

## 1. SCOPE

This Safety Instruction applies the principles established by the ScottishPower Safety Rules (Electrical and Mechanical), to achieve **Safety from the System** for personnel working on or testing **Low Voltage (LV) Apparatus**. Any reference to work on or testing of **LV Apparatus** in this Safety Instruction shall include any work activity so near **LV Apparatus** that **Danger** may arise.

Work on or testing of **Live LV Apparatus** shall be carried out in accordance with the Live Working Manual.

In addition to the requirements of this Safety Instruction, work on or testing of **LV** apparatus which is part of a Customer's installation shall be in accordance with PSSI 17.

## 2. ISSUE RECORD

This is a [Reference](#) document. The current version is held on the EN Document Library.

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Issue Date	Issue No.	Author	Amendment Details
September 2015	4	Phil Currie	7 Definitions for <i>ABC</i> and <i>SAFL</i> 9 Additional <b>Dangers</b> identified 10.6 reference to other lines in proximity 10.8 reference to lone working at height 10.12 controlling access, signing, guarding 11.1 clarification of methods of isolation; inclusion of loss of mains protection 11.2 examples of safe custody with order of preference 11.8 'consider whether conditions may have changed' 11.9 polarity and other tests – now refers to Live Working Manual 11.10 precautions when energising/re-energising 12.1 cables treat as <b>Live</b> unless visibly traced; permitted case for cutting cable beneath termination 12.2 <b>Isolated</b> overhead lines – major changes. Now deals with covered conductors and <i>ABC</i> 12.3 reconnection at request of meter operator/customer 12.5 mobile and portable generators 13.4 prove unearthed metal work not <b>Live</b> when working on <b>Live</b> overhead lines 13.5 work on insulated unscreened <b>Live</b> overhead lines Appendix 1 additional guidance and inclusion of ducts Appendix 2 complete re-write: supervision, managing fault level, PPE, new minimum of 1.5m undisturbed ground, mechanical excavation. Old conditions 1 and 2 replaced with general guidance. Minor sheath damage
Aug 2018	5	Jason Morgan	Appendix 1 fully updated with revised approach to identification of <b>LV</b> cables.
05/12/2018	6		Reverted back to Issue 4 wording in light of notification from DNO of LV Cable Identification Incident.

## 3. ISSUE AUTHORITY

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#### 4. REVIEW

This is a **Reference** document which has a 5 year retention period after which a reminder will be issued to review and extend retention or archive.

#### 5. DISTRIBUTION

This Energy Networks' Safety Instruction is maintained by EN Document Control and is part of the ScottishPower Safety Rules which is published to the SP Energy Networks Internet site.

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#### 7. DEFINITIONS

<i>ABC</i>	Aerial Bundled Conductor
<i>Switching and Fault Log (or SAFL)</i>	A form designed for recording <b>Switching</b> operations that have been instructed and/or carried out on a <b>System</b> . Refer to OPSAF-11-010 (MSP 1.8)

Terms printed in bold type are as defined in the ScottishPower Safety Rules (Electrical and Mechanical).

## 8. APPARATUS IDENTIFICATION

**LV Apparatus** on which work or testing is to be carried out shall be readily identifiable, or have fixed to it means of identification, which will remain effective throughout the course of the work or testing.

## 9. DANGERS

The main **Dangers** to personnel working on or testing **LV Apparatus** are electric shock or burns arising from:

- (i) The possibility of personnel mistaking that part of **LV Apparatus** on which it is unsafe to work without special precautions, for that which is out of service by **Switching** and on which it is safe to work;
- (ii) The possibility of the **LV Apparatus** being worked on accidentally or inadvertently being made **Live**;
- (iii) Inadequate precautions being taken under **Live** conditions;
- (iv) Inadequate precautions to shroud adjacent exposed metalwork;
- (v) The possibility when working on **Isolated LV Apparatus** of inadvertent contact with **Live** conductors within the work area;
- (vi) The release of fault energy due to inadvertent short circuit between conductors or failure of insulation during fault conditions;
- (vii) Inadequate precautions to suppress or safely discharge any induced or other impressed voltages in the conductors and associated fittings;
- (viii) Misidentification of **LV** cables which may result in opening an **HV** cable, duct or pipe in error.

