PR-NET-OSM-069

TESTING AT LOW VOLTAGE SUPPLY POINTS

OPERATIONAL SAFETY MANUAL - SECTION 10.4

Scottish & Southern Electricity Networks

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1 Introduction

1.1 The operation of the Distribution **System** requires **SSEN-D** to carry out work and testing at the service position on the **Low Voltage System**.

1.2 The Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR) place a specific duty to ensure that equipment is installed and maintained so as to prevent **Danger**. In the context of this policy it is interpreted to mean that correct polarity and the appropriate phase rotation (for three-phase supplies) **Shall** be ensured on a customer's supply before the customer is connected or reconnected.

1.3 Under the ESQCR, **SSEN-D** has a duty to report events on its **System** that result in a customer being provided with reverse polarity or changed rotation for three-phase supplies. These reports are made under the requirements of ESQCR Regulation 31.

NOTE: Full details of ESQCR reporting requirements are detailed in PR-NET-OSM-078 Reporting Requirements for Electricity, Safety, Quality, and Continuity Regulations - Operational Safety Manual - Section 12.7.

1.4 Section 8 of the **Operational Safety Rules** requires that where work or testing has involved the connection or reconnection of **Conductors**, a supply to customers **Shall** not be given until polarity checks, and if applicable, phase rotation checks are made.

1.5 Additional test measurements required by **SSEN-D** are:

- **Earth** Loop Impedance.
- Voltage measurement.
- **Live** supply indication

1.6 This Approved procedure is supported by the **SSEN-D Operational Safety Rules**.

2 Scope

2.1 This **Approved** procedure applies to all those working for or on behalf of **SSEN-D**.

2.2 This **Approved** procedure applies to testing at any service position on **SSEN-D**'s **Low Voltage System** and **Shall** include Street Furniture.

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents, and Table 3.2 - External 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-010	Management of Erroneous Operations - Operational Safety Manual -Section 3.3
PR-NET-OSM-078	Reporting Requirements for Electricity, Safety, Quality, and Continuity Regulations - Operational Safety Manual - Section 12.7
REF-NET-ENG-001	Common Acronyms and Terms Used in Networks Documents
PR-NET-ENG-021	Approval of Tools & Equipment for Use within **SSEN-D**
MA-NET-ENG-002	Tools and Equipment Catalogues
TG-NET-CAB-019	Phase Rotation and Phase Rotation Meters

WI-NET-CAB-129	Permitted Work and Responsibilities at Supply Points
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)

Table 3.2 - External Documents

Reference	Title
ESQCR	Electricity Supply, Quality and Continuity Regulations (as amended)

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 **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**.

4.3 **Operator**

The authorised Person permitted to carry out **Switching** on the **System**.

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

5.3 The Line Manager **Shall** ensure that:

- The correct tools and test equipment are provided
- Safe systems of work **Shall** be followed
- Persons under their responsibility **Shall** have the necessary **Approved** tools and test equipment available for use

5.4 The **Competent Person Shall** ensure that on-site:

- **Approved** safe systems of work are followed
- Only **Approved** tools and test equipment are used
- The correct PPE is used

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 test 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 Only instruments and equipment detailed in the **Approved** Tools and Equipment Catalogues (MA-NET-ENG-002), **Shall** be used on the **SSEN-D Low Voltage System** by **SSEN-D** staff, unless permitted as “legacy” instruments and equipment, as defined in PR-NET-ENG-021.

8.2 Third-parties may use their own **Approved** instruments and equipment provided the requirements of this document are met.

8.3 Instruments which require calibration **Shall** only be used within their calibration date. Instruments outside of the calibration date or where the calibration date is not known **Shall** not be used.

8.4 Where reverse polarity or an inadvertent reverse phase rotation is found to be provided, it **Shall** be reported immediately to the **Team Manager**, as appropriate.

9 Information, Instruction, Training and Monitoring

9.1 All **Operators** involved with **Low Voltage** testing at the customer interface (e.g. polarity testing) or the investigation and reporting of reverse polarity or incorrect phase rotation incidents on the **Low Voltage System**, **Shall** be formally trained in the following:

- The requirements of this **Approved** procedure and the **Operational Safety Rules**
- The hazards and risks associated with leaving a **System** with a reverse polarity and/or incorrect phase rotation
- The necessary tests required to enable compliance with this **Approved** procedure
- The procedures for reporting, rectifying, managing and investigating a reverse polarity and/or incorrect phase rotation incident
- The requirements for ESQCR Regulation 31 reporting

9.2 Each person undertaking work that involves the need to carry out polarity and/or phase rotation testing, **Shall** have at least one on-site check, or simulated site check, each year.

9.3 Re-training **Shall** be undertaken at least every four years and training records updated. Training **Shall** be formal and include both a written and practical assessment.

9.4 ESQCR Regulation 31 reports **Shall** be monitored to identify trends, with the purpose of reducing incidents. This function **Shall** be carried out by the **SSEN-D** Operational Safety Team.

10 Testing Live or Dead

10.1 When **Conductors** have been terminated at a supply point, the phase(s), neutral and **Earth** circuit connections **Shall** be verified using an **Approved** measuring instrument such as a test lamp, to ensure that phases are **Live** to both neutral and **Earth**.

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

10.3 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
- Remove the fuse or fuses at the cut-out
- Using the **Approved** test lamps, test the incoming and outgoing sides of the cut-out. Test between each phase and neutral, between each phase and **Earth**, and between neutral and **Earth**. For three-phase supplies, test between each phase
- Correct test lamp indication is shown in Figure 10.1 to Figure 10.5.

