PR-NET-OSM-027

LOW VOLTAGE SYSTEM SWITCHING AND EARTHING

OPERATIONAL SAFETY MANUAL - SECTION 4.3

Scottish & Southern Electricity Networks

	Name	Title
Author	N/A	Distribution SHE Team
Checked by	Peter Vujanic	Head of SHE Distribution
Approved by	Richard Gough	Designated Engineer

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1 Introduction

1.1 This document defines the **Approved** procedure for the operation of the **SSEN-D Low Voltage System**. Co-ordination and **Switching** activities align with the safety precautions defined in the **Operational Safety Rules (OSR).**

1.2 Compliance with the following procedures **Shall** enable staff to work safely and reduce the risk of injury to themselves and their colleagues.

2 Scope

2.1 The scope of this document **Shall** be limited to persons who are required to co-ordinate and carry out **Switching** for operational purposes on the **Low Voltage System**.

2.2 The procedures included herein have been developed to minimise incidents associated with human error by ensuring that:

- A consistent approach is maintained for the control and operation of the **Low Voltage System**
- The **Authorised Person** carrying out **Switching** operations is aware of the safety precautions necessary to prevent **Danger** to those concerned including, so far as reasonably practicable, **Danger** to third parties
- At all times consideration is given to the operating characteristics of the **Low Voltage System** and any operational limitation/restriction imposed

2.3 For the purpose of this document **Low Voltage Switching Shall** apply to:

- The insertion and withdrawal of **LV** fuses or links
- The opening and closing of an **LV** circuit breaker
- The making and breaking of a **LV** electrical circuit through another **Approved** method

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents, should be used in conjunction with this document.

Table 3.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
PR-NET-OSM-006	SSEN Distribution Operational Safety Rules – Operational Safety Manual – Section 1.1
PR-NET-OSM-028	Switching Terminology and Approved Abbreviations - Operational Safety Manual - Section 4.4
PR-NET-OSM-016	Co-ordination of Work and Operations on the Low Voltage System - Operational Safety Manual – Section 2.6
PR-NET-OSM-066	General Requirements for Work on the Low Voltage System - Operational Safety Manual – Section 10.1
PR-NET-OSM-069	Testing at Low Voltage Supply Points - Operational Safety Manual – Section 10.4
TG-NET-ENG-032	Fuse and Earth Fault Loop Impedance Requirements for Secondary Plant, Networks and Low Voltage Cut-outs – Design Standard
WI-NET-OSM-002	Personal Protective Equipment and Workwear for Live Environments
WI-NET-CAB-121	Low Voltage Conductor, Cable and Supply Point Testing
WI-NET-CAB-129	Permitted Work and Responsibilities at Supply Points
N/A	SSEN SHE Handbook (Held in Safety, Health and Wellbeing SharePoint Site)

4 Definitions

4.1 The words printed in bold text within this document are either headings or definitions. Definitions used within this **Approved** Procedure are defined within the list presented immediately below, or within Section 2 of the **OSR**.

4.2 **Earthed**

When applied to **Low Voltage Systems**, **Earthed** signifies the bonding of all the phase **Conductors** (including any switch or **Earth** wire) to the neutral **Conductor** by means of an **Approved** device or **Approved** leads.

4.3 **High Voltage (HV)**

A voltage exceeding 1000 volts AC or 1500 volts DC.

4.4 **Low Voltage (LV)**

A voltage not exceeding 1000 volts AC or 1500 volts DC.

4.5 **Operational Safety Rules (OSR)**

The **SSEN-D** Distribution set of rules, as read with related documents and procedures, that provide generic safe systems of work on the **System** therefore ensuring the health and safety of all who are liable to be affected by any **Danger** that might arise from the **System.**

5 General Responsibilities

5.1 Persons who are required to operate and undertake work on the **System**, **Shall** have a thorough understanding of the work and ensure on site risks are suitably assessed and appropriate control measures put in place before, during and after all activities.

5.2 Persons must ensure that, at all times during the work (or associated testing), **General Safety** arrangements are maintained and that other work areas are not adversely affected by the activities for which they are responsible.

6 Authorisation

6.1 Persons who are required to undertake **LV Switching** duties **Shall** hold the appropriate competence and authorisation to carry out specified duties. It **Shall** be the responsibility of the individual to ensure that any actions performed are within the bounds of their competency and authorisation level.

6.2 **Switching Shall** be carried out on the **LV System** by an **Authorised Person**.