## 10. GENERAL REQUIREMENTS

- 10.1 **LV Apparatus** on which work or testing is to be carried out shall, where reasonably practicable, be taken out of service by **Switching**.
- 10.2 The preferred method is to work on **LV Apparatus** which has been **Isolated**. This will not always be reasonably practicable, but no **Person** shall be engaged in any work or testing on any exposed **Live** conductor where **Danger** may arise unless:
  - (i) It is unreasonable in all the circumstances to isolate the **LV Apparatus** to remove hazards which could give rise to **Danger**; and
  - (ii) It is reasonable in all the circumstances for the work or testing to be carried out while the **LV Apparatus** is **Live**; and
  - (iii) Suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.
- 10.3 Work on or testing of **LV Apparatus** shall only be carried out by an **Authorised Person** who has completed the appropriate course of training.
- 10.4 Where work or testing is to be carried out on **LV Apparatus** which is part of **HV Apparatus**, adequate precautions shall be taken to avoid **Danger** from such **HV Apparatus** and when necessary, an appropriate **Safety Document** shall be issued by a **Senior Authorised Person**.

- 10.5 An **Authorised Person** shall decide under what conditions the work or testing is to take place and whether a **Safety Document** may be required to be issued by a **Senior Authorised Person**. This decision shall include when work or testing is to be carried out on **LV Apparatus** which is in proximity to exposed **HV Apparatus** which may be **Live**, or become **Live**.
- 10.6 If there are other overhead lines in proximity to an **LV** line to be worked on, the **Authorised Person** in charge shall ensure the **Working Party** are warned of the additional **Danger**. Where necessary, **Danger Notices** shall be used to form a demarcation barrier.
- 10.7 No work or testing shall be carried out on **Live LV Apparatus** or in proximity to exposed **Live LV** conductors, other than by an appropriately **Authorised Person**. All such work or testing shall be in accordance with the provisions of the Live Working Manual.
- 10.8 Any **Person** working on a tower, pole or high structure shall be in visual range of at least one other **Person** except where that work is of limited duration and is covered by an **Approved** procedure for lone working at height.
- 10.9 Before any wood pole is climbed it shall be sounded, and the condition of the foundations and the effectiveness of any stays examined. No pole badly impaired by decay or damage, or the stability of which may be affected by the condition of the foundation or any stays, shall be climbed until it has been supported by **Approved** means.
- 10.10 Where a **Person** is working on a pole, no work shall be carried out which may affect the stability of the pole.
- 10.11 The release of tension in, and the lowering of conductors and stays shall be carried out in a controlled manner in accordance with **Approved** procedures.
- 10.12 All working areas shall be properly secured, and where appropriate signed and guarded. Safe means of access and egress shall be provided. The **Authorised Person** in charge of the work or testing, or personnel nominated by him, shall control access to the work areas.

## 11. WORK OR TESTING ON ISOLATED APPARATUS

- 11.1 **LV** isolation shall be by the use of an **Isolating Device** or by adequate physical separation e.g. jumpers removed or secured, cable cores cut, separated and insulated.

Where isolation is by the operation of **HV Apparatus**, the isolation shall be achieved in accordance with PSSI 1.

Time switches, float switches, thermostats, sequence switching devices, loss of mains protection on **LV** connected embedded generation or similar automatic switching devices, are not **Isolating Devices** and shall not be used as such.

**Caution Notices** shall be affixed at all **Points of Isolation**.

- 11.2 Where reasonably practicable, all **Points of Isolation** shall be **Locked**. If this is not reasonably practicable, the fuses, links or other **Isolating Devices** shall be removed to safe custody. Captive links shall be secured in accordance with an **Approved** procedure.

Note: In order of preference, taking **Isolating Devices** into safe custody includes:

- Retained by the **Senior Authorised Person** issuing the **Safety Document** if one is applicable; or
- Retained by the **Person** in charge of the work/testing; or
- Left inside a secure **LV** pillar or substation. It is also permitted to leave link box links on top of the inner bell cover of a link box.