10.4 Where a Dead incoming supply is identified, the cut-out **Shall** be **Isolated**. This can be achieved by either removing the fuse from the carrier and replacing the empty carrier in the cut-out or by using purpose made shrouds. The cut-out **Shall** be sealed to prevent unauthorised interference.

10.5 Where the test lamps indicate a **Dead System**, then a second method of confirming accuracy of that result **Shall** be completed. This may include testing with an alternative **Approved** voltage measuring instrument or proving device or by proving the operation of the test lamps either on a **Live** source or with an **Approved** proving unit that produces a voltage capable of illuminating the test lamp's bulb.

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

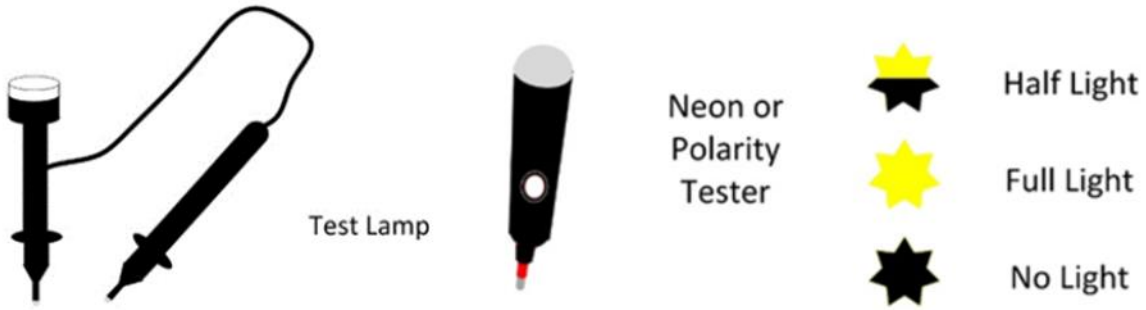

Figure 10.1 - Key to Items Used in Figures 10.2 – 10.5

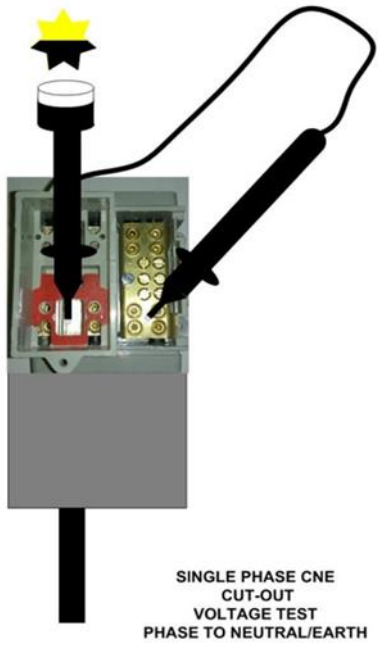

Figure 10.2 - Single Phase CNE Test

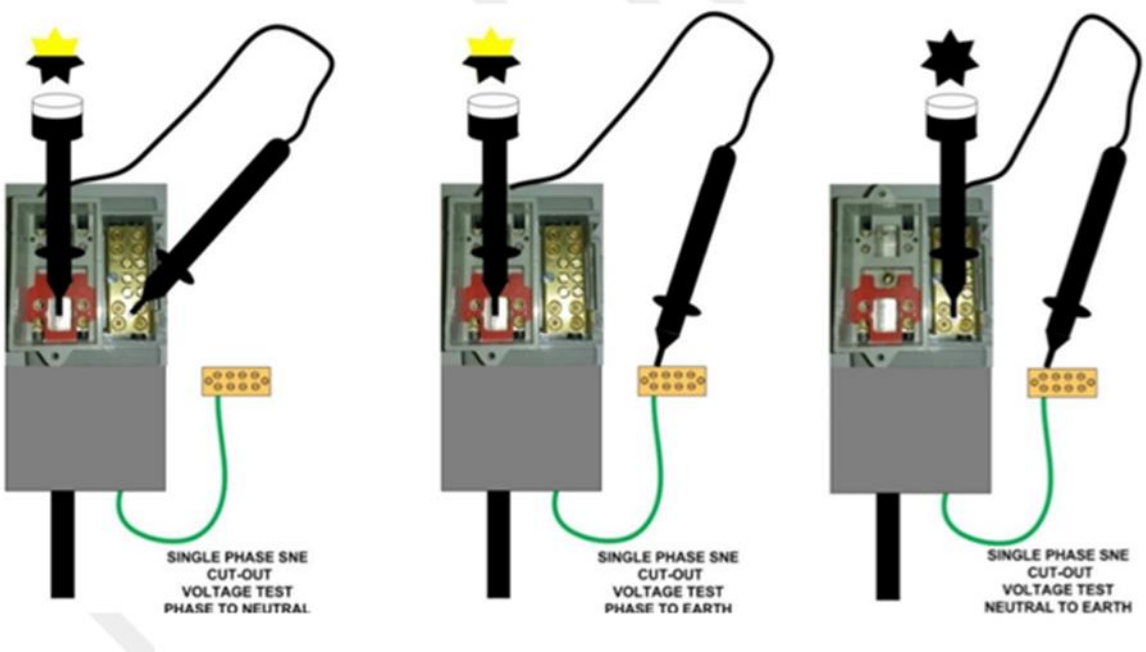

Figure 10.3 - Single Phase SNE Tests

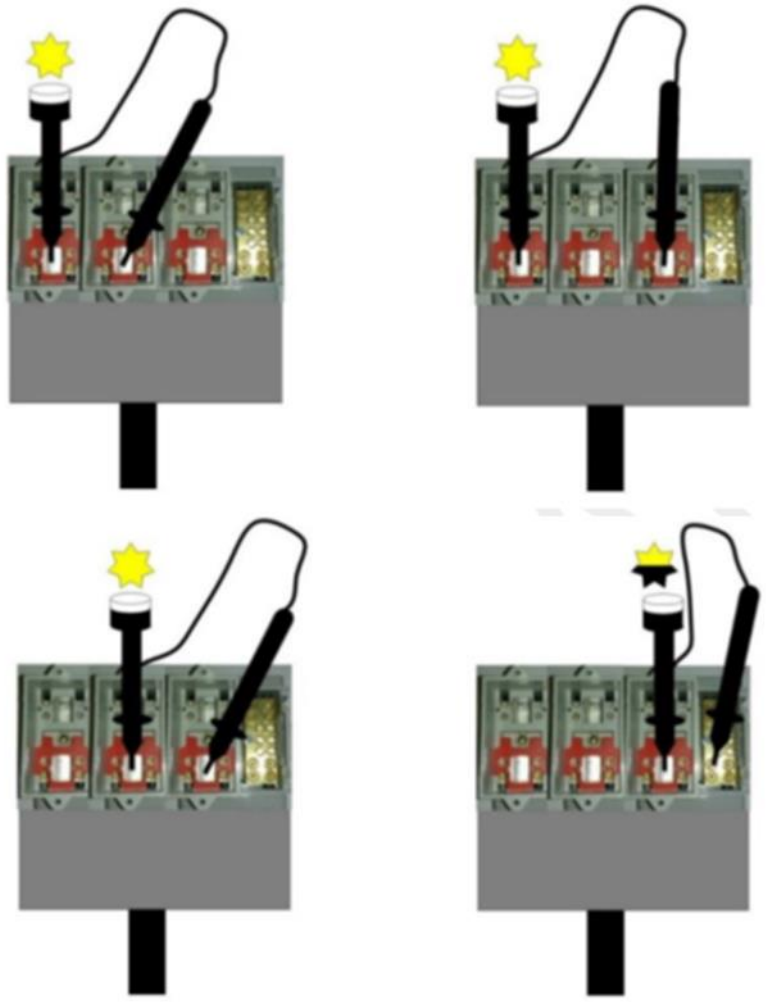

Figure 10.4 - Three-Phase SNE or CNE Tests

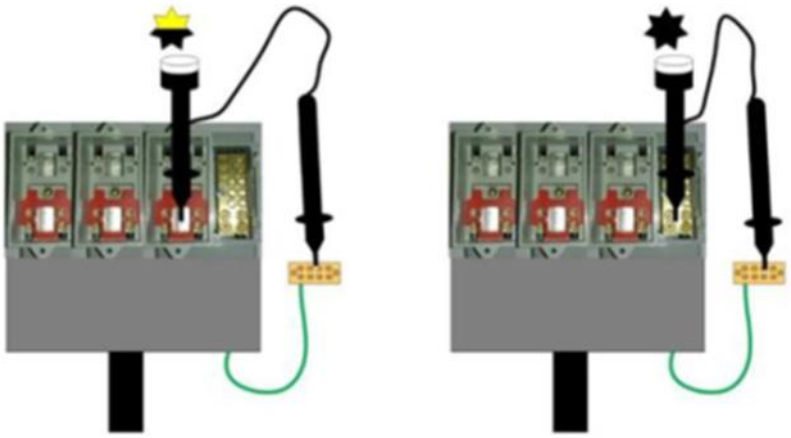

Figure 10.5 - Three-Phase SNE Additional Tests

Figure 10.6 - Drummond MTL 10 Indications

11 Measuring Supply Voltage

11.1 When **Conductors** have been terminated at a supply point the voltage between phase(s), neutral and **Earth** connections **Shall** be measured using a voltage meter to ensure that the voltage being supplied is within ESQCR limits (+ 10% - 6%) as shown in Table 11.1.

11.2 Only **Approved**, calibrated voltmeters or multimeters with fused leads **Shall** be used.

