PR-NET-OSM-026

HIGH VOLTAGE SYSTEM SWITCHING AND EARTHING

OPERATIONAL SAFETY MANUAL – SECTION 4.2

Scottish & Southern Electricity Networks

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CONTENTS

1 Introduction

1.1 This document defines the **Approved** procedure for **High Voltage Switching** and the application of **Earths** on the **SSEN-D** distribution **Systems**.

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 **Operators** who are required to control and carry out **Switching** on the **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 System
- The requirements of the Control Person(s) are accurately and unambiguously conveyed to the recipient of the Switching instruction
- The recipient executes the Switching instruction as instructed, without distraction or unnecessary delay
- At all times consideration is given to the operating characteristics of the System

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-025	General System Operating Arrangements - Operational Safety Manual Section 4.1
PR-NET-OSM-028	Switching Terminology and Approved Abbreviations - Operational Safety Manual - Section 4.4
PR-NET-OSM-031	Interlocks and Adjustments of Switchgear Mechanisms – Operational Safety Manual – Section 4.7
PR-NET-OSM-087	Management of Activities at the interface of High Voltage Customers – Operational Safety manual – Section 13.5
SP-NET-OHL-002	Portable Earthing Equipment and Operating Rods for Use in Low Voltage Substations up to and Including 132kV
TG-NET-SST-024	Portable Earth Requirements for use in Primary-Grid and Supergrid Substations
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 **OSR**.

4.2 **Field Controller**

The **Person** who by agreement with the **Distribution Control Engineer** takes responsibility for control of operations on a predefined part of the **System** under an **Approved** procedure.

4.3 **Field Control**

The generic term used on authorisation certificates to describe the Control of **HV Systems** by a **Person** other than the **Control Engineer**, i.e., by a **Field Control Engineer.**

4.4 **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.**

4.5 **Operator**

The **Authorised Person** permitted to carry out **Switching** on 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 **Switching** on the **System 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 authority level.

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

7 Records

7.1 For audit purposes, all **Switching** schedules and **Switching** log books **Shall** be retained for a minimum of 12 months. This requirement precedes any additional line management instructions.

7.2 Completed **Switching** schedules and log book particulars **Shall** be the responsibility of the **Authorised Person** in receipt of such.

8 Personal Protective Equipment

8.1 Persons who are required to work or undertake **Switching** duties on 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.

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

8.3 When carrying out **Switching**, **Approved** insulating gloves **Shall** be worn by the **Operator** before operating any of the following **Apparatus**:

- Test equipment, test leads, test prods
- Structure mounted equipment
- Overhead line Apparatus
- When applying portable Earthing

8.4 The insulated gloves **Shall** only be removed following the completion of the operation and when the **Operator** has moved away from the operating position.

8.5 Insulating gloves **Shall** be inspected before use to ensure they are within date and undamaged. Where concern exist, the gloves **Shall** be replaced before any operation is carried out.

9 General Requirements

9.1 Documentation

9.1.1 As a minimum prepared and checked **Switching** schedules, **Switching** log books and up-to-date diagrams detailing the ownership and control responsibility for each piece of **Apparatus Shall** be used to facilitate **Switching** on the **System**, in accordance with Network Operating Procedures detailed in PR-NET-OSM-025 Network Operating Procedures Operational Safety Manual Section 4.1.

9.1.2 **Switching** schedules and **Switching** log books **Shall** be of an **Approved** format.

9.1.3 **Switching** schedule requirements **Shall** comply with the **OSR** and PR-NET-OSM-025 Network Operating Procedures Operational Safety Manual Section 4.1. Switching schedule operations **Shall** normally be carried out in strict sequence unless a change in sequence is authorised by the **Control Engineer** or **Field Controller**.

9.2 Operation of Switchgear

9.2.1 Where reasonably practicable, manual **Switching** operations **Shall** be carried out with the **Apparatus Dead**. It is not considered reasonably practicable to operate the **Apparatus Dead** if any of the following points will be incurred:

- If one or more customers will be affected
- If any significant additional travel is required
- If the upstream switch that would be operated to make the switch Dead is not remotely operable

9.2.2 Where **Switching** operations are to be carried out with the **Apparatus Live**, where practicable they **Shall** be carried out in accordance with the hierarchy detailed in **OSR** 3.6.7:

1. Remotely via remote control facilities
2. Remotely on site via control panels in a different room to the switchgear being operated

3. Remotely via a control panel in the same room as / adjacent to the switchgear being operated
4. Remotely via an Approved umbilical device or similar
5. Manually via the operating facilities on the switchgear.

NOTE: If adherence to this hierarchy increases risk, i.e., the position of a remote operating panel increases risk to the **Operator**, this **Shall** be noted on the **Switching** schedule or log book, along with the method of operation used.

9.2.3 Switchgear **Shall** be operated in accordance with the **OSR** and original equipment manufacturer instructions. Where original equipment manufacturer instructions are no longer available, switchgear **Shall** be operated in accordance with the **OSR** and **SSEN-D** instructions.

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

9.2.5 Account must be taken of the temporarily increased fault level when grid or primary substations are paralleled. In such cases and following agreement with the **Control Engineer** or **Field Controller**, **Switching** in order to maintain the symmetrical fault level below the switchgear rating **Shall** be carried out.

9.2.6 Labels of a standard size and design **Shall** be permanently affixed to switchgear and be used as a means of identification which **Shall** remain effective throughout **Switching** duties.

9.2.7 Before operation, switchgear (including associated equipment) **Shall** be visually inspected for signs of distress, interference, pollution, undue noise or temperature rise or other indications, which may affect its capability. In the case where switchgear shows signs of distress, its condition **Shall** be reported immediately to the **Control Engineer** or **Field Controller**. The switchgear **Shall** be thoroughly examined before a decision is made about further operation.

9.2.8 **Switching Shall** not be carried out without the authority of the appropriate **Control Engineer** or **Field Controller**, except in emergency and other **Approved** cases.

9.2.9 Where carried out, emergency **Switching Shall** be reported to the **Control Engineer** or **Field Controller** without unnecessary delay. The circumstances necessitating such **Switching Shall** be explained at that time.

9.2.10 **Switching** and the confirmation of completion **Shall** be reported to the **Control Engineer** or **Field Controller Shall** without unnecessary delay.

10 Safeguarding Against Electrical Danger

10.1 Pre-Switching Checks

10.1.1 Before carrying out any **High Voltage Switching**, the **Person** who receives the instructions Shall consider any implications and **Shall** discuss any doubts with the person issuing the instructions.

10.1.2 Prior to any manual **Switching** operations being carried out, the following checks **Shall** be carried out by the **Operator**:

- Right Location – Right Switch – Right Operation
- All access and egress routes to and from the switchgear are clear
- The correct PPE is worn by the Operator and other persons in the immediate vicinity.

