To open or close the switch, two (2) operations must be carried out. (Refer to Figure 4)

- **First Operation:**
Release the mechanical interlock which allows the switch to be open or close. This operation is performed by pulling an auxiliary eye lever (manual lock out lever) using the insulated hook stick from ground level.
- **Second operation:**
Operation performed on the main arm (manual operating arm) of the switch to open or close function. Facilities are provided to padlock the mechanism in the open position or closed position.

For detailed instructions on the operation of the LBS, refer to Technical manual – RL Series Load Break Switch / Sectionalizer Version 28.

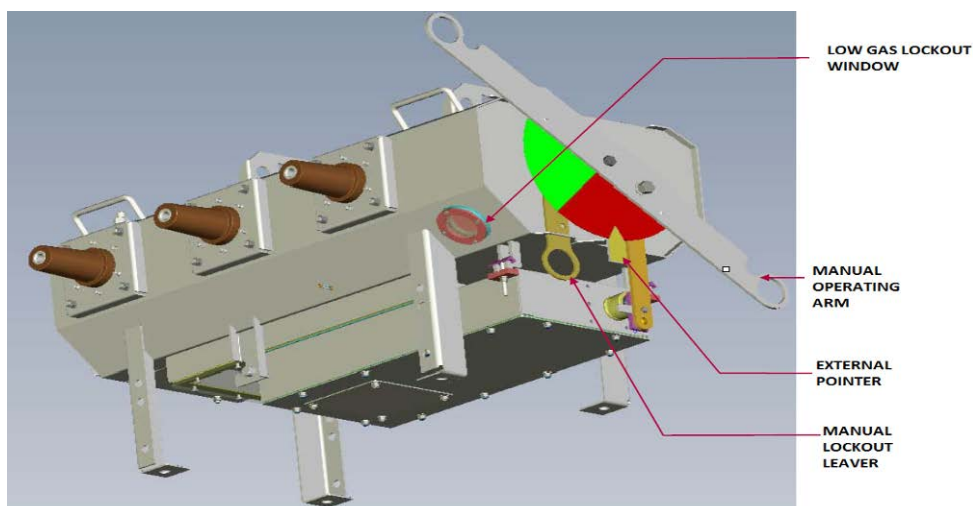


Figure 4: Manual operating arm and manual lockout lever

5.3.2 Remote operation

For a detailed instruction on remote operation of the LBS, refer Schneider Technical manual – RL Series Load Break Switch / Sectionalizer Version 28.

5.3.3 Switching operations

Switching operations must be carried out by authorised employees only. Refer to Division Procedure GNV 1061 - Transmission and High Voltage Distribution Network Switching.

5.3.4 Position indicators

The enclosed switch provides a reflective indication:

- (a) 'ON' indication—red in colour (closed), and
- (b) 'OFF' indication—green in colour (open) indication.

The indication is directly linked to the operating mechanism. The indication is clearly visible from the ground to provide a clear indication of the position of the enclosed switch.

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** 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 for certifying that all designs carried out by Regional employees conform to the requirements of this instruction.

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

It will be the ASP's responsibility to maintain 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