11.3 Use the voltmeter or multimeter to make the following individual measurements:

- Between all individual phases to the neutral/**Earth** (CNE cables)
- Between all individual phases to neutral (SNE cables)
- Between all individual phases to **Earth** (SNE cables)
- Between neutral and **Earth** (SNE cables)
- Phase to phase (three-phase)
- Phase to phase (split-phase)

Table 11.1 - Statutory Voltage Limits

System	Required Test	Acceptable Range	
		High	Low
Single Phase	Phase – Neutral / **Earth** (CNE)	253V	216V
	Phase – Neutral (SNE)	253V	216V
	Phase – **Earth** (SNE)	253V	216V
Three-Phase	Phase – Phase (SNE and CNE)	440V	376V
	Phase – Neutral (SNE)	253V	216V
	Phase – **Earth** (SNE)	253V	216V
Split-Phase	Phase – Phase (SNE and CNE)	506V	432V
	Phase – Neutral (SNE)	253V	216V
	Phase – **Earth** (SNE)	253V	216V
All	Neutral – **Earth** (SNE)	6V	0V

12 Pre-work Checks

12.1 Where reasonably practicable and for reference purposes, the following tests **Shall** be completed before the supply to a consumer is disconnected:

- Polarity
- Phase Rotation (for three-phase Systems)
- **Earth** Loop Impedance
- **Live** supply indication

12.2 The following sequence **Shall** be followed:

1. Prior to work which has the potential to change the polarity, as a reference point and where practicable, confirm the correct polarity either at the supply point (Appendix A) and at a socket outlet within the property using the **Approved** plug in polarity tester (if accessible). The plug-in polarity tester' **Shall** remain in the same socket outlet as a final polarity check following restoration of supplies (Appendix B).