6.3 Competence and authorisation certificates **Shall** be retained personally and be made available upon request.

7 Personal Protective Equipment

7.1 Persons who are required to undertake **LV Switching** duties **Shall** wear suitably **Approved** Personal Protective Equipment (PPE) in accordance with work instruction WI-NET-OSM-002 - Personal Protective Equipment and Workwear for Live Environments.

7.2 When carrying out **Low Voltage Switching**, the minimum PPE requirements are:

- Helmet

- Safety Spectacles / Visor
- Safety Footwear
- Electrical gloves with protective outers
- Arc protective (Class 2) workwear, whole body covered

7.3 Substation small wiring operations or work such as the connection of protection relays, use of test terminal blocks, removal and replacement of 110V control fuses/links or panel type VT **LV** fuses etc. may be carried out wearing safety spectacles and Class 1 arc garments following the completion of a suitable risk assessment.

8 General Requirements

8.1 Records

8.1.1 **Switching** and associated work **Shall** be carried out in conjunction with the appropriate records being consulted. Records **Shall** where practicable be made available on site. If there is any difficulty in relating the records to the site situation / running arrangements, a supervisor **Shall** be consulted.

8.1.2 The **Authorised Person** carrying out **Switching Shall** adhere to the requirements detailed in PR-NET-OSM-016 Co-ordination of Work and Operations on the Low Voltage System - Operational Safety Manual Section 2.6.

8.1.3 As a minimum requirement the **Authorised Person** carrying out **LV Switching Shall** have access to up-to-date **System** running arrangements. This **Shall**, where practicable, be achieved using Geographic Information System mapping (GIS) or local Depot **System** diagrams.

8.1.4 Temporary changes to the **LV System** running arrangements **Shall** be recorded. These changes may result from any of the following activities:

- Temporary backfeed
- Routine use of LV links
- Temporary generator connections for fault restoration or maintenance
- **System** refurbishment
- Overlay of distributing mains and services
- New connections
- Installation of permanent or temporary auto-reclosing devices
- Installation of monitoring devices

8.1.5 As a consequence of planned work or during extended fault restoration that may result in the **LV System** running under abnormal conditions, a schematic record of the affected part of the **System Shall** be made available in the location, namely:

- For an underground distribution **System**, records **Shall**, where practicable, be secured in the substation or **LV** pillar that supplies the affected part of the **System**
- For an overhead distribution **System**, records **Shall**, where practicable, be secured in a weatherproof wallet or similar, adjacent to the pole mounted transformer fuses, or where the work affects a limited area, at the supply point of the affect part of the **System**

- For other circumstances an alternative communication format **Shall** be agreed between all parties and in advance of the current working group leaving the work location

8.1.6 Records of **System** running arrangements **Shall** include, but not be limited to:

- Date
- Contact details for the **Authorised Person** and **Working Party** co-ordinator (where applicable)
- Location of work(s)
- Nature of work(s)
- Isolation(s) on the **System**

8.1.7 For accuracy permanent alterations made to the **LV System** running arrangements **Shall** be updated in accordance with the 'Green Label Processes' defined in the relevant Work Instructions. This **Shall** be carried out as soon as reasonably practicable, temporary marked up drawings **Shall** be made available until permanent alterations have been completed.

8.1.8 The "Green Label" process is the accepted terminology within SSEN for the process to submit and update Low Voltage system arrangements to the Geographic Information System (GIS) or mapping record.

8.2 Control Boundary

8.2.1 Safety precautions required across **LV** control/ownership boundaries **Shall** be carried out and documented accordingly. Such procedures **Shall** be agreed between the controller/owner of the other **System** and **SSEN-D** and **Shall** be made known to the staff concerned.

8.2.2 On the **SSEN-D System**, the **LV** boundary with **HV** Distribution Control **Shall** be the **LV** isolating mechanism of the distribution transformer, e.g. **LV** links, **LV** circuit breaker or **LV** switch. All operations of **LV** boundary equipment **Shall** be under the **Control** of the **HV Control Engineer**, as part of an **HV Switching** Schedule.

8.3 Identification of Apparatus

8.3.1 **Apparatus** such as link boxes and feeder pillars **Shall** be suitably labelled to identify the specific **Apparatus** and individual circuits. For underground link boxes the individual circuit identification **Shall**, where practicable, be derived from **LV** schematic diagrams.

8.3.2 Substations **Shall** have a permanently fixed property notice giving the unique identification number or location of the substation. For **LV** overhead lines geographic records **Shall** be used.

8.3.3 **LV** switchgear including isolators, switches and circuit breakers **Shall** have permanently affixed identification labels.

