PR-NET-OSM-063

ACCESS AND WORK ON HIGH VOLTAGE UNDERGROUND CABLE ANCILLARY SYSTEMS

OPERATIONAL SAFETY MANUAL - SECTION 8.2

Scottish & Southern Electricity Networks

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1 Introduction

1.1 **High Voltage** underground cable **Ancillary Systems** are those **Ancillary Systems** associated with cables operating at a voltage above 1000V AC & 1500V DC within **SSEN-D**.

1.2 This document defines the operational requirements for access to and work on those cable **Ancillary Systems** within **SSEN-D**, to ensure such work can be completed in a controlled manner, whilst limiting risk to all persons involved.

2 Scope

2.1 The scope of this document relates to operational requirements for access to and work on **High Voltage** underground cable **Ancillary Systems** under the **SSEN-D Operational Safety Rules (OSR).**

2.2 It applies to all persons employed by or working on behalf of **SSEN-D** who are authorised to work on these **Ancillary Systems**.

2.3 This **Approved** procedure is provided to help ensure that, following appropriate risk assessment, any work on **High Voltage** underground cable **Ancillary Systems** is undertaken safely using **Approved** techniques, with the correct equipment and PPE, and is in compliance with **SSEN-D OSR** and all relevant legislation.

2.4 It also covers work on **Ancillary Systems** associated with **High Voltage** underground cables (including fibre-optic) in proximity to other **High Voltage** cables or to overhead lines which may then be affected by induced voltages.

2.5 Additionally, it covers any work on **High Voltage** underground cable **Ancillary Systems** that form part of a Third Party owned **System**, if that work is undertaken by persons on behalf of **SSEN-D**.

2.6 This scope does not apply to:

- working on the **Conductors** of **High Voltage** cables
- procedures for dealing with **High Voltage** cable faults
- testing requirements
- submarine cables

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-026	High Voltage Switching and Earthing - Operational Safety Manual – Section 4.2
PR-NET-OSM-062	Access and Work on High Voltage Underground Cables – Operational Safety Manual - Section 8.1
TG-NET-CAB-032	Asset Management of Fluid Filled Cables
WI-NET-CAB-122	Work Element Process 5. Safety Requirements for Low Voltage Jointing Works

Reference	Title
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
ENA ER C55	Insulated Sheath Power Cable Systems
ENA ER C99	Guidance for Working on Cables Under Induced Voltage Conditions
ENA ER S37	Code of Practice for the Safe Working on Pilot, Auxiliary and Communication Cables
ENA ER C135	Guidance for the Operation and Management of Fluid Filled Cables

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 **Ancillary System**

Auxiliary Cable, pressurised fluid system or special insulated sheath bonding system associated with **High Voltage** cables.

4.3 **Auxiliary Cable**

Multicore, multipair or fibre-optic cable (often referred to as pilot cable) associated with a **High Voltage** underground cable for the purposes of protection and/or intertripping or other communications between circuit ends.

4.4 **Fluid / Gas Filled Cable System**

System of fluid or gas kept under positive pressure to enhance the insulating properties and current rating of a **High Voltage** underground cable, including tanks, gauges and all interconnecting pipework.

4.5 **Operational Safety Rules (OSR)**

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

5 General Responsibilities

5.1 All work must be carried out in compliance with **SSEN-D** Safety, Health and Environmental Policy and procedures, including **OSR**.

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

5.3 The procedures and instructions in this **Approved** procedure must only be carried out by suitably trained and authorised persons

5.4 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 All personnel involved in operations and work on **High Voltage** underground cable **Ancillary Systems Shall** hold the requisite authorisations for the operations and work to be undertaken, aligned with the primary operating voltage of the **Apparatus**.

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

7 Personal Protective Equipment

7.1 When working on the **Ancillary Systems** of **High Voltage** underground cables, **Approved** PPE **Shall** be worn, depending upon the work being undertaken.

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

8 Dangers from High Voltage Cable Ancillary Systems

8.1 The main **Dangers** to personnel working on **High Voltage** cable **Ancillary Systems** are electric shock, burns or falls arising from:

- Working on the **Ancillary Systems** of a wrongly identified **High Voltage** underground cable
- Voltage difference between parts of a cable **Ancillary System** with separate **Earthing** zones when a fault occurs in one of these **Earthing** zones
- Induced voltages on **Ancillary Systems** from the associated **Live** cable(s)
- Induced voltages on the cable and/or its **Ancillary Systems** due to load or fault current of other adjacent cables or overhead lines
- Electric shock due to making contact between disconnected cable sheath bonding or **Auxiliary Cable** connections at different potentials
- Physical conditions in the vicinity of the point of work due to deep excavations or working at a height
- The sudden release of fluid from pressurised cables

8.2 Although not representing an immediate **Danger** of harm to personnel as such, there may also be a risk of trip when working on the **Ancillary Systems** of **Live** circuits leading to loss of supplies and disruption to customers or a loss of **System** protection for energised protection

8.3 In addition to those **Dangers** above fibre-optic cables may present additional hazards e.g. Optical power from light sources and optical fibre fragments piercing the skin or eyes.

