PR-NET-OSM-071

MANAGEMENT OF NEUTRAL FAULTS ON THE LOW VOLTAGE SYSTEM

OPERATIONAL SAFETY MANUAL - SECTION 10.6

Scottish & Southern Electricity Networks

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CONTENTS

1 Introduction

1.1 **Neutral Faults** can result from:

- Failure of the neutral **Conductor** within a cable or joint.
- Incorrect connection of mobile generators.
- Jointing error.
- Loss of the neutral/**Earth** connection in a Distribution substation as a result of fault or theft.

1.2 **Neutral Faults** can result in damage to customers' equipment and in some instances damage at the service position to meters.

1.3 This document defines the requirements and responsibilities for management of **Neutral Faults** on the **SSEN-D Low Voltage** Distribution **System**.

1.4 Following this **Approved** procedure will ensure a safe and effective response to **Neutral Faults**, to isolation and checking of affected supplies and to supply restoration.

1.5 This document provides guidance to enable appropriate customer communications and insurance provision for the repair / replacement of customer property, which is damaged because of **Neutral Faults**.

2 Scope

2.1 This document relates to operational requirements for management of **Neutral Faults** on **SSEN-D**'s **Low Voltage** Distribution **System**, whether suspected or confirmed **Neutral Faults**.

2.2 It applies to all persons employed by or working on behalf of **SSEN-D**, who are involved in the management activity associated with **Neutral Faults**.

2.3 The scope of this document does not apply to the loss of **HV System** neutral **Earthing** at primary substations, which is covered in PR-NET-OPS-024.

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-078	Reporting Requirements for ESQCR - Operational Safety Manual Section 12.7
PR-NET-OPS-024	Loss of System Neutral Earthing of Primary Substations
PR-NET-OPS-071	SSEN Claims Handling
WI-NET-OSM-002	Personal Protective Equipment and Workwear for Live Environments
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 **Operational Safety Rules**.

4.2 **Appointed Electrician**

Electrician recognised as competent under an **Approved** trade scheme, e.g. NIC-EIC, who is employed to complete testing of domestic wiring and apparatus on behalf of **SSEN-D**.

4.3 **Service Provider**

Organisation contracted by **SSEN-D** to provide a repair or replacement service for damaged appliances.

NOTE: This is currently HASTE.

4.4 **Neutral Fault**

Proven fault condition that reduces the effectiveness of the neutral return **conductor** to such an extent that abnormal voltages could be present on customer installations.

4.5 **Suitably Competent Person**

Person who has the technical knowledge and experience to understand the **Dangers** and electrical principles associated with a high impedance neutral return **conductor**.

4.6 **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**.

4.7 **Team Manager**

Supply Restoration **Team Manager** or Standby **Team Manager**, as appropriate.

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

6.3 All persons carrying out work on **Low Voltage** cables **Shall** be authorised in writing for the tasks.

7 Personal Protective Equipment

7.1 Persons who are required to work or carry out **Switching** on or near the **System Shall** wear suitably **Approved** Personal Protective Equipment (PPE). Furthermore, where warning labels or signs identify the existence of a particular hazard, additional and appropriate PPE **Shall** be worn.

7.2 As a minimum, PPE **Shall** meet the requirements of WI-NET-OSM-002.

8 General Requirements

8.1 In the event a **Neutral Fault** condition is suspected or confirmed, the **Team Manager Shall** be notified and **Shall** manage the overall situation and be responsible for escalation to Region level if required.

8.2 **Neutral Faults** are categorised as follows:

- **Low Voltage** service equipment faults, e.g. cut-outs
- **Low Voltage** cable faults
  - Single-phase service
  - Three-phase mains
- Loss of the neutral/**Earth** at a distribution substation or Pole Mounted Transformer.

8.3 Customer reports of bright lights or dim lights, electrical appliances not working and fluctuating voltages are symptomatic of **Neutral Faults**, where customers are supplied from the same **Low Voltage** mains cable.

8.4 Where damage by a third-party is the suspected or confirmed cause of the **Neutral Fault**, the Third Party Damages Team **Shall** be informed.

8.5 Where customer equipment is damaged as a result of a **Neutral Fault**, the claims handling procedure in PR-NET-OPS-071 **Shall** be followed.

8.6 Reporting requirements are detailed in PR-NET-OSM-078 Reporting Requirements for ESQCR - Operational Safety Manual Section 12.7.

NOTE: When **Neutral Faults** occur, which result in the loss of neutral, it is possible for customer supplies to exceed statutory limits, which can result in damage to customer equipment, in particular electrical appliances.