- The switchgear in the expected state
- The switchgear, supporting structures or insulators are not showing any signs of distress, defects or interference
- The visible Earthing is sound
- The levels of insulating oil and/or insulating gas are correct
- There are no unusual smells or noises
- The suitability and integrity of operating handles and other ancillary equipment needed to complete the intended operations
- If the operation can be carried out Dead
- That the Operator is trained, confident and knowledgeable in the operation of the switchgear
- That the Operator holds the authorisation to operate the switchgear
- That the Operator has been instructed to operate the switchgear

10.1.3 Where visual inspection identifies that any switchgear indicates signs of distress, the **Control Engineer** or **Field Controller Shall** be informed before any operation is carried out. If the **Authorised Person** believes the gear is unsafe to operate **Live**, it **Shall** only be operated **Dead**, irrespective of any network or customer considerations.

10.2 Interlocks

10.2.1 Safeguarding persons from the **Danger** associated with the operation of switchgear **Shall** be achieved through the use of interlocks.

10.2.2 Interlocks are installed to prevent operation of switchgear outside of normal parameters. Under normal conditions interlocks **Shall** not be overridden.

10.2.3 In cases where it is necessary to override an interlock for operational purposes this **Shall** be carried out in accordance with PR-NET-OSM-031 Interlocks and Adjustments of Switchgear Mechanisms - Operational Safety Manual Section 4.7.

10.3 Isolation and Earthing

10.3.1 The safeguarding of persons against electrical **Danger** whilst working on **Dead** overhead and underground **Systems Shall** be achieved through a combination of isolation and **Earthing**, where:

- Isolation is the physical disconnection of the part of the System to be worked on from all sources of supply
- Isolation is applied at both High Voltage and Low Voltage and is undertaken before the issue of a Safety Document, unless an Approved procedure allows otherwise
- Isolation is secured through the fitting of an Approved Caution Notice, and where the facility exists, an Approved Safety Lock. Safety Locks Shall be different from all other standard locks used on the System. For the purpose of this procedure the term Safety Lock Shall refer to:
  - **Safety Locks** (South licence area)
  - Isolation Locks (North licence area).
- Earthing is the connection to the conductive mass of Earth through adequately rated Earthing devices including switchgear and Approved Earthing leads.

- Earthing Shall be achieved through the application of Circuit Main Earths and Additional Earths
- Circuit Main Earths Shall be applied between the work zone and all High Voltage points of isolation on the System prior to the issue of a Safety Document
- Additional Earths, where appropriate, Shall be applied after the issue of a Safety Document to protect against other electrical hazards, including:
  - **Induced voltages**
  - **Transformers back-fed from Low Voltage interconnection or Low Voltage generation**
  - **Accidental contact with Live overhead Conductors crossing the zone of work**
  - **Visual identification that the zone of work has been made Dead and safe to work on where the Circuit Main Earth is not visible from the work location**

10.3.2 The application and removal of **Additional Earths Shall** be recorded by the recipient of the **Safety Document**. Where practicable an **Additional Earth** schedule **Shall** be used. This schedule **Shall** also be used to record any special requirements that may apply.

10.3.3 **Low Voltage System** isolation **Shall** be established ensuring safety from the **System** and all sources of stored energy.

10.3.4 Known sources of generation **Shall** include **SSEN-D** mobile generation and any other known fixed generation able to operate in parallel with or independent to the **System**, connected at either **High Voltage** or **Low Voltage**. This excludes small, fixed generating sites rated at 300kW or less, installed after 1995 and compliant with either the Energy Networks Association Engineering Recommendation ER G59/G99 and/or ER G83/G98 (which require(s) generation to 'shut down' for 'loss of mains').

10.3.5 Generators that are to be treated as a 'Known Generation Source' **Shall** be referenced on the **System** diagram and treated as sources of supply.

10.3.6 Static and dynamic reactive compensation equipment (such as a static VAr compensator) **Shall** be treated as possible sources of supply.

10.4 Switching Operations

10.4.1 The following requirements **Shall** be met when **Switching**:

- Where reasonably practicable, only one operational lock should be removed at any one time
- Where ground-mounted High Voltage switchgear is used as a point of isolation and following instruction from the Control Engineer or Field Controller, a Safety Lock Shall be applied so that it does not need to be disturbed at any time until the equipment is being restored to service
- Where switchgear has separate operating mechanisms and / or handles for isolation and Earthing, a Safety Lock Shall be applied to the 'ON / OFF' mechanism
- Where switchgear is fitted with a single operating mechanism and / or handle for both isolating and Earthing, a Safety Lock Shall be applied to the interlock / selector in the 'OFF / EARTH' position when the switch is being used to create a point of isolation
- Where the facility exists, any switch which has been used to apply an Earth on the System Shall be mechanically locked in the Earth position using:
  - **'X' type operational lock (South license area)**

- **'POS' type lock (North license area).**

10.4.2 An **Approved** umbilical or other device is one which is either provided by the manufacturer for remote control of the switchgear, or an electrical or mechanical device that is issued by **SSEN-D** for use with the particular switchgear.

10.5 Proving Dead

10.5.1 No Person **Shall** use any **Approved** voltage testing device without adequate training in its use and **Shall** use the device in accordance with relevant safety procedures and instructions issued. The user of a device **Shall** be fully conversant with the characteristics of the device and its use.

10.5.2 Prior to an **Approved** voltage testing device being used, the user **Shall** carry out a visual inspection to check the condition of the device. If there is any doubt that the device is not in good condition, it **Shall** not be used for testing and immediately taken out of service. Any calibration or test dates **Shall** be checked, should they be exceeded, the device **Shall** be immediately taken out of service, pending re-calibration or appropriate testing.

10.5.3 **Approved** voltage testing devices **Shall** be tested to prove they are functional both immediately before and after use, this includes visual and audible indications where applicable.

10.5.4 Where reasonably practicable, the testing of **Approved** voltage testing devices **Shall** be carried out with a manufacturer supplied proving unit, in accordance with instructions. Where this is not reasonably practicable, they **Shall** be tested against a known source of supply at the same voltage level as the **Conductor** to be tested. Internal test facilities **Shall** not be used as a substitute for a manufacturer proving unit or known voltage source check.

10.5.5 Where reasonably practicable, when overhead **Conductors** are tested by means of Capacitive Voltage Indicators, the test **Shall** be carried out from ground level. Where this is not reasonably practicable, and work at height is required, sufficient insulating rods **Shall** be used to ensure that the **Safety Distance** is not infringed.

10.5.6 Voltage Presence Indicator Systems (VPIS) fitted to compartments of **High Voltage Apparatus** are not **Approved** for proving **Dead**.

NOTE: BS EN 62271-206 states the use of VPIS alone is not a reliable means for proving **Dead Conductors** as the absence of an indication might not be solely due to the absence of voltage, e.g., failure of a lamp.

10.5.7 Voltage Detection Systems (VDS) in accordance with BS EN 61243-5 may be used to prove **Conductors** which they are connected to are **Dead**. Prior to use the VDS **Shall** be tested for correct function.

10.5.8 There is no requirement to test and prove a circuit **Dead**, before using a circuit-breaker to apply an **Earth**, except where there is doubt about the circuit identification.