Annexure 1: PTCC controller images and block diagram

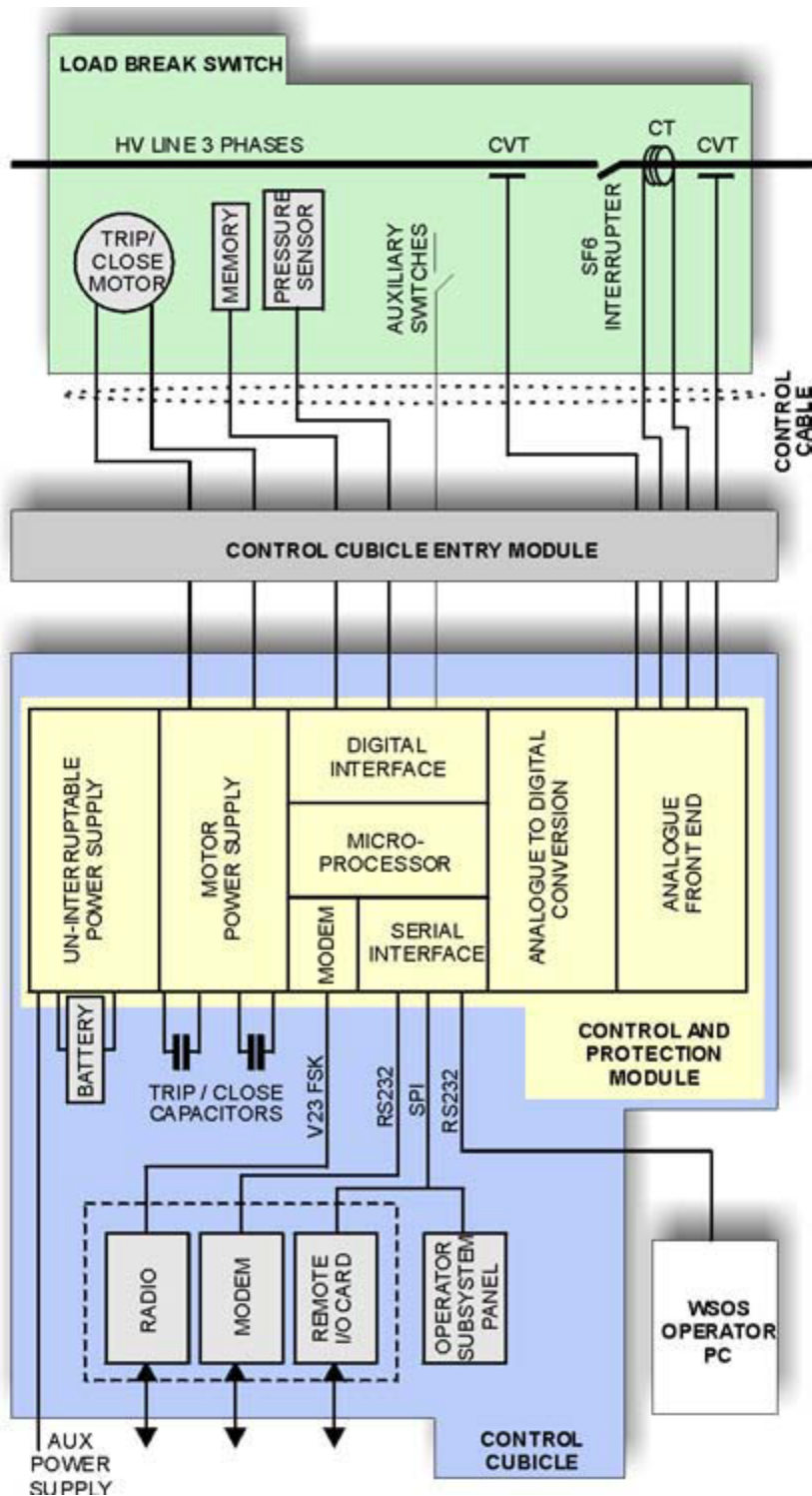


Figure A1a: PTCC Block diagram

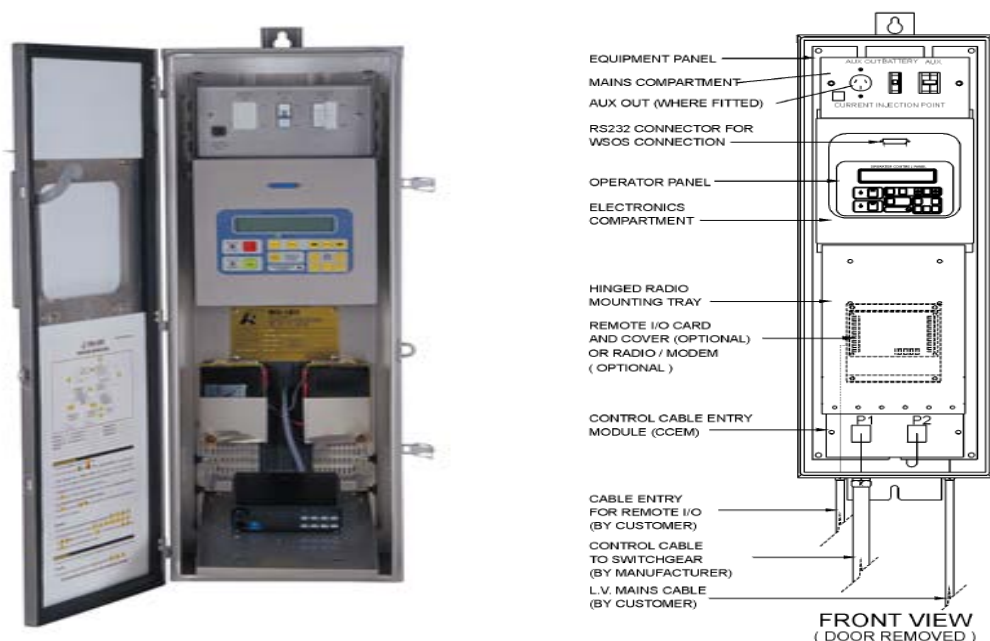
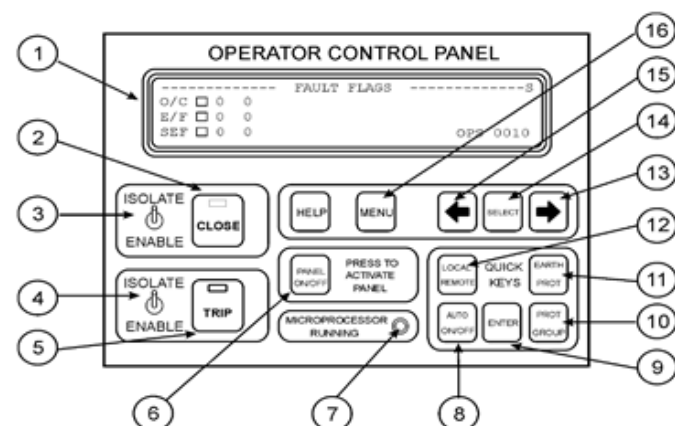