NOTE: The plug-in polarity tester is not an **Approved** means of establishing polarity and **Shall** only be used for indication purposes.

2. Remove the cut-out fuse(s), and for PME **Systems**, or street furniture, disconnect the customers main **Earth** lead from the PME **Earthing** Terminal (see note in Appendix A).
3. Test polarity on the incoming side of the cut-out (Appendix A).
4. On three-phase supplies, check the phase rotation using an **Approved** test device to confirm the rotation (Appendix C).
5. Carry out an **Earth** Loop Impedance test (Appendix D).
6. Where necessary to maintain safety at the cut-out position, replace the fuse carrier(s) into the cut-out with fuses removed or apply **Approved** shrouding.

13 Post-work Checks

13.1 On completion of work and prior to the restoration of supplies at the service position, there is a requirement to confirm, where reasonably practicable, the following:

- Correct Polarity
- Correct Phase Rotation (for three-phase **Systems**)
- **Earth** Loop Impedance
- **Live** supply indication
- Voltage Measurement

13.2 Where the sequence of testing detailed in 12.2 cannot be followed and the polarity cannot be proven, then supplies to those individual locations **Shall** not be restored.

13.3 The following sequence **Shall** be followed:

1. Commencing with the cut-out fuses removed and where required the customers **Earth** connection to the PME **Earthing** terminal and neutral tail removed, use an **Approved** test lamp to confirm all phase **Conductors**, all neutral **Conductors** and all

Earth Conductors (Section 10). Using an **Approved** voltage measuring device confirm the phase voltages (section 11.).

2. Test the **Earth** Loop Impedance (Appendix D) to ensure the values are within those required by **SSEN-D**.
3. Confirm the correct polarity at the supply point (Appendix A).
4. If the polarity is correct and the **Earth** Loop Impedance results are satisfactory, reconnect the customers main **Earth** lead (if disconnected earlier).
5. If the phase rotation was checked prior to disconnection, check again using an **Approved** test device to confirm the rotation has not changed (Appendix C). Where it was not possible to check the supply prior to work, e.g. in the event of a fault affecting the incoming supply, ensure the customer switches off any three-phase machines.
6. Restore the cut-out fuse(s), seal terminal covers and fuses as necessary and restore the customers supply.
7. Where a 'plug in polarity tester' was left connected, check the indication to confirm the polarity is correct at the same socket outlet.
8. Where it was not possible to use a 'plug in polarity tester' before work commences, e.g. in the event of an incoming fault, then polarity **Shall** be checked at a minimum of two socket outlets on separate circuits (e.g. ring main and cooker), where this is possible. Where the test indicates an unexpected result, this **Shall** be investigated prior to leaving site.
9. To confirm correct phase rotation, allow the customer to check the correct operation of one of their machines.
10. Where it is not possible to access a property then the requirements of steps 7 and 8 may be omitted.
11. Where any testing has been omitted, the specific property details and tests omitted **Shall** be recorded on the incident notes related to the job, or for planned work a specific incident raised specifically to record those details.

13.4 After supply point testing with no metering or customer equipment connected has been completed, the cut-out **Shall** be left as follows:

1. All connections are suitably tight.
2. Replace neutral cover at the cut-out.
3. Insert fuse carrier(s) with correctly rated fuses.
4. Fit security seals.
5. Fit labels as required. PME, Phase identification colours, Phase Rotation, etc.

13.5 Where metering or customer equipment is connected and supply point testing has been completed, the cut-out **Shall** be left in accordance with WI-NET-CAB-129.

13.6 For new connections, the appropriately rated cut-out fuse **Shall** be installed in the fuse holder of the cut-out. It **Shall** not be placed on top of the cut-out or any other location. All spare **Conductor** holes in the cut-out **Shall** be sealed with plastic plugs to prevent access to the terminal block.

13.7 Where it is necessary to leave a customer disconnected due to an issue with the metering equipment, both meter tails **Shall** be removed from the cut-out and the holes sealed with plastic plugs to prevent access. The fuse **Shall** remain installed in the fuse holder.

14 Actions Following the Discovery of Incorrect Polarity

14.1 If any incorrect polarity is found before work starts, isolate the supply and inform the **Team Manager**. Following this, inform the customer as there may be a need to check the internal wiring for any issues.

14.2 The **Team Manager** Shall manage the process of:

1. Completing the ESQCR Regulation 31 reports (for reverse polarity incidents).
2. Maintaining electronic records of the incident.
3. Notifying the relevant Investigating Manager as defined in PR-NET-OSM-010 Management of Erroneous Operations - Operational Safety Manual -Section 3.3.
4. Notifying the meter operator if applicable.

14.3 In the case of incorrect polarity or phase rotation being provided, a suitable and sufficient investigation **Shall** be made by an Investigating Manager as soon as possible after the event has been reported, and the following principles **Shall** apply:

1. If the reverse polarity or inadvertent reversed phase rotation is on **SSEN-D** equipment, a Line Manager of the person discovering the fault **Shall** conduct the investigation.
2. Where a Line Manager cannot be identified, the **Team Manager Shall** undertake the investigation.
3. Where the reverse polarity or inadvertent reversed phase rotation is on the metering installation, the meter operator **Shall** be instructed to carry out the investigation.
4. Where the reverse polarity is on the Customer's installation, the supply **Shall** be left safe, i.e. the cut-out fuse **Shall** be removed and the cut-out sealed. The customer **Shall** be informed of the reason for the isolation of the supply. No investigation is required in this situation, but details **Shall** be recorded by the Customer Contact Centre.
5. Where it is necessary to rectify the reverse polarity or inadvertent reversed phase rotation on the **SSEN-D LV** Distribution **System** prior to an investigation taking place, evidence **Shall** be gathered. Photographs **Shall** be taken before and after rectification work and seals retained. Details of any work done **Shall** be recorded.
6. A copy of the investigation report **Shall** be sent to the **SSEN-D** Operational Safety Manager and this **Shall** be retained and referenced to the ESQCR Regulation 31 report where required.