9 General Requirements for Work on High Voltage Cable Ancillary Systems

9.1 All persons who work on **Ancillary Systems** of **High Voltage** cables **Shall** have the correct authorisation and training for the work required.

9.2 Work or testing on **Ancillary Systems** associated with **High Voltage** cables, e.g. **Fluid Filled Cable Systems**, **Auxiliary Cables**, special insulated sheath bonding systems, etc. **Shall** only be carried out in accordance with **Approved** procedures.

9.3 Work or testing on the **Ancillary Systems** of a **High Voltage** underground cable can take place with the associated circuit in or out-of-service depending upon the work or testing to be done. However, any work or testing **Shall** only be carried out using **Approved** procedures.

9.4 All **High Voltage** underground cable **Ancillary Systems Shall** be treated as in-service unless confirmed as out-of-service by a **Senior Authorised Person**.

9.5 Work or testing **Sh**all not commence on any **High Voltage** underground cable **Ancillary System** unless the person in charge of the work is in receipt of the correct **Safety Document** and has been personally instructed at the point of work by the **Senior Authorised Person** issuing the **Safety Document.**

10 Risk of Trip for Work on High Voltage Cable Ancillary Systems

10.1 Where work is to be carried out on any underground cable **Ancillary System** which has an associated risk of initiating a protection scheme, to either:

- cause a switch or circuit breaker to open
- cause the operation of a change over scheme, or
- initiate an alarm through to the NMC
- then the **Control Engineer Shall** be informed before any such work commences and work **Shall** only commence with the agreement of the **Control Engineer**

10.2 Where the operation of such a scheme could cause a loss of supply to customers the **Control Engineer Shall** decide if additional **Switching** is necessary to mitigate the consequences before work commences.

10.3 For alarm indications only, the **Control Engineer** may agree to carry out a sequence of actions to recover the situation should any alarms be received. Such actions may extend from simple communication with site to initiating **Switching**.

11 Identification of Auxiliary Cables Associated with High Voltage Cables

Cable records **Shall** be consulted prior to any work or testing on **Auxiliary Cables** associated with **High Voltage** underground cables. If, after consulting records, there is any doubt about the identification of an **Auxiliary Cable** or doubt as to which circuit it is associated with, it **Shall** be positively identified in an **Approved** manner using injected signal tone or physical tracing methods.

12 Work on Auxiliary Cables Associated with High Voltage Cables

12.1 Once it has been positively identified and confirmed it is not a fibre-optic, the **Auxiliary Cable** should be opened using **Low Voltage Live** jointing techniques to confirm that the cable is an **Auxiliary Cable** and not a power cable. This must be carried out under the

Personal Supervision of the **Senior Authorised Person** who has made the positive identification. Furthermore, the **Senior Authorised Person Shall** personally indicate the cable to be opened to the **Authorised Person** opening the cable.

12.2 If at any time during the cable opening process there is any indication that the cable may not be an **Auxiliary Cable**, then personnel **Shall** cease work immediately and consult the **Senior Authorised Person** providing **Personal Supervision**.

12.3 When the **Auxiliary Cable** has been opened, unless all cores in the cable can be proved **Dead** (**Isolated** & not **Live**), work **Shall** proceed as if the cable is **Live**. An **Approved Low Voltage** testing device **Shall** be used for this purpose.

12.4 If necessary, proving **Dead** may be carried out as for **High Voltage** underground cables, i.e. by spiking after advising the **Control Engineer**.

12.5 See Section 16 for guidance on dealing with induced voltages.

12.6 Further guidance for safe working on pilot, auxiliary and communication cables can be found in ENA Engineering Recommendation S37.

13 Work on High Voltage Cable Insulated or Specially Bonded Sheaths

13.1 Work or testing on insulated or specially bonded sheaths of **High Voltage** underground cables **Shall** where practicable be carried out with the associated circuit **Dead**.

13.2 Where, for operational reasons, such work or testing has to be carried out with the associated circuits **Live**, then it **shall** be carried out following **Approved** procedures to ensure that personnel are not at risk of electrocution from dangerous potential voltage gradients that may occur between different parts of the sheath bonding system which may inadvertently become isolated from each other.

13.3 Insulating gloves and temporary bonds **Shall** be used to avoid **Danger** from such potential gradients when the associated circuit is in-service and also when there is **Danger** of induced voltages from other nearby circuits, see Section 16.

13.4 Work or testing on the sheath **Shall** not be carried out unless a suitable **Safety Document** has been issued.

13.5 When it is required to carry out tests on the serving of insulated sheath cable systems, precautions **Shall** be taken to minimise **Danger** from induced voltages caused by adjacent **Live** circuits.

13.6 The **High Voltage** underground cable **Shall** be identified in accordance with **Approved** procedures prior to the issue of a **Permit-to-Work** for serving or sheath repairs.