10.5.9 Where work is being carried out on a distribution ring main unit it **Shall** be proved **Dead**, prior to work commencing, by closing all available switches to the **Earth** position. Additional information is available in Appendix B

10.6 Circuit Main Earths

10.6.1 The **Circuit Main Earth** is an essential part of the safety precautions for work on a **High Voltage System**. The **Circuit Main Earth Shall** be applied between all isolated **High Voltage** sources and the point of work. Where practicable the **Circuit Main Earth Shall** be located outside of the zone of work and in such a way that it will not be disturbed during the course of work.

10.6.2 Where **Approved** portable **Earthing** equipment is used it **Shall** be applied in accordance with the **OSR**. When left unattended consideration **Shall** be given to the duration of the work and accessibility by third parties.

10.6.3 Where it is necessary to remove and/or replace a **Circuit Main Earth** during the course of the work, for example when removing a spur **Conductor**, this **Shall** be carried out with the agreement of the **Control Engineer** or **Field Controller** and under the **Personal Supervision** of a **Senior Authorised Person**. All activities to be undertaken **Shall** be recorded on the **Permit-to-Work** under 'Other Precautions'.

10.6.4 The application of a **Circuit Main Earth Shall** be in accordance with the following hierarchy:

1. Through suitably rated switchgear (**Earthing** switch or circuit breaker with integral **Earthing**).
2. Through a circuit breaker with accessory **Earthing** facilities.
3. Through **Approved** portable **Earthing** equipment applied at the discretion of the **Authorised Person**.

10.6.5 The first **Earth** applied to, and the last **Earth** removed from the **System Shall** where reasonably practicable be achieved utilising a circuit breaker or **Earthing** switch provided for that purpose.

10.6.6 Where the use of an **Earthing** switch or circuit breaker is not reasonably practicable, a portable **Earthing** device **Shall** be used and the **High Voltage Conductors Shall** be checked by means of an **Approved** voltage testing device before the application of the portable **Earthing** device.

10.6.7 An exception to testing for voltage is permitted on **Systems** energised at 66 kV and above where it is not practicable to do so unless an **Approved** procedure is in place.

10.6.8 Where circuit identification cannot be proven and doubt exists, the circuit **Shall** be proved **Dead** by means of an **Approved** voltage testing device prior to applying the **Earth** via a circuit breaker.

10.6.9 Any **Earthing** switch or circuit breaker used to apply a **Circuit Main Earth** on the **System Shall** not be located inside the zone of work, except under circumstances detailed in Appendix A.

10.6.10 Where work is being carried out on a distribution ring main unit or freestanding fuse switch **Circuit Main Earths Shall** be applied at the switchgear remote from that site, to facilitate the operation of all switches whilst still maintaining a safe zone of work.

10.6.11 Where work is being carried out on equipment beyond a fused switch without earthing facilities, **Circuit Main Earths Shall** be applied at a suitable location upstream of the fused switch. The fused switch **Shall** remain in the closed position to maintain a safe zone of work for the duration of the work.

10.7 Use of a Single Circuit Main Earth on Overhead Lines

10.7.1 Under the exception of **OSR** 4.1.1 (iv) where work is required at a single point on an overhead line and it is not reasonably practicable to apply a **Circuit Main Earth** at each side of the zone of work, a **single Circuit Main Earth** applied at the point of work is acceptable, providing that:

- The work to be undertaken will not interfere with the continuity of the overhead line Conductors
- The work is less than 3 metres from the Earth connection
- The work remains continuous throughout

10.7.2 When this exception is used, the **Senior Authorised Person** issuing the **Safety Document Shall** agree the location of **Circuit Main Earth** with the **Control Engineer** or **Field Controller**, and the **Safety Document** recipient.

11 Precautions Against Accidental Re-energisation from a Low Voltage Source

11.1 Work on a High Voltage System where the Transformer Low Voltage System is Dead

11.1.1 For work on a **High Voltage System** where the transformer **Low Voltage System** is **Dead**, the following **Shall** be confirmed:

- The Low Voltage System is not backfed
- The Low Voltage System is not reasonably expected to become Live
- The Low Voltage System is not connected to any 'Known Generation Source'
- The System diagram(s) confirm no interconnected back-feed

11.1.2 For work on a transformer where the **Low Voltage System** is **Dead**, at least one of the following precautions **Shall** be taken:

- The Circuit Main Earth or Additional Earth is applied between the transformer and the zone of work
- All Low Voltage fuses or links are withdrawn, and isolation applied
- Any switch or isolator that controls the transformer Low Voltage System is secured open by Approved means
- A Low Voltage bond that is connected to Earth is applied to any Low Voltage System at the point between the transformer and the connected customers

11.2 Work on a High Voltage System where the Transformer Low Voltage System is Live

11.2.1 For work on a **High Voltage System** where the transformer **Low Voltage System** is **Live**, the following **Shall** be confirmed:

- The Low Voltage System is backfed
- The Low Voltage System is connected to a 'Known Generation Source'
- The System diagram(s) confirm an interconnected back-feed is possible

11.2.2 For work on a **High Voltage System** where the transformer **Low Voltage System** is **Live,** at least two of the following precautions **Shall** be taken:

- a **Circuit Main Earth** or **Additional Earth** is applied between the transformer and the zone of work, or
- a **Low Voltage** bond that is connected to Earth is applied to any isolated **Low Voltage System** at the point between the transformer and the connected customers.
- AND
- the **Low Voltage** switch is open between the transformer and the zone of work, or
- all **Low Voltage** fuses or links are withdrawn, and isolation applied, or

- any switch or isolator that controls the transformer Low Voltage System is secured open by Approved means.

11.2.3 In cases where **Low Voltage** isolation only can be achieved, the following situations **Shall** be considered exceptions to the additional precautions specified in the **OSR**:

- Where a transformer is directly connected to the High Voltage System without intermediate switchgear and where there are no accessible High Voltage connections (e.g., overhead Conductors) between the zone of work and the transformer (e.g., teed cable connected transformer or a transformer with fully shrouded connections)
- Where the zone of work includes the transformer and/or the High Voltage switchgear directly connected to the transformer, in such a manner that no Earth can be fitted between the zone of work and the transformer

11.2.4 Where a number of transformers exist in the same location and **Low Voltage** interconnected backfeed can be achieved and/or a 'Known Generation Source' exists and it is not reasonably practicable to visit each location in order to create a **Low Voltage** point of isolation, then isolation may be achieved at **High Voltage** using an intermediate point. In such cases a **Circuit Main Earth Shall** be applied at the intermediate point on the **System** and prior to the zone of work being released for work.

11.3 Additional Requirements

11.3.1 The **Earths** referred to in 11.1.2 and 11.2.2 will normally be **Additional Earths**. In the case these **Earths** are applied before the issue of a **Safety Document**, they **Shall** be itemised on the **Switching** Schedule and treated as a **Circuit Main Earth**.

11.3.2 If the **Low Voltage System**(s) connected to distribution transformers are being worked on in connection with work on the **High Voltage System**, the **Low Voltage** work **Shall** be specified on the **Safety Document**.