8.3.4 **LV Apparatus Shall**, prior to any **Switching** operation, be correctly identified in accordance with the following:

- The **Authorised Person** carrying out the **Switching Shall** study the relevant **LV System** diagram, cable records, maps etc
- The **Authorised Person Shall** compare the information from the **LV System** diagram and other associated data against the information available on site, e.g. identification plates, circuit labels etc. and where:

- The information compares positively, operate the **Apparatus** in accordance with the manufacturer operating procedures and to the safety precautions defined in the **OSR**, or
- The information fails to compare, and doubt remains, refer to a supervisor for guidance

8.4 Tools and Equipment

8.4.1 Work on or testing of **LV Apparatus** and **Conductors Shall** only be carried out by a suitably **Authorised Person** using **Approved** tools, equipment and instruments in accordance with **Approved** procedures.

8.4.2 Where other hazards exist in the working environment that are not covered by the **OSR**, e.g. environmental hazards, consideration should be given to including these in the risk assessment and method statement, the use of **Immediate Supervision**, or the issue of a **Limitation-of-Access** document.

8.5 Selection of LV Links for use on Underground Link Box Applications

8.5.1 Care **Shall** be taken when selecting the correct link(s). Failure to do so may result in **Danger** to the operative during **Switching**.

8.5.2 Link(s) to be inserted **Shall** be of the **Approved** type and of the correct size and type for application. The link(s) **Shall** be visually inspected prior to use with particular attention given to the freedom / correct movement of the busbar clamp wedge device.

8.5.3 Appropriate and **Approved** manufacturer tools **Shall** be used to insert and remove the link(s).

8.6 Selection of LV Links for use on Pole Mounted Link Pole Applications

8.6.1 Care **Shall** be taken when selecting the correct link(s). Failure to do so may result in **Danger** to the operative during **Switching**.

8.6.2 Link(s) to be inserted **Shall** be of the **Approved** type and of the correct size and type for application. The link(s) **Shall** be visually inspected prior to use with particular attention given to the condition of the insulation.

8.6.3 The operative **Shall** ensure the link(s) can be operated without making inadvertent contact with any **Earthed** metalwork.

8.7 Selection of LV Fuses in Insulated Carriers for Ground Mounted and Overhead Applications

8.7.1 Care **Shall** be taken when selecting the correct fuse(s). Failure to do so may result in **Danger** to the operative during **Switching**.

8.7.2 Fuse(s) to be inserted **Shall** be of the **Approved** type and of the correct size and type for application. Fuse barrel dimensions **Shall** be compared to ensure adequate clearance. The ratings of associated **LV** cables and the correct discrimination with **HV** and **LV** fuses **Shall** be observed at all times, this information is available:

- For underground applications use TG-NET-ENG-032

8.7.3 Fuse(s) for use in substation fuse-boards, pillars, cabinets and pole mounted cut-outs **Shall** be selected in accordance with the nameplate rating of the feeding transformer and the outgoing **Conductor** size of the circuit protected.

8.7.4 Fuse(s) and carrier(s) **Shall** be visually inspected prior to use with particular attention given to cracking of insulation and the freedom/correct movement of the insulated thumb screw busbar clamp device.

8.7.5 Prior to application the fuse(s) **Shall** be checked for continuity using an **Approved** insulation/continuity tester.

8.8 Voltage and Polarity Confirmation

Voltage and polarity verification **Shall** be confirmed before and after fuse(s) and link(s) are inserted or withdrawn. **Approved LV** voltage indicators **Shall** be used in accordance with **Approved** procedures:

- WI-NET-CAB-121
- WI-NET-CAB-129

9 Low Voltage Switching

9.1 General

9.1.1 **Switching** for operational purposes **Shall** be carried out in accordance with the **OSR** and original equipment manufacturer instruction.

9.1.2 All **LV Switching Shall** be carried out in accordance with the requirements of PR-NET-OSM-016 Co-ordination of Work and Operations on the Low Voltage System - Operational Safety Manual Section 2.6.

9.1.3 Regardless of application, **LV Apparatus Shall** only be operated within its normal and short circuit rating. **Apparatus** having inadequate rating will be subject to an operational restriction.

9.1.4 Where **Switching** on the **LV System** affects the **HV System**, e.g. **System** parallels, auxiliary supplies to substations etc., the **Authorised Person Shall** inform the **Control Engineer**.