14.4 Where the problem lies with the customers installation, e.g. reverse polarity on a ring main, the **SSEN-D** representative on site **Shall** indicate the nature of the problem and the remedial measures required, as required under the ESQCR.

15 Revision History

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

Appendix A Polarity Testing

1. Only **Approved** testing devices **Shall** be used to test polarity.
   - An EA Technology Polarity Tester. This must be labelled 'EA Technology' or 'Polarity Tester'. No other similar voltage proximity indicator **Shall** be used. The tester requires two 1.5V batteries, and these **Shall** be replaced when the indicator light fails to consistently light up when tested against a known **Live** source. If the tester lights up at more than 4mm from a **Live Conductor**, then the device must be replaced. The tester **Shall** be checked against a known source of supply before testing.
   - A NEON pen. When using a NEON pen, it is permitted to remove one insulated glove to complete a polarity test as the instrument requires a circuit to be made using the body to **Earth**, to function as designed. The insulated glove **Shall** be replaced following completion of the test.
2. Test instruments **Shall** be tested on each occasion before use using an **Approved** proving unit or a known source of supply.
3. NEON pen indicators may be tested using an insulation resistance tester. Set the instrument to the 500V scale and test the NEON for a minimum resistance of 1.5MΩ and look for the indicator lamp illuminating.
4. When using the **Approved** testing device, **Low Voltage** insulated gloves **Shall** be worn, with the exception of a NEON pen as detailed in section 1 above.
5. Tests **Shall** be carried out on all phase **Conductors**, all neutral **Conductors** and all **Earth Conductors**.
6. Remove the cut-out fuse(s), and for PME **Systems**, or street furniture, disconnect the customers main Earth lead from the PME **Earthing** Terminal.
7. Remove any equipment terminal covers required for access to test terminals.
8. Test polarity on the supply side of the cut-out.
9. Replace the cut-out fuse(s).
10. Test the polarity of all the **SSEN-D** owned and/or fitted equipment.
11. If the polarity is correct as indicated in Figures A.1 and A.2, remove the cut-out fuse(s).
12. Replace the customers main **Earth** lead (if removed earlier) and all equipment covers.
13. Replace the cut-out fuse(s) seal all fuses/ access covers as necessary.