9 General Assessment of a Suspected Neutral Fault

9.1 Appropriate customer fault data **Shall** be used to formulate an initial assessment of a suspected **Neutral Fault**. Data **Shall** be collected from various sources including:

- Customer reports
- Measurement of the **System** voltage and **Earth**-Loop Impedance at affected customer properties and **Low Voltage** street furniture
- Measurement of **Low Voltage** circuit phase loadings

9.2 Where customer reports suggest the existence of **Danger** or unsafe situations, the affected **Low Voltage** feeder way **Shall** be disconnected at source until the reports can be verified.

9.3 Where reports of damage to a customer's internal wiring have been received, the service cut-out fuse(s) **Shall** be removed by an attending **Competent Person** and a domestic wiring check performed in accordance with Appendix A by an **Appointed Electrician**.

9.4 Where reports of damage involve a single **Low Voltage** service cut-out unit, the service cut-out fuse(s) **Shall** be removed and the unit inspected by a **Competent Person** before the supply is restored to the customer.

9.5 Where reports of damage involve several **Low Voltage** service cut-out units in the same locality, the affected **Low Voltage** feeder way **Shall** be disconnected at source until each report can be verified.

10 Neutral Faults Affecting Single-Phase Service

10.1 A **Neutral Fault** in a single-phase service has no risk from neutral voltage rise; the supply cannot exceed normal **System** voltage and the customer will be without supply. Customers should be advised to turn-off their supply at their consumer unit and, where applicable, the double pole switched fuse isolator at the meter point and not to restore it until advised by **SSEN-D**.

10.2 The Fault Dispatcher **Shall** dispatch a Suitably **Competent Person** to the affected customer to investigate.

10.3 Fault location, repair and supply restoration **Shall** be performed as for a normal service fault. There is no requirement to test the customer's installation as Appendix A.

11 Neutral Faults Affecting Three-Phase Mains

11.1 Fault Dispatch & Assessment

11.1.1 In the event a **Neutral Fault** condition is suspected or confirmed, affected customers **Shall** be advised, as quickly as possible, to turn off their supply at their consumer unit and where applicable the double pole switched fuse isolator at the meter point and not to restore it until advised by **SSEN-D**.

11.1.2 The Fault Dispatcher **Shall** inform the **Team Manager** and dispatch a suitably **Competent Person** to the location of the suspected or confirmed **Neutral Fault** to investigate.

11.1.3 The **Competent Person Shall** investigate the presence and location of the **Neutral Fault** by instigating:

- 'Door to door' checks of customers' supplies and whether any customers' installations pose a **Danger**
- Testing supply voltage and **Earth**-Loop Impedance at customers' outdoor cut-outs, where customers' installations cannot be checked
- Testing supply voltage and **Earth**-Loop Impedance at street lighting cut-outs, link boxes and at other similar locations

11.1.4 Voltage and **Earth**-Loop Impedance checks at properties that have reported high/low voltage **Shall** be recorded along with the **Low Voltage** circuit phase loadings.

11.1.5 Where a **Neutral Fault** is confirmed, affected supplies **Shall** be **Isolated**, at the cut-out, as soon as practicable. The **Competent Person Shall** notify Fault Dispatch and the **Team Manager** of the **Neutral Fault** condition and details for restoration of supplies.

11.1.6 Where damage to customer equipment has been reported, or is suspected, the **Team Manager Shall assess** the damage and, where appropriate, arrange, via Fault Dispatch, for the **Service Provider** to attend (see PR-NET-OPS-071). The **Team Manager** should co-ordinate the **Service Provider** technicians, as necessary.

11.1.7 Where an affected customer cannot be contacted for access to their service position then that service **Shall** be identified, disconnected outside the property, where reasonably practicable.

11.1.8 A letter (see Appendix 1 of PR-NET-OPS-071) **Shall** be left at all affected properties advising customers to contact **SSEN-D** if they find a problem with their supply or any electrical equipment.

11.1.9 Where it is confirmed that a **Neutral Fault** has affected commercial / industrial premises, then the incoming **SSEN-D** supply of each affected premise **Shall** be **Isolated** until such times as either an **Appointed Electrician** or a competent third-party has completed an independent check of the customer's installation.

11.1.10 Where the competent third-party has not completed an independent check, the customer **Shall** be advised not to restore supplies to their installation until such times as these checks are completed.

11.1.11 Where it is confirmed that a **Neutral Fault**, caused by a failure on the **SSEN-D** Distribution **System**, affects one or more properties or premises operated by an Independent Distribution Network Operator (IDNO), the controlling authority for that **System Shall** be contacted immediately and **SSEN-D** supplies to that part of the **System Shall** be made **Dead** at the point of connection.

11.2 Repair

11.2.1 The **Neutral Fault Shall** be located and repaired as directed by the **Team Manager**. Excavation and repair of the fault **Shall** be performed as normal.

11.2.2 The failed component, which has caused the **Neutral Fault**, **Shall** be removed and inspected. A record of the failed component **Shall** be made including any photographs. Where the **Team Manager** believes this is an unknown type of failure, i.e. not an existing failure type, then the failed component **Shall** be suitably labelled and taken to the local depot for inspection by an asset engineer.