9.1.5 For planned work, **LV Switching Shall** be controlled using an up-to-date copy of the **LV System** diagram. The diagram **Shall** be clearly marked to show the current running arrangements, and the location and sequence of **LV Switching** operations. Additionally, the **LV System** diagram **Shall** confirm that no temporary alteration information exists, e.g. abnormal running arrangements.

9.1.6 For unplanned work an up-to-date copy of the **LV System** diagram **Shall,** where practicable be made available on site, except where a suitably **Authorised Person** who holds an up-to-date copy of the **LV System** diagram communicates directly with the **Authorised Person** on site, who **Shall** confirm their understanding by explaining:

- the **System** running and that no temporary alteration information exists
- the safe working area
- the work to be carried out and precautions required

9.1.7 The parallel of substations **Shall** be limited to the shortest practicable time. This is particularly important where substations are supplied from different **HV** sources of supply.

9.1.8 Before and after each **Switching** operation, **LV** supplies **Shall** be checked to confirm the correct operational requirements have been achieved, i.e. supplies still **Live** or circuit **Dead**.

9.2 Insertion and Withdrawal of Fuses and Links

9.2.1 The **Authorised Person Shall** correctly identify the location and circuit of the fuse or link to be operated. Where practicable and in order to identify fuse operation, a check **Shall** be made before the specific fuse is removed or replaced to confirm the outgoing side of the fuse is either **Live** or **Dead**. This check **Shall** be achieved through the use of **Approved** test lamps or voltmeter, testing between the outgoing side of the **LV** fuse and a known Neutral or **Earth**. Test results **Shall** be compared to Table 8.1.

9.2.2 Should the condition of **LV** circuit be unknown, or it is not considered to be a healthy circuit, where reasonably practicable a Fuse Mate or Rezap device **Shall** be used initially to make the circuit **Live**.

9.2.3 Where alterations on single or three phase equipment are to take place, the phases and neutral cores **Shall** be identified before work starts. The polarity and phase rotation **Shall** be confirmed and the results recorded in accordance with an **Approved** procedure.

9.2.4 When replacing a fuse after a suspected fault, the condition of the **LV System** or part thereof **Shall** be confirmed to ensure it is safe to replace the fuse with a suitably rated equivalent. Where reasonably practicable a Fuse Mate or Rezap device **Shall** be used initially to make the circuit **Live**.

9.2.5 The **LV** fuse **Shall** not be replaced where the following conditions are present:

- The cable or stalk/spill is severely damaged in the pillar or cabinet
- The circuit/phase is shorted to another phase (phase to phase fault)

9.2.6 The operator should be aware that when removing or replacing a fuse, load will be 'broken' or 'made' and the following may be experienced:

- Arc energy may be experienced at the point of disconnection/connection between the fuse contacts and busbar
- Where the fuse has operated under fault conditions, fault current may be experienced when replacing the fuse

To mitigate such the circuit load **Shall** where reasonably practicable be reduced.

9.2.7 If a service cut-out fuse requires removing or replacing where fault current may exist, the meter isolator **Shall** be opened, where fitted.

NOTE: There are many different types of service cut-outs and distribution fuses on the **LV System**. In addition to these procedures, operators must always read and follow any instruction that may be present on-site.

9.3 Procedure for the Insertion and Withdrawal of LV Fuses or Links

9.3.1 The following procedure **Shall** be used to withdraw **LV** fuse(s) or link(s):

1. Assemble correct tools/equipment and check condition.
2. Wear Approved PPE in accordance with **SSEN-D** policy.
3. Fit detachable handle to fuse carrier or link where applicable.
4. Apply pressure to the fuse carrier or link and slacken retaining wedges or screws until loose.
5. Firmly grip the fuse carrier or handle.
6. Withdraw the fuse carrier or link using a positive uninterrupted action so that both the top and bottom contacts are broken at the same time.

9.3.2 Where a fuse or link is removed so as to create a point of isolation on the **LV System**, isolation **Shall** be carried out in accordance with the **OSR**. Any fuse that has operated and been withdrawn **Shall** be removed from site and disposed of appropriately.

9.3.3 The following procedure **Shall** be used to insert **LV** fuse(s) or link(s):

1. Assemble correct tools/equipment and check condition.
2. Wear **Approved** PPE in accordance with **SSEN-D** policy.
3. Check continuity of fuse using an **Approved** insulation/continuity tester where applicable.
4. Fit detachable handle to fuse carrier or link where applicable.
5. Ensure thumb-screws/wedges are fully loosened.
6. Check fuse or link contacts ensuring compatibility with fixed contacts of the associated **Apparatus**.
7. Verify voltage conditions as appropriate.
8. Insert the bottom contact of the fuse or link into the lower fixed contact of the associated **Apparatus**.
9. Using a positive uninterrupted action hinge the fuse or link into the upper fixed contact (or where the design prevents the hinge action use a horizontal motion)
10. Holding the fuse carrier or link in position, tighten fully the retaining wedges or screws.