11.3.3 Where the **High Voltage** work has been completed and **Low Voltage** work activities remain, the **Low Voltage** work **Shall** be suspended to allow any **Safety Document** to be cancelled and the **High Voltage System** made **Live**. Only then **Shall** the **Low Voltage** work recommence.

11.3.4 Where work identified on the **Safety Document** requires a **Low Voltage System** point of isolation, the **Senior Authorised Person** issuing the **Safety Document Shall** ensure this requirement is included within the relevant section of the **Safety Document**.

11.3.5 Where isolation is required to make **Apparatus** and **Plant** safe, this **Shall** be applied by the **Senior Authorised Person** in conjunction with the recipient of the **Safety Document** and prior to any work commencing. Thereafter, control of the isolation **Shall** be the responsibility of the **Safety Document** recipient.

11.3.6 In some situations, **Low Voltage Isolated** ancillary supplies will need to be restored to complete functional maintenance/ testing of **Plant** and/or **Apparatus**, e.g., restoration of motive supplies to a tap-changer needed to complete a maintenance. When this is needed the **Senior Authorised Person** issuing the **Permit to Work Shall** make clear the **Isolated** supplies which can be restored safely during the work by the **Competent Person** in receipt of the **Permit to Work**. The **Senior Authorised Person Shall** record this information in the "other precautions" section of the **Permit to Work** and ensure the **Isolated** ancillary supplies which can be restored by the **Competent Person** are clearly identified on site by the **Senior Authorised Person** to the **Competent Person**. When clearing and surrendering the **Permit to Work** the **Competent Person** in charge of the **Working Party Shall** make clear the status of any such **Low Voltage Isolated** supplies recorded on the **Permit to Work** and ensure this information is effectively communicated to the **Senior Authorised Person**. **Low Voltage** ancillary supplies feeding **Plant** and **Apparatus Shall** be **Isolated** using **Approved Caution Notices**.

11.4 Voltage Transformers (including Auxiliary Transformers and Tertiary Windings)

11.4.1 In order to prevent possible backfeed, isolation of the voltage transformer is permissible by withdrawing the **Low Voltage** fuses. Upon removal a **Caution Notice Shall** be applied and where the facility exists a **Safety Lock Shall** be applied.

11.4.2 Before any withdrawable voltage transformer is isolated or re-connected, the associated **High Voltage** connections **Shall** be **Isolated** from all points of supply.

11.4.3 Where an isolatable voltage transformer is not equipped with self-closing shutters on the primary connections, it **Shall** not be isolated unless a **Permit-to-Work** is issued. When self-closing shutters are not fitted, the primary isolation of the voltage transformer during **Switching** will lead to the **Operator** immediately encroaching safe **Working and Access Clearances** to the exposed contacts, that at this stage would neither be proven **Dead** or **Earthed**.

11.4.4 Isolation against a possible back-feed from a voltage transformer associated with pole mounted switchgear or a **High Voltage** Metering unit is not required where there is no possible source of a.c. supply into the equipment.

11.4.5 Where auxiliary transformers or tertiary windings are associated with a main transformer then isolation **Shall** be applied against any possible **Low Voltage** back-feed.

11.4.6 Where the tertiary winding is connected at **High Voltage** then in addition to isolation, a **Circuit Main Earth** or **Additional Earth Shall** be applied.

11.5 User Owned Point of Low Voltage Isolation

11.5.1 Where a transformer supplies a user at **Low Voltage**, cross boundary isolation may be required. Typically, this requires the user to provide **Low Voltage** isolation on equipment they own so as to prevent backfeed onto the **System**. In such cases, **Low Voltage** isolation **Shall** be arranged as follows:

- Where the user is competent and able to operate their Low Voltage switchgear, then the principles detailed in the Approved Procedure – PR-NET-OSM-087 Management of Activities at the interface of High Voltage Customers – Operational Safety manual – Section 13.5 Shall apply. This ultimately requires the user to establish the required isolation before confirming the isolation, and period it will be maintained for, to the SSEN-D Authorised Person on site
- Where the user is not competent or able to operate their switchgear, then Company staff may operate the user's Low Voltage switchgear as Dead operation only and apply isolation to enable work on the transformer or High Voltage System

11.5.2 In both instances, the **Authorised Person** on site **Shall** confirm, to the **Control Engineer**, that isolation has been established on the user's system and will be maintained for the duration of work on the **High Voltage System**. Although the **SSEN-D Control Engineer** has no jurisdiction over the user's system, for completeness, they **Shall** record the confirmations (establishment and removal of the isolation) from the **Authorised Person** on site in the control log.

12 Additional Earths

12.1 General Requirements

12.1.1 Where **Additional Earths** are being applied in Grid / Primary substations onto exposed **High Voltage Conductors** they **Shall** be fitted by, or under the **Personal Supervision** of, a suitably **Authorised Person.**

12.1.2 At the discretion of the **Senior Authorised Person** the recipient of a **Safety Document** may remove **Additional Earths** and re-apply them at the same location.

12.1.3 In all other situations **Additional Earths** are the responsibility of the **Safety Document** recipient and will be applied after the issue of a **Safety Document** by them, or under their **Personal Supervision.**

12.1.4 When the recipient of a **Permit-to-Work** clears and returns the document to a **Senior Authorised Person**, they **Shall** ensure that the **Senior Authorised Person** is aware of the position of any **Additional Earths** that have not been removed. The **Senior Authorised Person Shall** then inform the **Control Engineer** or **Field Controller** of the position of these **Earths.**

- The Control Engineer Shall re-classify the Earth(s) as Circuit Main Earth(s)
- In these circumstances the Senior Authorised Person Shall ensure that the cross-sectional area of the Earthing equipment and/or Earthing Conductor is sufficient for the application (SP-NET-OHL-002 & TG-NET-SST-024). Where it is found to be unsuitable, the Earth Shall be replaced with agreement with the Control Engineer and under the Personal Supervision of the Senior Authorised Person

12.2 Additional Precautions

The **Senior Authorised Person** issuing a **Safety Document Shall** specify additional precautions to avoid **Danger** where necessary. These precautions **Shall** be recorded on the **Safety Document**. Where hazards exist, and a **Circuit Main Earth** is not fulfilling the function, **Additional Earths Shall** be provided. A non-exhaustive list of known hazards is provided immediately below as guidance:

- Live overhead lines crossing over or under the line being worked on
- Danger of induced voltages from adjacent Live equipment
- Danger from transformers where the Low Voltage System may be Live

13 Isolation Against Earths and Unproved Phasing

13.1 Additional Precautions

13.1.1 In addition to the requirements of the **OSR** and to maintain isolation between a zone of work and sources of supply, isolation **Shall** where practicable be maintained between **Earthed** equipment and any **High Voltage** source.

13.1.2 The only situation where it is acceptable to change the operational sequence so that a **Circuit Main Earth** may be applied before the **Apparatus** is fully Isolated from the **System**, or isolation is removed before all **Earths** have been removed, **Shall** be where significant risk has been identified with normal practices.