11.3 Testing of Customer Installations Following A Neutral Fault

11.3.1 Prior to restoration of supplies, any affected customer installation **Shall** be checked / tested by either an **Appointed Electrician**, or a suitably competent third-party in accordance with Appendix A - except for single-phase service **Neutral Faults**.

11.3.2 Testing of domestic customer installations directly supplied from the **SSEN-D Low Voltage** Distribution **System Shall** be completed by an **Appointed Electrician**.

11.3.3 Testing of commercial installations or electrical equipment situation in commercial / industrial premises **Shall** be completed by the customer's competent third-party.

11.3.4 Testing of properties / premises controlled by an IDNO **Shall** be completed by the IDNO or its competent third-party.

12 Restoration of Supplies

12.1 Before restoring supplies to a three-phase Distribution **System** affected by a **Neutral Fault,** the **Competent Person Shall** confirm that all customer supplies that could have been

affected by the **Neutral Fault** have either been **Isolated** from the **System** or have been satisfactorily checked / tested by a **Competent Person** and are safe to re-energise.

12.2 The restoration of supplies to properties / premises controlled by an IDNO, **Shall** not take place until a formal request to re-energise the IDNO controlled **System** has been made directly by the IDNO appointed Control Person to the **SSEN-D** Control Person (namely the **Competent Person**).

12.3 The restoration of supplies to commercial / industrial premises **Shall** not take place until a formal request is received and the customer's competent third-party has confirmed the installation is safe to re-energise.

12.4 A courtesy call **Shall** be made to each affected customer, who reported a fault, by the Customer Contact Centre on restoration of supplies in order to confirm that no problems are still being experienced following the incident on the **System**.

13 Loss of Neutral at a Distribution Substation

13.1 The initial assessment of the fault **Shall** be performed at the feeding substation by a **Authorised Person**. The phase voltages on the **Low Voltage** distribution board **Shall** be recorded along with the individual **Low Voltage** circuit phase loadings. Load imbalances across **Low Voltage** phases can lead to voltages above statutory limits on the **System**. If voltages outside statutory limits are measured then the **Low Voltage** board **shal**l be made **Dead**.

13.2 If reports of electric shocks, reports of fire, or unsafe situations are occurring, then the affected **Low Voltage** feeder way(s), **Shall** be disconnected immediately until the reports can be verified.

13.3 Once the **Low Voltage** distribution board has been made **Dead**, **Low Voltage** feeder ways that have a backfeed available from another substation can be used to restore supply to that **Low Voltage** circuit, providing that any reports of electric shocks, reports of fire or unsafe situations have been either investigated or the affected customer's cut-out fuse removed.

13.4 Immediate repairs should then be undertaken to restore the neutral connection at the substation.

13.5 On completion of repairs, the **Low Voltage System Shall** be re-energised, providing that any reports of electric shocks, reports of fire or unsafe situations have been either investigated or the affected customer's cut-out fuse removed.

13.6 The **Service Provider** should be dispatched to the location via Fault Dispatch, to assist with any repairs to customers' equipment.

14 Revision History

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

Appendix A Post Neutral Fault Testing of Customer Supplies

The following test procedure applies to checking / testing customer installations, affected by a **Neutral Fault**, by an **Appointed Electrician** or competent third-party prior to re-energisation.

1. Confirm request from **SSEN-D Competent Person** or **Team Manager** to recommission customer supply.
2. Where applicable, confirm authorisation certificate is valid and in date.
3. Wear **Approved** PPE for **Live Low Voltage** testing.
4. Risk assess the environment and the electrical integrity of **SSEN-D** service position and customer installation. Ensure public safety can be maintained for the duration of the testing.
5. Confirm isolation on customer installation to remove load.
6. Check for correct supply voltage at **SSEN-D** supply terminal.
7. Check for correct polarity at **SSEN-D** supply terminal.
8. Check for satisfactory earth loop impedance at **SSEN-D** supply terminal.
9. Visually inspect customer installation for any signs of damage or **Danger**.
10. Check insulation resistance of customer installation (Line and Neutral to **Earth**) – including per circuit insulation tests where poor results are found.
11. Replace **Low Voltage** cut-out fuse(s).
12. Confirm polarity on customer installation.
13. Restore customer load and check supplies are normal and do not present **Danger**.
14. Check correct operation of RCD device, where fitted.
15. If satisfactory, seal **Low Voltage** cut-out fuse carrier if authorised to do so, if not identify to **SSEN-D Authorised Person**.
16. Notify **SSEN-D Authorised Person** or **Team Manager** of time of restoration.
17. Record recommissioning of customer supply on record sheet and return to Line Manager along with the installation test paperwork.
18. If any aspect of testing on the customer installation is unsatisfactory then the supply **Shall** not be restored and a faulty installation card **Shall** be left.