- 11.3 Where a **Limited Work Certificate** is to be issued and it is reasonably practicable for the **Apparatus** to remain **Isolated** throughout the course of the work or testing, the **Senior Authorised Person** preparing the **Limited Work Certificate** shall take any removable **Isolating Devices** and/or **Safety Keys** into safe custody.
- 11.4 Where it is not reasonably practicable for the **Apparatus** to remain **Isolated** throughout the course of the work or testing, the **Senior Authorised Person** may issue the removable means of isolation and/or **Safety Keys** to the **Authorised Person** who is to do the work or testing. The **Authorised Person** shall keep these in safe custody, preferably by retaining them in his personal possession, except when the **Apparatus** is made **Live**.
- 11.5 In order to facilitate the handing over of **Safety Keys**, they shall be readily identifiable with the **Limited Work Certificate** or with the **Apparatus** with which they are associated.
- 11.6 Where work or testing is to be continued by another **Authorised Person**, the **Authorised Person** who was doing the work shall surrender any removable **Isolating Devices** and **Safety Keys** either to a supervisor or to that other **Authorised Person**. If these are surrendered to a supervisor, he shall retain them in safe custody until he reissues them to the **Authorised Person** who is to continue the work or testing. Where a **Limited Work Certificate** is involved, the transfer of any removable **Isolating Devices** and **Safety Keys** shall be carried out in accordance with the appropriate parts of Safety Rule B4.3 – Transfer of **Limited Work Certificates**.
- 11.7 Before work or testing commences, the **Authorised Person** who is to do the work or testing shall, so far as is practicable:
- (i) Screen off any adjacent exposed or unprotected **Apparatus** which may be **Live** or shall be considered to be **Live** and/or make use of **Approved** rubber gloves and insulated tools in order to avoid **Danger**;
  - (ii) Check, by the means of an **Approved** voltage testing device, that the **Apparatus** on which work or testing is to take place is not **Live**. The device used shall be tested immediately before and after use.
- 11.8 If work or testing is interrupted, the **Authorised Person** continuing the work or testing shall first consider whether conditions may have changed and if necessary, carry out the procedure in 11.7 (ii) and confirm that **Caution Notices** and, where applicable, **Safety Locks** remain in place at all **Points of Isolation**.
- 11.9 Where work is carried out that may affect the polarity, voltage, earth loop impedance (where an earth terminal is being provided) and (where appropriate) phase rotation at customer supply terminals:
- new supplies shall not be commenced until tests described in OPSAF-12-061 (LWM 2.6) have been carried out to establish that these characteristics meet required standards;
  - existing supplies shall be tested and recommenced in accordance with OPSAF-12-061 (LWM 2.6).
- 11.10 Before energising any **LV Apparatus**, all personnel known to be working on the **Apparatus** shall be removed from the point(s) of work until any **Switching** (including the connection of jumpers or cable cores) has been completed. This applies also when energising a circuit from a mobile generator. Where isolation has been created for a customer, the supply shall only be reconnected with their consent. Where formal agreement is deemed necessary, reference shall be made to PSSI 17.

## 12. ADDITIONAL PRECAUTIONS FOR WORK ON SPECIFIC ISOLATED LV APPARATUS

The following precautions shall be taken in addition to those detailed in Section 11 above:

### 12.1 Underground Cables

12.1.1 The identification of underground cables shall be completed in accordance with Appendix 1 of this Safety Instruction.

Subject to the provisions of Section 12.1.2 below, a section of cable shall be treated as **Live** [utilising **Approved Live** working techniques, tools and equipment in accordance with OPSAF-12-011 (LWM 4.1)] unless it and any connected cables or services can be physically traced along their entire length between all **Points of Isolation**, and has been proved to be not **Live**.

12.1.2 For the specific purpose of cutting a disconnected cable beneath a termination e.g. a disconnected cutout where it can be established beyond reasonable doubt that there are no other connected customers or sources of backfeed between the point of disconnection and the termination, then **Live** working techniques need not be employed and the cable may be cut below the termination.