13.1.3 Any alteration to the normal sequence of isolation and **Earthing Shall**, so far as is reasonably practicable, be avoided. Where a risk assessment determines otherwise, then the operational sequence **Shall** be agreed with the **Control Engineer** in advance.

13.1.4 Isolation **Shall**, where reasonably practicable, be maintained on any **Apparatus** where the checking of **High Voltage** phasing has not been carried out. In the case of a withdrawable circuit breaker, where check phasing involves **Low Voltage** connections being made across a point of Isolation, it **Shall** be permissible to remove the point of Isolation immediately prior to the check phasing activity, this Isolation **Shall** be replaced immediately upon completion of the **High Voltage** phasing check.

13.1.5 Following confirmation of correct phasing, the switch or circuit breaker involved **Shall,** where reasonably practicable, be closed to electrically prove the **System**, ensuring a suitable delay is in place prior to any re-opening, to allow protection **Systems** to operate if necessary.

NOTE: Examples of the isolation, and **Earthing** required to establish a safe working environment on **High Voltage** overhead **Systems** are given in Appendix A.

14 Earthing of Outdoor Busbars on Systems with a Nominal Voltage of 33kV and above (3 metre / 9 metre rule)

14.1 General Requirements

14.1.1 The application of **Approved Earthing** leads to outdoor busbars involves additional hazards, especially where there is **Live** equipment adjacent to the point of **Earthing** or where high-level busbars are involved.

14.1.2 Where it is not reasonably practicable to apply the **Circuit Main Earths** between the point of work and the point(s) of isolation, then to reduce the risk of accidental contact with **Live** busbars, a **Circuit Main Earth** may be applied to an alternative position along a continuous **Conductor** as follows:

- On a permanent connection teed between the zone of work and the point(s) of isolation at a distance not exceeding:
  - 3 metres (at 33kV) from the tee
  - 9 metres (at 66kV and above)
- Beyond the point(s) of isolation and the zone of work at a distance not exceeding:
  - 3 metres (at 33kV)
  - 9 metres (at 66kV and above).

  NOTE: Examples of the 3 metre / 9 metre rule are given in Appendix A.

14.2 Additional Requirements

14.2.1 The use of remote **Circuit Main Earths Shall** be identified on the relevant **Switching** schedule so the **Control Engineer** is aware and is able to approve the schedule, these **Shal**l also be noted on the Control Transfer Certificate if applicable.

14.2.2 Where, following the initial application of **Circuit Main Earths**, connections are to be broken between the point of work and the applied **Earths**, the **Senior Authorised Person Shall** sanction the use of further **Circuit Main Earths** or **Additional Earths** as required.

14.2.3 **Approved Earth** leads for use in substations **Shall** be in accordance with SP-NET-OHL-002 and TG-NET-SST-024. **Approved Earthing** leads **Shall** be examined immediately before

use paying particular attention to condition of contacts, leads, clamps, connections and cleanliness. The number of **Approved Earthing** leads applied per phase **Shall** be decided by the **Senior Authorised Person**, dependent on the fault level at each individual site.

14.2.4 The precautions defined in Section 14 are relevant only where it is not reasonably practicable to apply **Circuit Main Earths** between the point of work and the point(s) of isolation. However, in any situation a portable **Circuit Main Earth** applied to busbars within 1 metre of a permanent joint, is considered to be effectively **Earthing** the joint and all associated connections.

15 Application of Circuit Main Earths to Towers on Systems with a Nominal Voltage of 33kV and above

15.1 General Requirements

15.1.1 Where there is a requirement to apply a **Circuit Main Earth** to a line **Conductor** on a tower (typically to allow jumpers to be disconnected and part of the circuit made Live), then where the relevant circuit has already been **Earthed** in accordance with the **OSR**, the following procedure **Shall** apply:

- An appropriate **Safety Document**, **Shall** be issued in accordance with the **OSR**. The 'Work to be Carried Out' Section of the **Safety Document Shall** include reference to the application and removal of **Earths** that are used as **Circuit Main Earths**. **Approved Earth** lead capacity when used as a **Circuit Main Earth Shall** be within the **System** fault level at the point of application
- Where the **Safety Document** is cancelled, the **Control Engineer** or **Field Controller** will be advised of the exact location and position of any **Circuit Main Earth**(s) applied under the **Safety Document**.
- The Switching Schedule or job, **Shall** include an item after cancellation of the relevant **Safety Document** to apply the **Circuit Main Earth**, with a text addition to confirm this has been applied under the **Safety Document**.

15.1.2 It may be necessary to apply a **Circuit Main Earth** to a circuit(s), on a tower when the relevant circuit has not been **Earthed** in accordance with the **OSR**. In such cases the issue of a **Permit-to-Work** or **Sanction-for-Test** is not permitted and the following procedure **Shall** apply:

- A **Limitation-of-Access Shall** be issued for access to the tower, therefore satisfying the requirement of the **OSR** for a **Safety Document** to be issued to access towers above the anti-climbing device.
- An appropriately **Authorised Person Shall** identify the correct circuit(s) to be **Earthed** on site, using circuit colours, inter-cautioning flags and/or other identification equipment as appropriate, and provide **Personal Supervision** for the access and Earthing of the circuit(s).

15.2 Use of Flexible Earths on Overhead Lines at 132kV

15.2.1 It is acceptable to use flexible **Earths** of an **Approved** type as **Circuit Main Earth** on overhead lines at 132kV. In such cases a minimum of three allowable flexible **Earths Shall** be applied to each phase **Conductor**.

Reference should also be made to TG-NET-SST-024.

15.2.2 The use of existing phase **Conductor** jumpers as **Circuit Main Earths** to **Earth** their associated phase **Conductors** is permitted, providing the **Earth** end of the jumper is solidly connected to **Earth** via tower steelwork or a separate **Earth Conductor**. In such cases all connections **Shall** be confirmed fit for purpose by a **Senior Authorised Person**, who **Shall** in turn confirm this to the **Control Engineer** or **Field Controller**. A record of this confirmation **Shall** be entered by the **Control Engineer** or **Field Controller** into the respective control log.

15.2.3 **Approved** flexible **Circuit Main Earths** and **Additional Earths Shall** not normally be fitted to steel fittings. Where it is not practicable to fit **Approved** flexible **Circuit Main Earths** and **Additional Earths** to **Conductors**, it is acceptable to consider the use of steel fittings for the application of **Approved** flexible **Circuit Main Earths** and **Additional Earths**. In such cases a **Senior Authorised Person Shall** complete an assessment and agree the use of the steel fitting with the **Control Engineer** or **Field Controller**. A record of the agreement **Shall** be recorded by the **Control Engineer** or **Field Controller** in the respective control log.

15.2.4 **Additional Earths** used in this application **Shall** have a minimum CSA of 50mm^2.