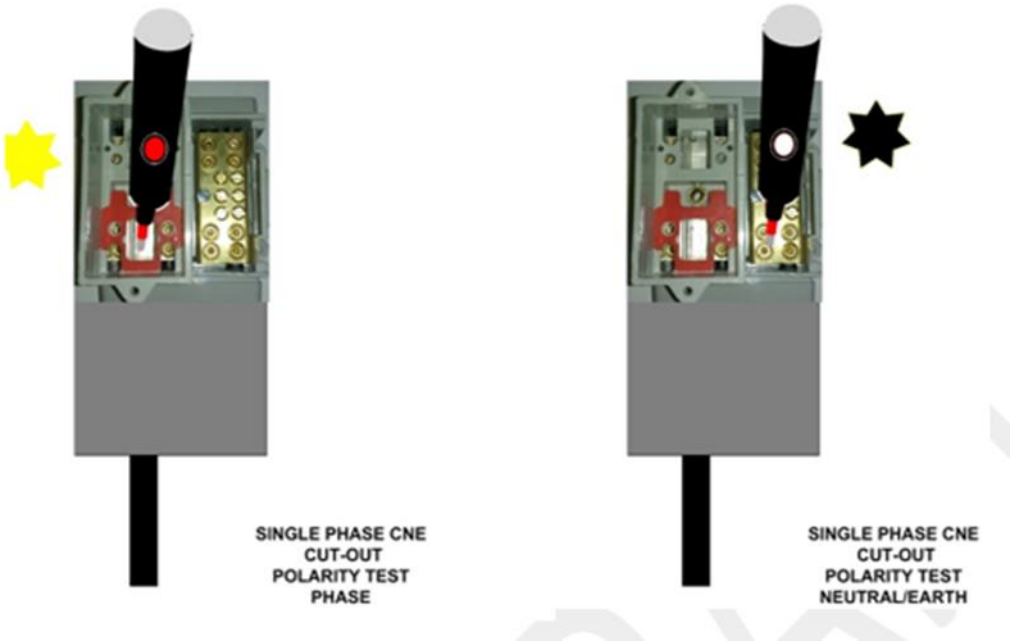

Figure A.1 – Single Phase CNE Polarity Test

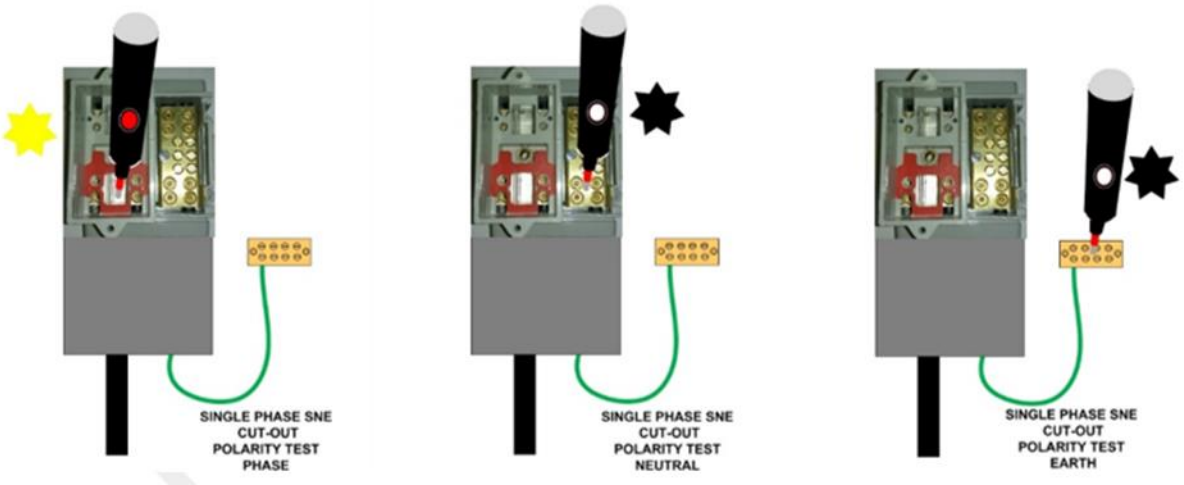

Figure A.2 – Single Phase SNE Polarity Test

Appendix B Polarity Testing (Plug in tester)

1. The **Approved** 'plug-in tester' provides access to the terminals of a single phase 230V socket for the purpose of testing the polarity of the socket. It **Shall** be used as described below and in conjunction with the **Approved** procedure for the work being carried out.

2. The **Approved** 'plug in tester' **Shall** only be used in conjunction with an **Approved** voltage testing device, to test the polarity.

3. The following procedure **Shall** be followed to test polarity:

   i. Plug in the **Approved** 'plug in tester' into the socket to be tested.

   ii. If the socket has a switch, put the switch to 'On'.

   iii. The 'Mains On' indicator on the 'plug-in tester' where fitted, will glow.

   iv. Check each of the three test terminals of the 'plug-in tester' with the **Approved** voltage testing device.

   v. If the polarity of the socket is correct, only the **Live** terminal (L) will indicate the presence of a voltage.

   vi. If the neutral or **Earth** terminals indicate the presence of a voltage, contact your supervisor, the customer and the Customer Contact Centre immediately and remove the 'plug in tester' from the socket. Do not proceed with the work.

   vii. This device is to be used to test polarity of a socket both before and after work is carried out at the service position, therefore both of these tests **Shall** be carried out at the same socket.

4. It is important to measure the resistance between each plug pin of the device and the corresponding test point on a regular basis (minimum annually by a tool inspector) to ensure integrity of the device. In serviceable condition a value of 560kΩ ±1% will be registered for each measurement.

Appendix C Phase Rotation Testing

1. Phase rotation direction **Shall** be verified at three-phase cut-outs to facilitate the connection of customers three-phase equipment.
2. Phase rotation can only be verified on three-phase cut-outs and cannot be checked on single or split-phase Systems.
3. For new three-phase customers the rotation **Shall** be deemed correct if the rotation is anti-clockwise and the phase installation has been constructed Brown (L1), Black (L2) and Grey (L3) from Left to Right, or, Brown (L1), Black (L2) and Grey (L3) from Top to Bottom.
4. The rotation of the three phases **Shall** not be altered once a three-phase customer has been connected without the agreement of the customer. This is because an incorrect phase rotation at the supply point might have been corrected on the customer's equipment or network. Reversing a phase rotation can gives issues with three phase motors and the machinery.
5. Only an **Approved** test device **Shall** be used to test for phase rotation, as detailed in MA-NET-ENG-002.
6. When undertaking a phase rotation test, **Approved** PPE **Shall** be worn.
7. Connect the coloured leads of the instruments as indicated in Figure C.1. The rotation meter will begin to rotate when the third phase connection is connected.

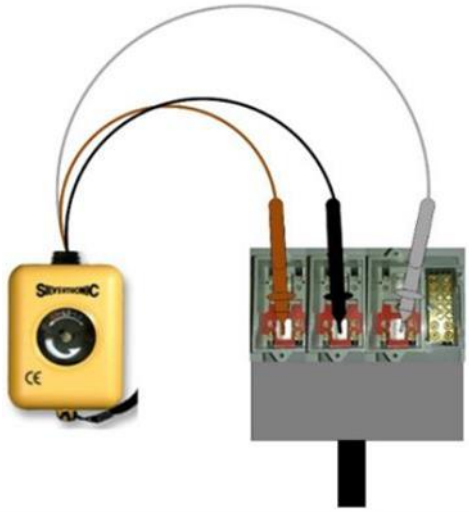

Figure C.1 – Connection of a Phase Rotation Meter

8. **SSEN-D** standard rotation is anticlockwise. The instrument shown in figure C.1 indicates standard rotation by the white arrow on a disc rotating in an anti-clockwise direction.
9. Not all phase rotation meters indicate rotation in the same way. Some meters use a rotating disk or sequential rotating lights, and some illuminate a sequence indicator. Refer to TG-NET-CAB-019.