Figure A1b: PTCC



Number	Item	Description
1	Display	Back-lit LCD, 4 line with 40 characters per line.
2	Close key	Generates a Close request to the CAPM when the panel is active. A red LED is embedded in the key. The LED is lit when the LBS is closed.
3	Isolate/Enable Close switch	Isolates the Close key. When the switch is in the Isolate position the motor is disconnected from the control electronics. Thus the switch provides a physical isolation point for the control circuitry. The LBS cannot be closed and an audible alarm in the panel will sound. The Close key operates normally when the switch is in the Enable position.
4	Isolate/Enable Trip switch	Isolates the Trip key. When the switch is in the Isolate position the motor is disconnected from the control electronics. Thus the switch provides a physical isolation point for the control circuitry. The LBS cannot be opened and an audible alarm in the panel will sound. The Trip key operates normally when the switch is in the Enable position.
5	Trip key	Generates a Trip request to the CAPM when the panel is active. A red LED is embedded in the key. The LED is lit when the LBS is open.
6	Panel ON/OFF key	The PANEL ON/OFF key turns the panel on and off.

Figure A1c: Operator control panel

Annexure 2: AVDC2 controller images and block diagram

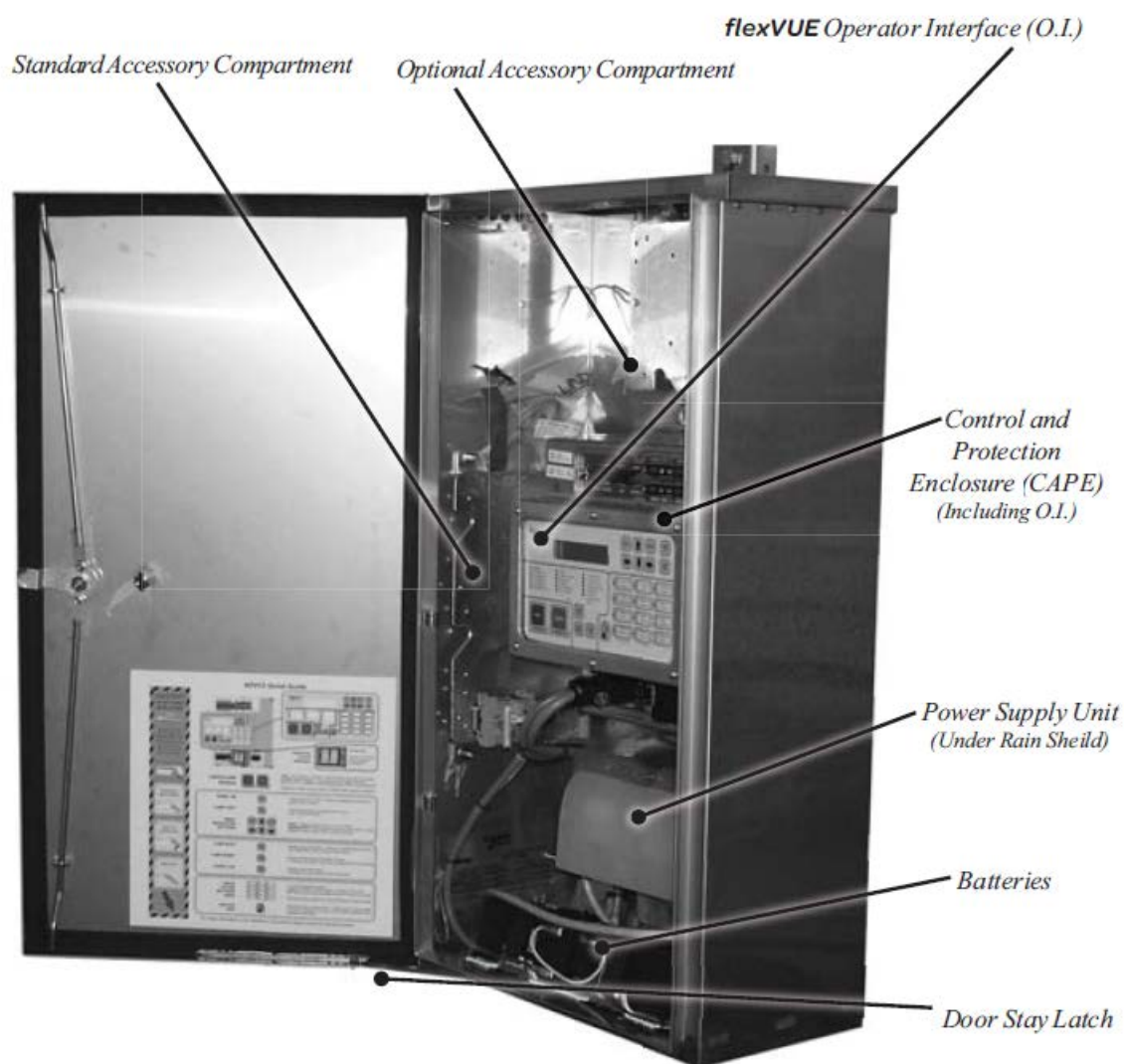


Figure A2a: Ultra ADVC2

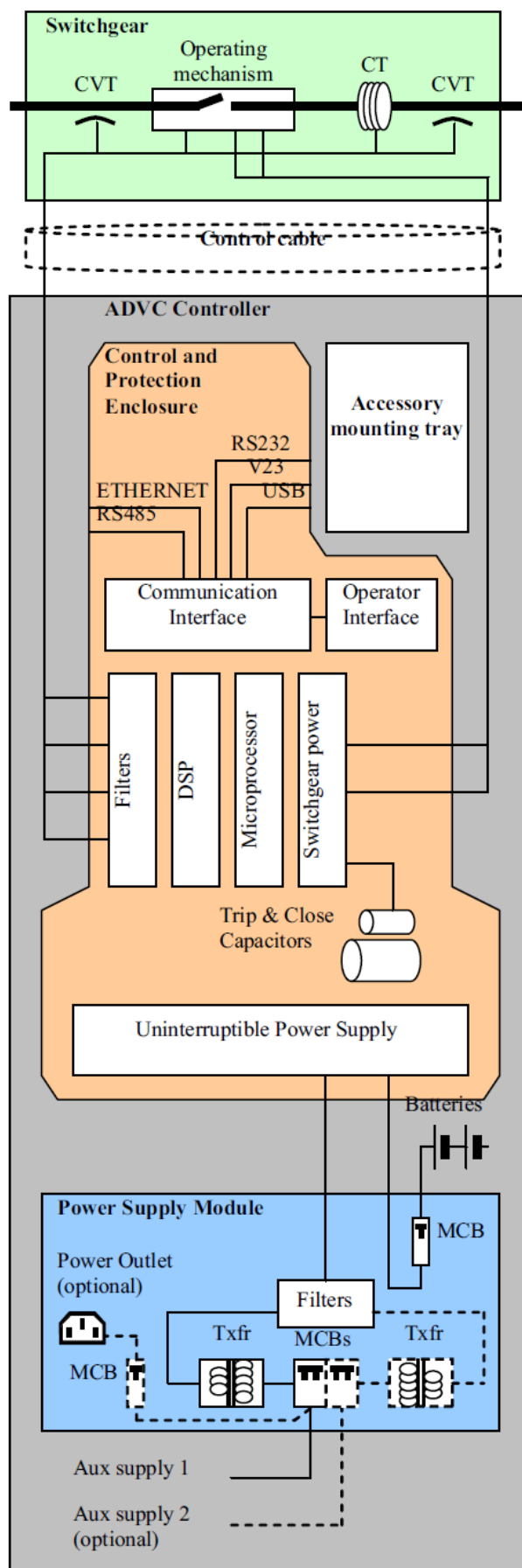


Figure A2b: ADVC2 block diagram