16 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	New document created.	NA	1.00	Richard Gough
02	Minor revisions made to provide greater clarity for users.	PR-NET-OSM-026 (Rev 1.00)	1.01	Richard Gough
03	Minor revisions made to ensure Appendix A shows Approved Caution Notice images and user guidance is clear.	PR-NET-OSM-026 (Rev 1.01)	2.00	Richard Gough
04	Minor revisions made to provide greater clarity for users.	PR-NET-OSM-026 (Rev 2.00)	2.01	Richard Gough
05	Inclusion of Appendix B – Proving Dead	PR-NET-OSM-026 (Rev 2.01)	2.02	Richard Gough
06				

Appendix A Examples of Isolation and Earthing for Work on High Voltage Systems

1 High Voltage Overhead Spur with Pole Mounted Transformers

1.1 A single point of Isolation is required against the **High Voltage** source and a **Circuit Main Earth** applied between this and the zone of work (see Figure A.1). 'Boxing-in' the zone of work with the **Circuit Main Earth** and the **Additional Earths** satisfies the requirement of this procedure.

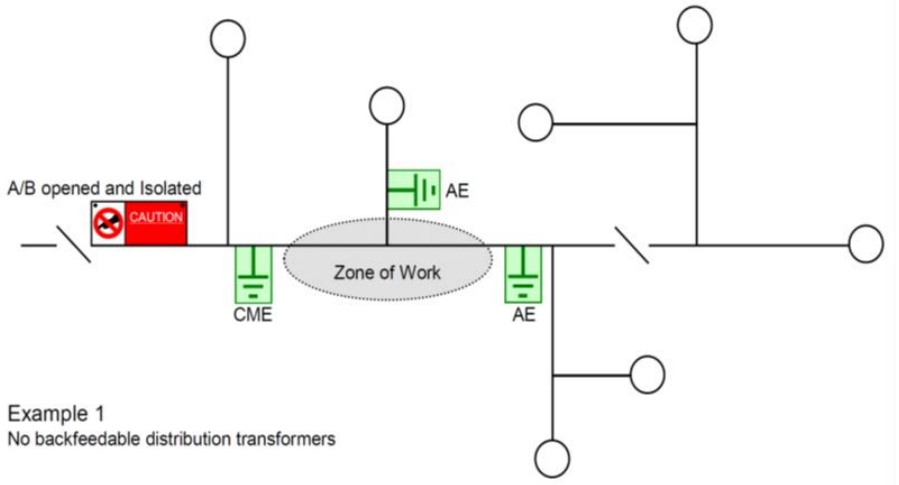

Figure A.1 - Teed Overhead System with Single Point High Voltage Isolation, Multi-point Earthing and Low Voltage Backfeed Prevention – Solution 'A'

1.2 Alternatively, **Low Voltage System** Isolation can be used, e.g., where the application of **Additional Earths** is not practicable (see Figure A.2).

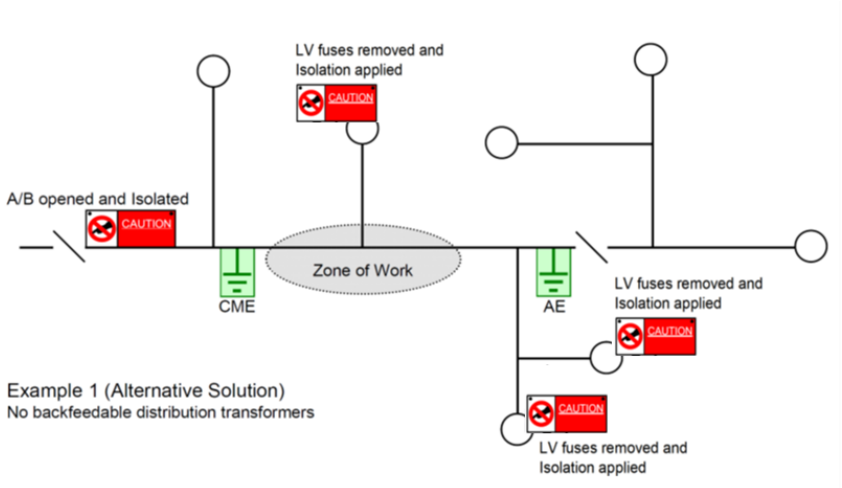

Figure A.2 - Teed Overhead System with Single Point High Voltage Isolation, Multi-point Earthing and Low Voltage Backfeed Prevention – Solution 'B'

2 High Voltage Overhead Spur with Pole Mounted Transformers and Low Voltage Backfeed

2.1 In addition to the **High Voltage** source, Isolation **Shall** be achieved against all transformer **Low Voltage** backfeeds. An **Additional Earth** or **Circuit Main Earth Shall** be applied between each transformer **Low Voltage** backfeed and the zone of work (see Figure A.3).

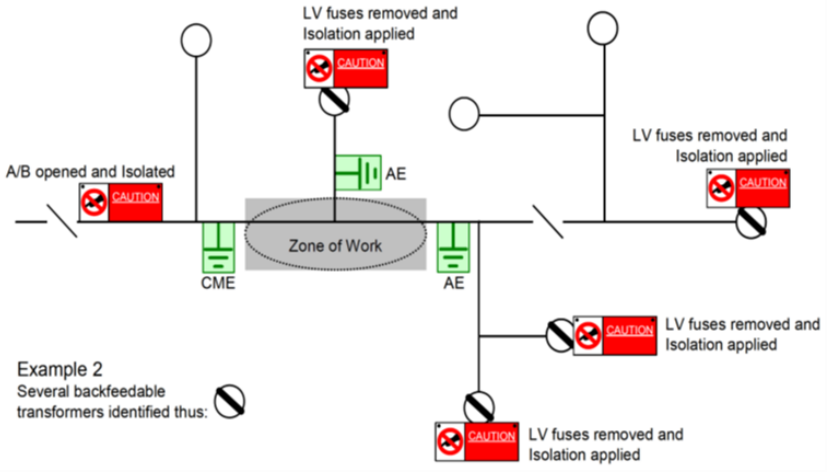

Figure A.3 – Teed Overhead System with Multi-point High Voltage Isolation and Earthing and Low Voltage Backfeed Prevention

3 High Voltage System incorporating Overhead and Underground Circuits Isolated for Ground Mounted Substation Maintenance

3.1 Isolation and earthing of the **System** cannot be carried out at Substation 'B' as a consequence of there being no switchgear.

3.2 Considering it is situated within the zone of work, it is good practice to open and **Earth** the switchgear at substation A before releasing it under **OSR** 4.1.

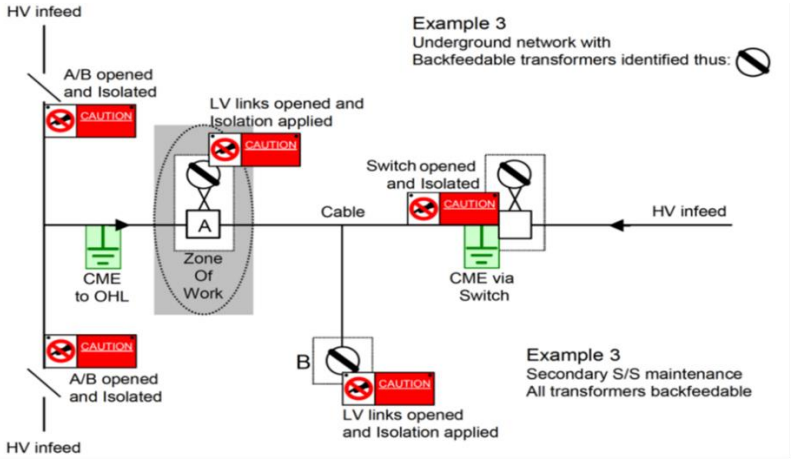

Figure A.4 - Teed High Voltage System with Multi-point High Voltage Isolation and Earthing to allow for Ground Mounted Substation Maintenance

4 High Voltage System with zone of work crossed by a Live overhead line

4.1 Subject to a site risk assessment, the **Senior Authorised Person** may decide to provide **Personal Supervision** for work in the area adjacent to the overcrossing overhead line.