Appendix D Earth Loop Impedance Testing

1. **Earth** Loop Impedance (ELI) can also be termed '**Earth** fault loop impedance' or 'loop impedance'. When **Conductors** have been terminated at a supply point the ELI between phase(s) and neutral or **Earth** connections **Shall** be measured using an **Earth** loop impedance tester to ensure that correct values are supplied.
2. Correct **Earth** loop impedance values are required to ensure enough current flows within a faulty circuit to operate **Low Voltage** fused protection within defined time limits at the fuse position on the **Low Voltage System**.
3. The ELI is critical for the selection of fuse rating as the higher the value of ELI, the longer a fuse will take to operate for any given size. The network ELI is dictated by either the need for the supply termination fuse to operate in 5 seconds or the distributor network fuse to operate in 100 seconds. Legacy **Low Voltage Systems** may have longer clearance times.
4. Only an **Approved** test device **Shall** be used to test for **Earth** Loop Impedance, as detailed in MA-NET-ENG-002.
5. When undertaking an **Earth** Loop Impedance Test, **Approved** PPE **Shall** be worn.
6. For Multi-phase supply terminations an ELI test **Shall** be completed using all supply phases, as the expected results are required for any **Earth** loop impedance test involving any phase.
7. **Earth** loop impedance testers are supplied with either 2 leads or 3 leads. Both variants can be used on SNE and CNE **Systems** as illustrated in Figures D.1 and D.2.
8. For a two-lead **Earth** Loop Impedance meter:
    - For a CNE network cut-out only one test is required. This test is completed between the phase(s) and combined neutral/**Earth** terminal. The leads are connected as illustrated in Figure D.1.
    - For an SNE supply point termination two tests are required. The first test is completed between phase(s) and the separate **Earth** terminal and the second test is completed between phase(s) and the neutral. The leads are to be connected as illustrated in Figure D.1.

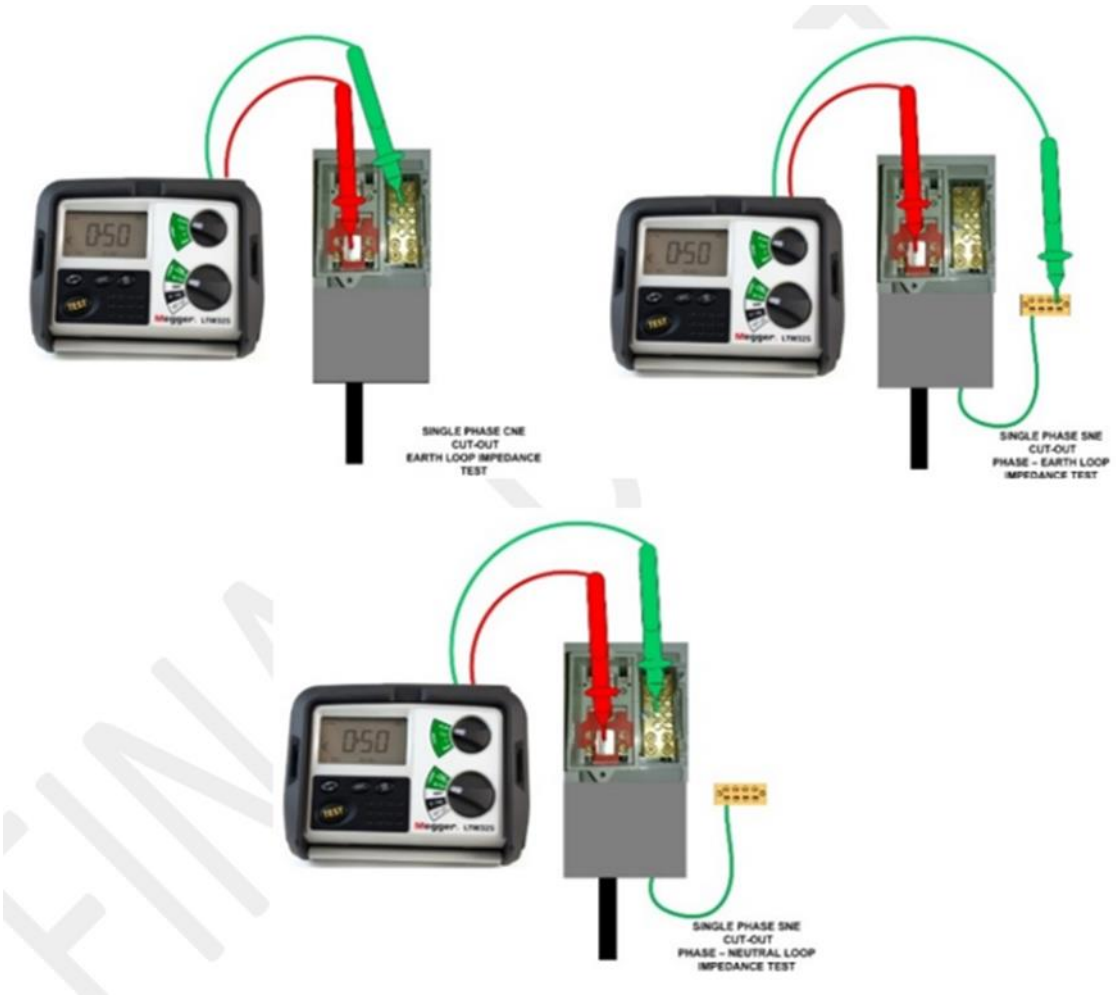

Figure D.1 – Connection of a Two-Lead Earth Loop Impedance Meter

9. For a three-lead **Earth** Loop Impedance Meter:

- For a CNE network cut-out, only one test is required. This test is completed between the phase(s) and combined neutral/**Earth** terminal. A three-lead instrument is used by combining the neutral and **Earth** test leads together at the combined neutral/**Earth** terminal being tested. The leads are connected as illustrated in Figure D.2.
- For a SNE network cut-out two tests are required. The first test is completed between phase(s) and the separate **Earth** terminal and separate neutral terminal. The second test is completed between phase(s) and neutral terminal by combining the **Earth** and neutral leads together at the cut out, like a three-lead test on a CNE cut out. The leads are to be connected as illustrated in Figure D.2.