13.7 Cable sheath **Earth** link boxes **Shall** be identified by their position and labelling. Any missing labels **Shall** be replaced as soon as practicable.

13.8 When testing the insulated or specially bonded sheath of **High Voltage** underground cables, the links providing the **Earth** connection to the sheath **Shall**, where practicable, be removed after the testing equipment has been connected to the sheath and replaced before the test equipment is disconnected.

13.9 ENA Engineering Recommendation C55 gives further detail regarding Insulated Sheath Power Cable Systems.

14 Work on Fluid Filled Cable Systems

14.1 Labels identifying the main cable circuit, fluid section and setting pressures are normally fitted adjacent to all gauge/pressure transducer positions. If they are missing, they **Shall** be replaced as soon as practicable.

14.2 No work, other than work external to the pressurised parts, **Shall** be carried out on **Fluid Filled Cable Systems** until the pressure has been adjusted to a level that avoids **Danger**.

14.3 When working on or testing **Fluid Filled Cable Systems** associated with **High Voltage** cables, personnel **Shall**, as far as is reasonably practicable, take precautions to ensure that the pressure does not fall below the minimum required to maintain the electrical strength of the cable insulation. Even when the associated cable is **Dead**, damage can still be caused to the cable and/or **Fluid Filled Cable System** due to low pressure.

14.4 When working on or testing **Fluid Filled Cable Systems** with the associated circuit **Live**, personnel **Shall**, as far as is reasonably practicable, take precautions to minimise the risk of either causing an “Emergency Minimum Pressure” (Switch Out Pressure) alarm being sent to Control or sending an automatic low pressure trip signal, where such a feature has been installed. This can be achieved by removing the relevant alarm or trip links with the agreement of the **Control Engineer**. However, any links removed **Shall** be replaced on completion of work or testing.

14.5 Personnel working on or testing **Fluid Filled Cable Systems Shall** advise the **Control Engineer** before carrying out any work or testing, so that any spurious alarms triggered during the work or testing can be filtered if they occur, thus avoiding unnecessary tripping of **Live** circuits.

14.6 Further information on the control of pressure of **Fluid Filled Cable Systems** can be found in **SSEN-D** document TG-NET-CAB-032 and more detail is available in ENA Engineering Recommendation C135.

15 Work on Ancillary Systems in the Vicinity of or Connected to Overhead Lines

15.1 Where work on **High Voltage** underground cable **Ancillary Systems** takes place within 15m of an overhead tower line or 9m of a wood pole line, then information about the presence of the line **Shall** be made available to the **Working Party** and they **Shall** be instructed by a supervisor or manager on the precautions that need to be taken before any work commences.

15.2 Further guidance can be found in WI-NET-CAB-122.

16 Induced Voltages on High Voltage Cable Ancillary Systems

16.1 Where work is to be carried out on any **High Voltage** cable **Ancillary System** which may be subjected to induced voltages from either the associated circuit or other **Live** circuits in proximity, then such work **Shall** require additional precautions to be taken to prevent **Danger** from such voltages, in accordance with **Approved** procedures and to comply with clause 8.3.2 of the **OSR**.

16.2 **High Voltage** cable **Ancillary Systems** (especially **Auxiliary Cables** and **Insulated sheaths**), even when the associated circuit has been **Isolated** from the **System** and **Earthed**, can be subject to hazardous **High Voltages** by induction from adjacent **Live** cables or overhead lines, particularly so if high fault currents flow, and also due to induction

from overhead lines connected to or in proximity to the **Ancillary System** being worked on, or from other natural phenomena.

16.3 During fault conditions, differences in **Earth** potential can occur at the point of work, between any conducting components, such as insulated cable sheaths, cores or armouring of **Auxiliary Cables**, or metallic pipes, tanks and gauges forming part of a **Fluid Filled Cable System**, etc., and also between these components and local **Earth**.

16.4 **High Voltage** gradients can be present across any break in metallic connections associated with a **High Voltage** cable **Ancillary System**, e.g. sheath bonding connections, **Auxiliary Cable** cores, fluid filled cable pipework, etc. In such cases, **Approved Conductor** continuity bonds **Shall** be used to prevent **Danger**.

16.5 Exposed sheaths or armours of **Auxiliary Cables Shall** be covered with **Approved** insulating material prior to work taking place on the **Auxiliary Cable** cores.

16.6 Where practicable the cores of the **Auxiliary Cable** being worked on **Shall** be disconnected at all points and shorted together to **Earth** to avoid **Danger**.

16.7 When working on one core of an **Auxiliary Cable**, the other cores **Shall** be insulated or so placed as to avoid accidental contact.

16.8 Further guidance on dealing with induced voltages in general can be found in PR-NET-OSM-062 Access and Work on **High Voltage** Underground Cables – Operational Safety Manual - Section 8.1, and in ENA Engineering Recommendation C99.

17 Revision History

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