12.1.3 Work on or testing of a suspected or confirmed damaged, deteriorated or distressed **LV** underground cable or joint shall be carried out in accordance with the procedures set out in Appendices 1 and 2 of this Safety Instruction.

### 12.2 Overhead Lines

In order to protect personnel from the **Dangers** of inadvertent backfeeds, induced or impressed voltages or the connection of generation to the **System**, the following precautions shall be applied when working on **Isolated** overhead lines.

12.2.1 Work on or adjacent to **Isolated** exposed open-wire conductors (see Diagram 1)

Before work or testing is commenced on exposed open-wire **LV** overhead conductors which have been **Isolated**, they shall be proved to be not **Live** at the point of work using an **Approved** voltage testing device. The voltage testing device shall be proved before and after use.

**Approved LV** shorting kits shall be applied so as to ensure all conductors are shorted together. When applying shorting kits the first clamp shall be connected to the earth or neutral/earth conductor. On 6-wire **Systems**, when shorting kits have five conductor clamps, two shorting kits shall be applied at each position.

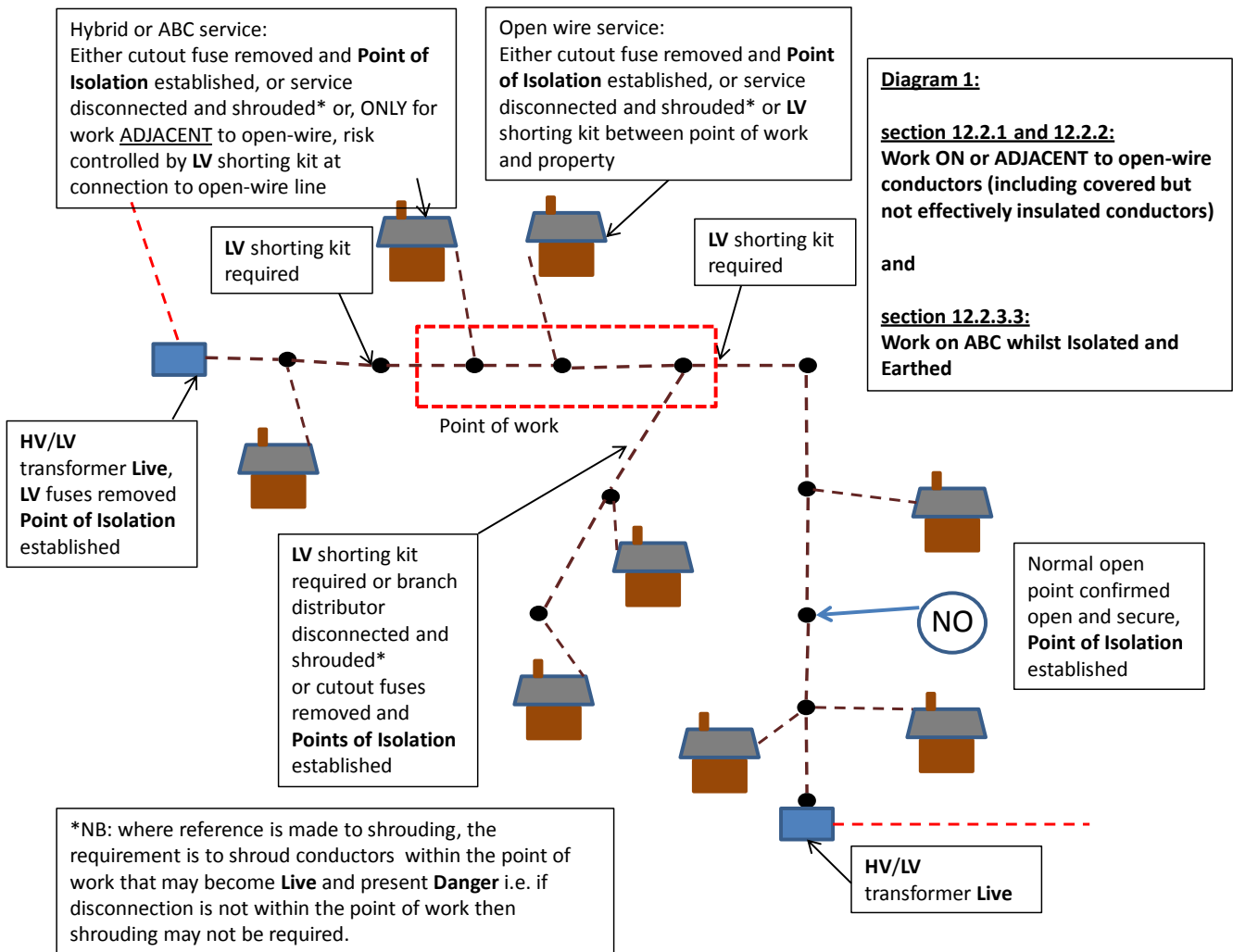
During the testing and application of shorting kits, flame retardant coveralls, **Approved** rubber gloves and a minimum of light eye protection shall be worn.