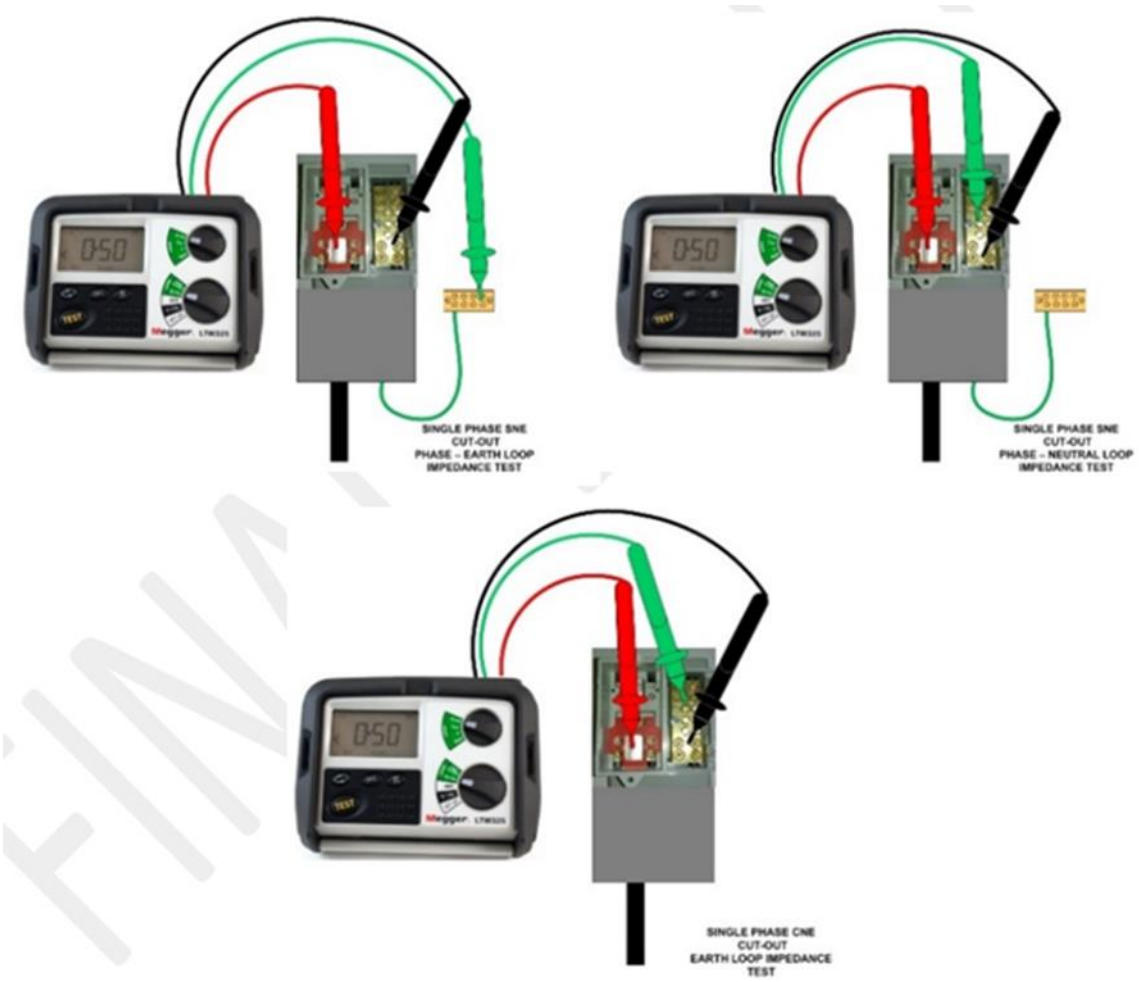

Figure D.2 – Connection of a Three-Lead Earth Loop Impedance Meter

10. For legacy networks and those networks installed before 2016, the permitted maximum ELI values and cut-out fuse sizes are given in Table D.1.

Table D.1 – Legacy Network Cut-Out Fuses

Maximum Cut-out Fuse Size	Type of Earthing	Maximum Value of ELI
Up to and including 25A	Lead cable sheath or continuous **Earth** wire	0.8Ω
Above 25A and including 100A	PME installations	0.35Ω
	Lead cable sheath, continuous **Earth** wire or hybrid SNE/CNE network	0.8Ω
200A	PME, SNE or Hybrid PME/SNE	0.2Ω
315A		0.2Ω
400A		0.15Ω
500A		0.15Ω

11. Work which involves new or existing **Low Voltage** distributors and services being connected to a legacy network **Shall** use the permitted maximum ELI values and cut-out fuse sizes given in Table D.1.

12. For new network installations and those networks installed after 2016 the permitted maximum EFLI values and cut-out fuse sizes are given in Table D.2.

Table D.2 – New Network Cut-Out Fuses

Maximum Cut-out Fuse Size	Type of Earthing	Maximum Value of ELI
6A	PME	17.48Ω
10A		14.20Ω
16A		4.94Ω
20A		3.67Ω
25A		2.74Ω
Above 25A and including 100A	PME	0.25Ω [NOTE 2]
	SNE or PME hybrid using 3, 4 core wavecon to the secondary substation [NOTE 1]	0.25Ω [NOTE 2]
200A	PME, SNE or Hybrid PME / SNE	0.25Ω [NOTE 2]
315A		0.16Ω [NOTE 1]
400A		0.13Ω [NOTE 1]
500A		0.10Ω [NOTE 1]
Supplies above 500 A	SNE	0.10Ω [NOTE 3]

NOTE 1: This value allows the cut-out fuse to operate in 5s.

NOTE 2: This value allows a 400A substation feeder fuse to operate in 100s.

NOTE 3: Clearance time dependent on MCCB or ACB protection setting.