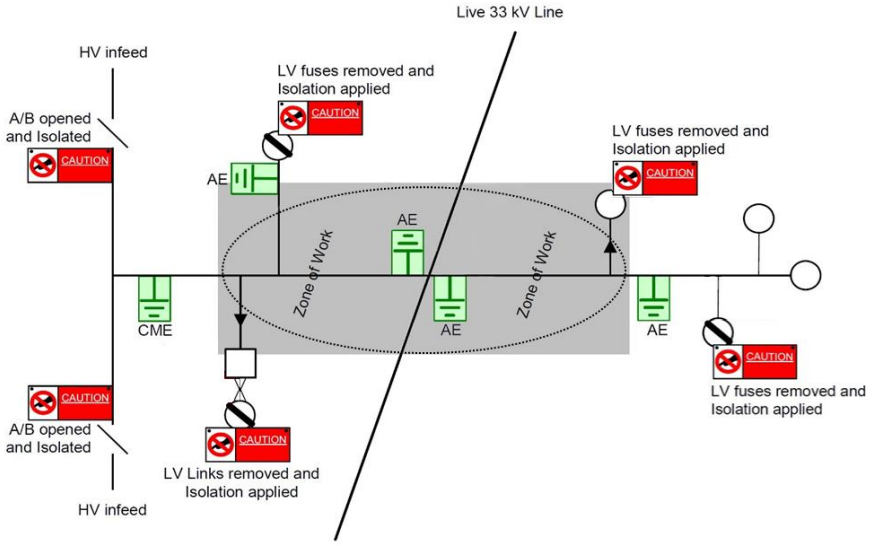

Figure A.5 - Teed High Voltage System with Multi-point Isolation Earthing where the Zone of Work is Crossed by a Live Overhead Line

5 The SSEN-D 3 Metre and 9 Metre Rule

One **Circuit Main Earth** applied on a permanent connection teed between the point of work and the point(s) of Isolation on the **System** at a distance not exceeding 9 metres (at 66kV and above) or 3 metres (at 33kV) from the tee (see Figure A.6). Note: the preferred **Circuit Main Earth** position where safe and practicable – shown as B in Figure A.6 below.

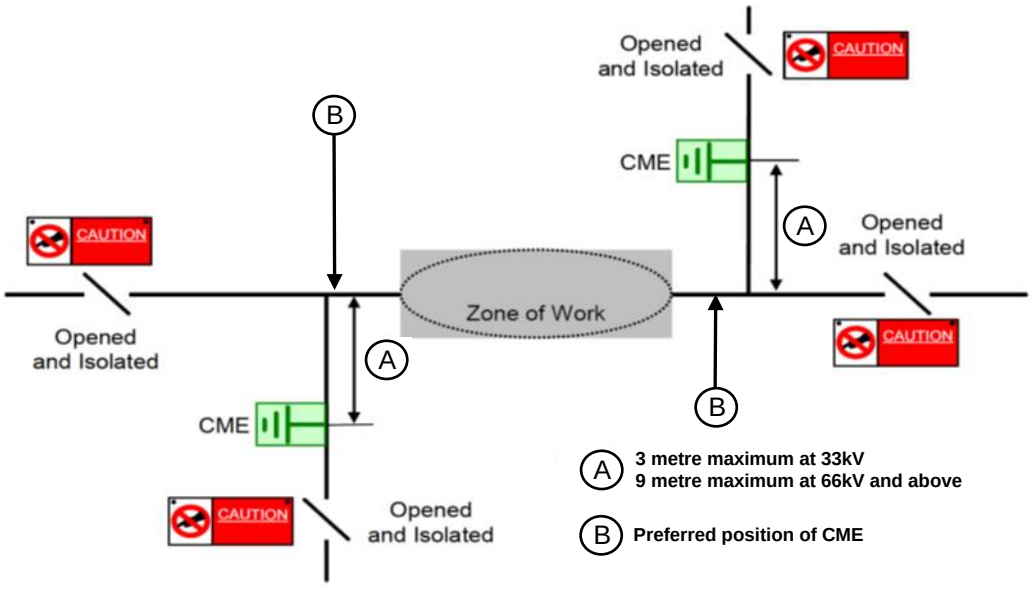

Figure A.6 - Example 1 – 3 Metre and 9 Metre CME Position Rule

5.1 Figure A.7 below illustrates the use of the 3 and 9 metre rule (3m up to 33kV / 9m above 33kV, i.e., on 66kV and 132kV systems) for the application of **Circuit Main Earths**, where it is not safe and/or practicable to apply **Circuit Main Earths** at the preferred positions shown in the diagram as point B.

5.2 If **Circuit Main Earths** are applied at point(s) B; the **Senior Authorised Person** can decide if a **Circuit Main Earth**, or an **Additional Earth** is to be applied at point C.

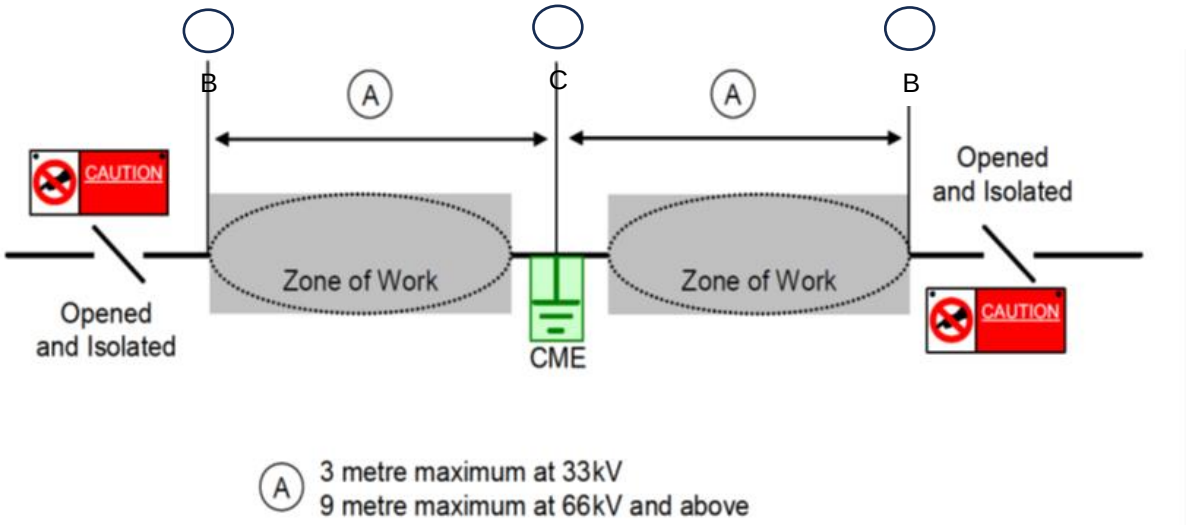

Figure A.7 - Example 2 – SSEN-D 3 Metre, 9 Metre Rule

Appendix B Proving Dead

Introduction

No person should use any voltage testing device without adequate training in its use and should use the device in accordance with relevant safety procedures and instructions issued. The user of a device should be fully conversant with the characteristics of the device and its use.