Subject to the provision in the Note 1 below, **Approved LV** shorting kits shall be applied between the point of work and all potential in-feeds from the **System**, branch distributors and connected services. The short(s) shall be applied as close as reasonably practicable to the point of work.

Note 1: The application of shorting kits is not required between the point of work and branch distributors and services when:

- cutout fuse(s) have been removed and **Points of Isolation** established at all the cutout(s);
- or
- services and/or branch distributors have been disconnected using **Live** working procedures and shrouded as necessary to prevent **Danger**.

Note 2: As an alternative precaution only available when working adjacent to exposed open-wire lines (e.g. when tree cutting or erecting scaffolding), the risk from effectively insulated connections e.g. ABC, Hybrid or Split-Concentric services or ABC branch distributors within the section of line identified for work may be controlled by the application of a shorting kit at the point of connection of the service(s) or branch distributor to the open-wire line. This alternative precaution is due to the low level of risk associated with work adjacent to such cables and is not available when working on the exposed open-wire lines.



12.2.2 Work on or adjacent to **Isolated** covered but not effectively insulated conductors in an open-wire configuration (see Diagram 1)

When work is to be carried out on or adjacent to covered conductors that are not effectively insulated (e.g. hessian or pvc covered), following isolation of the circuit, in order to facilitate testing of conductors and the subsequent application of **Approved LV shorts**, a section of covering shall be removed from the conductors.

The removal of the covering from the conductors constitutes **Live** working and shall be carried out in accordance with the appropriate section of the Live Working Manual.

When the covering has been removed to expose the conductors, the testing and application of **Approved LV** shorts shall be completed as for exposed open-wire conductors in Section 12.2.1 above.

When work has been completed and the **LV** shorts removed, the exposed conductor shall be covered and protected against water ingress.

### 12.2.3 Work on **Isolated** Aerial Bundled Conductors (*ABC*)

Depending on the work to be done, work on **Isolated ABC** may be carried out with the line in any of the following conditions:

- **Isolated** and **Earthed** with a minimum of one **LV** shorting kit applied in accordance with 12.2.3.2;
- **Isolated** and **Earthed** in accordance with 12.2.3.3;
- Not part of the **System**. (Whilst not falling under the definition of **Isolated** it is practical to include these lines within this section).

#### 12.2.3.1 Earthing of *ABC* – general

The following are **Approved** methods of earthing an *ABC* line:

- (a) At an *ABC* link box (splitter box) using an **Approved** shorting lid;
- (b) By the application of an **Approved** shorting kit at an **LV** pole mounted fuse unit. This is only permitted when the shorting kit may be applied to all phases and the neutral and, where applicable earth conductors;
- (c) By the application of an **Approved** shorting kit to terminals attached to the conductor via **Approved** piercing shorting connectors. Note: the application of **Approved** piercing shorting connectors in this circumstance constitutes **Live** work and shall be carried out in accordance with the relevant section of the Live Working Manual;
- (d) Where the ends of a section of line may be stripped of insulation (e.g. when a new section of *ABC* is being erected), by the application of 'standard' **Approved** screw-on shorting kits.