9.3.4 Before any fuse is replaced, the operator **Shall** ensure the fuse and carrier are dry, free from dust or grit and in good condition. The correct size of fuse **Shall** be checked against TG-NET-ENG-032 or the fusing guide label that is attached to the cabinet or pillar and changed if necessary.

9.3.5 Before replacement of any fuse that makes a circuit **Live**, the operator must inform all persons in the vicinity or working on the circuit that the supply is about to be made **Live**.

9.3.6 After the fuse has been replaced the supply, polarity and phase rotation **Shall** be confirmed. This is especially important following any **LV** alterations that may have taken place.

NOTE: Polarity and phase rotation need not be checked after replacement of a blown fuse.

9.3.7 The checking of polarity at a service cut-out, **Shall** be carried out in accordance with PR-NET-OSM-069 Testing at Low Voltage Supply Points - Operational Safety Manual Section 10.4.

9.3.8 After all operations have been completed, any broken or removed seals **Shall** be renewed with **Approved** high security seals and all locks replaced.

9.4 Testing for LV Fuse Operation

9.4.1 Test results for a **Live** supply (indicating a healthy fuse):

Table 9.1 - Indication of a Healthy LV Fuse

Supply	Voltmeter (Nominal Voltage)	Old Test Lamp Indication	New Test Lamp Indication	Test Parameter
Single Phase	230 volts	Half Light	3 Lights	Between phase and Neutral/Earth
Three Phase	400 volts	Full Light	4 Lights	Between each Phase
	230 volts	Half light	3 Lights	Between Phase and Neutral /Earth on each fuse.

9.4.2 Test results for a **Dead** supply (indicating fuse has operated):

- 0 (zero) volts on Voltmeter
- No light on Test Lamp

NOTE: Caution is required on integrated **LV Systems** as the outgoing cable may have a backfeed, giving an indication that the fuse under test is healthy.

9.5 Proving Dead

9.5.1 When work on **Low Voltage Conductors** is to be carried out **Live**, the requirements of PR-NET-OSM-066 General Requirements for Work on the **Low Voltage System** - Operational Safety Manual Section 10.1 Shall be followed.

9.5.2 When work on **Low Voltage Conductors** is to be carried out **Dead**, this **Shall** be verified using an **Approved** testing device, such as a test lamp.

9.5.3 When undertaking testing, only **Approved** instruments **Shall** be used.

9.5.4 General principles:

- Test lamps **Shall** be visually inspected prior to use, ensuring the leads and casing are in serviceable condition
- Test lamps **Shall** be tested on each occasion before and after use using an **Approved** proving unit or a known source of supply
- Using the **Approved** test lamps, test between each phase and neutral, between each phase and **Earth**, and between neutral and **Earth**. For three-phase supplies, test between each phase
- No lights should be displayed during any test

9.5.5 Where test lamps indicate an unexpected result, this **Shall** be investigated prior to any further work being carried out.

9.6 Application of Earths and Bonding Devices

9.6.1 The **Earthing** and bonding of **Conductors Shall** be carried out using an **Approved Earthing** device or **Earthing** leads. Bonding and **Earthing** devices **Shall** be inspected immediately before use, paying particular attention to cleanliness and the condition and security of contacts, clamps and leads. **Earthing** devices or leads that show any evidence of damage **Shall** not be used.

9.6.2 Approved bonding and **Earthing** devices **Shall** be fitted as near as practicable to the point-of-work or between the point of work and any potential source of supply.

9.6.3 The isolated circuit, **Shall** be proved **Dead** using an **Approved** voltage indicator before applying the **Earth**.

9.7 Automation

9.7.1 Where work is to take place on a **System** fitted with automation, this **Shall** be set to non-auto or removed prior to **Live** work commencing.

9.7.2 Where auto-reclosing devices are installed, the unit's operations instructions must be followed if they are to be set to non-auto, auto, or removed.

9.7.3 All permanent automation devices, monitoring equipment and advanced network management devices **Shall** be recorded in accordance with 'Green Label' processes.

9.7.4 For temporary installations, records may be kept locally.

10 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	New document created	TBC	1.00	Richard Gough
02				