References

The documents detailed in Table 16.1 - Scottish and Southern Electricity Networks Documents and Table 16.2 – Miscellaneous Documents, should be used in conjunction with this document.

Table 16.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
MA-NET-CAB-003	High Voltage Jointing
OSM	1.1
WI-NET-CAB-400	Identification, Phase Checking and Setting to Work on 11kV, 33kV and 132kV Cable Circuits.
WI-NET-SST-074	Procedure for the Management of Test Prods

Table 16.2 – Miscellaneous Documents

Title
ENA Engineering Recommendation G9

Proving Dead – Methods

Resistive Testing

Resistive testing relies on a device being used which places a load between a single phase and a neutral / earth point to give an indication of Voltage.

The term Voltage Indicator applies to any (**Approved**) device used to prove the voltage level of **HV Conductors**.

Capacitive Testing

Capacitive testing relies on a device being used to detect an electro-static charge in a **Conductor**. It must be noted that an electro-static charge below the threshold of a particular device may not be detected.

Shorting a Conductor to Earth

This method ensures a **Conductor** is **Dead** (at or about zero Volts) by shorting one or more phases to a known **Earth** or between phases so that a protective device will de-energise the circuit once the short circuit is achieved.

This method includes placing a switch into the **Earthed** position or the use of a Spiking Gun prior to work on a cable.

Risk Management

Risk Management – Resistive and Capacitive Devices

The main risks to **Persons** arising from the use of **Approved** Voltage Indicators are:

- Failure to use the **Approved** testing device in accordance with the **Approved** Procedure and the manufacturer's instructions
- Use of an **Approved** testing device not fit for purpose
- Inadvertent insertion of a hand or tool into **Live** busbar spouts
- Use of an **Approved** testing device outside its rated voltage
- Infringement of **Safety Distances**

Risk Management – Shorting a Conductor to Earth

- Closing a system earth onto a **Live Conductor** resulting in any flash-over not being contained within the equipment
- Application of a portable **Earthing** device of insufficient rating to a live **Conductor**
- Firing a Spiking Gun chisel into a **Live Conductor** resulting in a flash-over within a joint bay

Use of Voltage Testing and Earthing Devices

General pre-use checks

Prior to a voltage testing device being used, the user should carry out a visual inspection to check the condition of the device. If there is any doubt that the device is not in good condition, it should not be used for testing and immediately taken out of service.

Use of Approved Testing Device - Voltage Indicator

Check that the device is rated for the operating voltage of the **Conductors** to be tested and that an **Approved** proving unit with a valid test date is available to test the device where relevant.

Check that there is a valid calibration label on the device indicating that the device is within test date (where relevant to the device). If out of date do not use.

Examine the device and connecting cables for any visual indication of damage. If damaged do not use.

Ensure that any moisture that may be present on the surface of the device is removed using a clean dry cloth.

Test the device in accordance with the instructions indicated on the proving unit or against a safely accessible known source of supply. If the results are not correct do not use the device.

Once testing is complete the operator **Shall** re-test the device in accordance with this section to ensure that it is still fully functional.

Where tests prods are used to facilitate proving **Dead** or testing the user S**hal**l ensure they are in date for test, clean and in good condition. (WI-NET-SST-074).

Use of Approved Voltage Indicator Capacitive Type

Capacitive Voltage Indicators **Approved** for use shall where reasonably practicable provide both visual and audible indication in the event that a **Live** conductor is tested.

Prior to use, the Indicator **Shal**l:

Be examined to ensure that it is rated for the operating voltage of the **Conductor** to be tested, there is no visual indication of damage or distress and it is within the current test and inspection periods.

Prior to use, any required insulated rods **Shall** be examined to ensure that there is no visual indication of damage and that they are within the current test and inspection periods.

Be tested to prove that it is functional. Where reasonably practicable, this test **Shall** include the use of an external proving unit to prove correct operation; the test **Shal**l prove the functionality of both the audible and visual indications.

Testing of the unit may also be via a known source of **HV** supply where it is safe to do so.

Only where it is not reasonably practicable to use an external proving unit or safely against a known **HV** supply may the test be carried out by use of the self-test button only.

Where reasonably practicable, when overhead conductors are tested by means of Capacitive Voltage Indicators, the test S**hall** be carried out from ground level. Where this is not reasonably practicable, sufficient insulated rods shall be used to ensure that the **Safety Distance** is not infringed.

The voltage testing device should be used wherever possible on a horizontal straight section of busbar or overhead line with the device well separated from other adjacent busbar or overhead lines.

The voltage testing device should be applied at right angles to the **Conductor** under test to minimise the risk of any other part of the device coming into contact with the **Conductor**.

The voltage testing device should be kept away from any **Conductor** not under test.

The voltage testing device should not be applied at complex configuration positions or in the vicinity of any sharp bend in the **Conductor**.

Capacitive voltage testing devices will not respond to D.C. voltages such as residual voltage due to capacitive charge on a **Conductor**.

At the completion of the test of the overhead **Conductor**, the Indicator **Shall** be re-tested in accordance with this section to ensure that it is still fully functional.

Use of Shorting a Conductor to Earth

Spiking a Cable:

This method refers to the use of an **Approved** Spiking gun.

It relies on the chisel penetrating the cable sufficiently to ensure that at least one phase is shorted to the **Earthed** screen of the **Conductor** such as if the cable were to be live any protective device would operate to remove supplies to that cable.

The Spiking Gun should be set-up in accordance with WI-NET-CAB-400.

Once the Spiking gun has successfully fired the operator will wait a period of at least 3 minutes and contact the relevant Control Room to ensure no circuit trip alarm have been received and carry out any necessary local checks before removing the Spiking gun.

Closing a rated switch into **Earth**:

This method refers to the situation where rated ring or circuit switches are closed in to “circuit earth”, typically used when setting up a piece of switchgear for routine maintenance.

Once the Zone of Work has been set up and a **Safety Document** issued, the relevant circuit / ring switches should be closed to **Earth** such as if the circuit were to be live any protective device would operate to remove supplies to that circuit.

Proving Dead at EHV Voltages

Currently the options for proving dead at higher **EHV** voltages are limited. The use of **Approved** capacitive testing devices is possible up to 132kV.

The procedures detailed above are still to be followed.