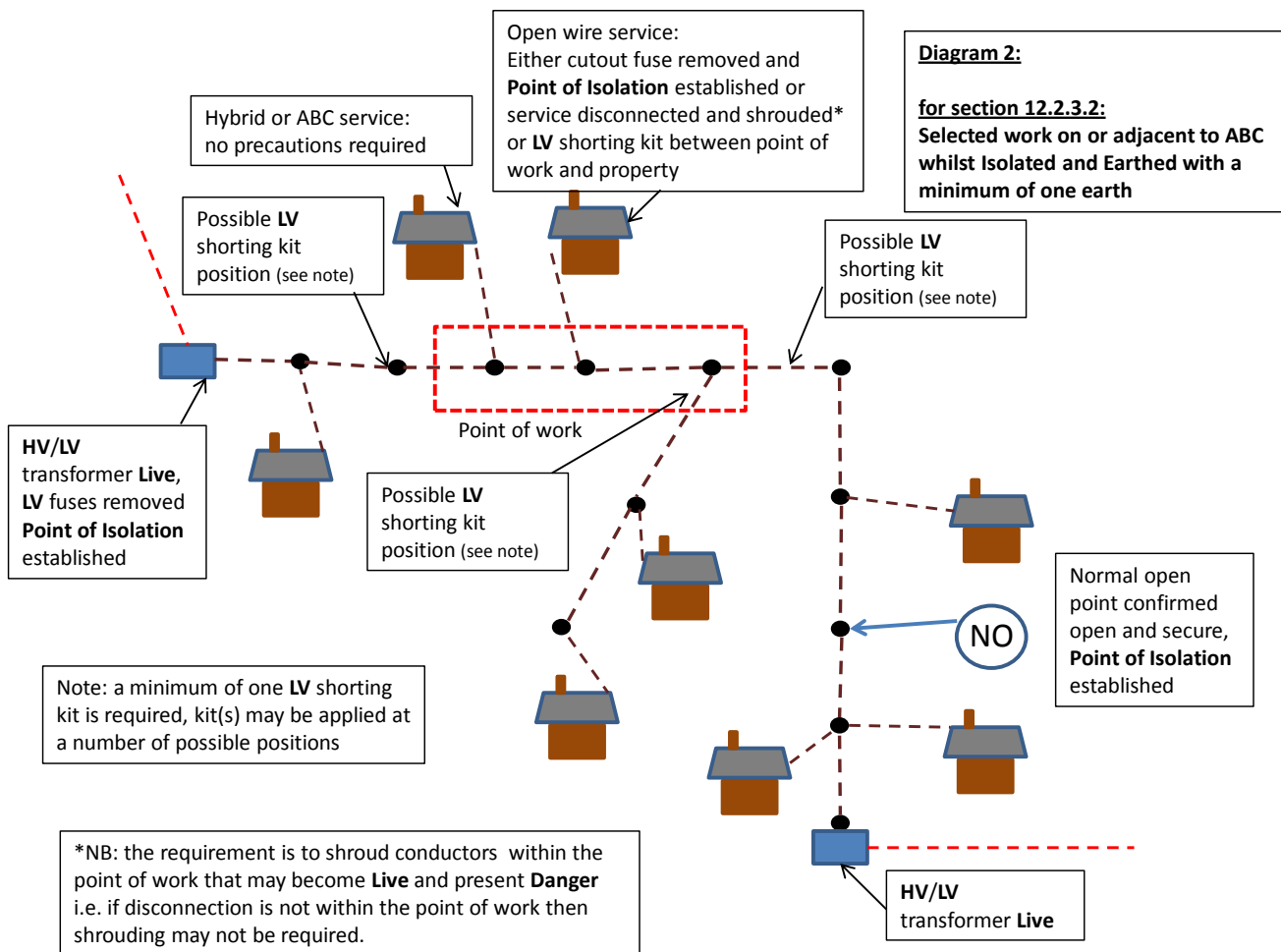
Note: when the section of *ABC* forms part of the **System** or it is subject to the risk of induced or impressed voltages, the stripping of insulation from conductors in this situation constitutes **Live** work and shall be carried out in accordance with the relevant section of the Live Working Manual.

Before being **Earthed** by any of the above methods, the conductors shall be proved to be not **Live** at the point of earthing using an **Approved** voltage testing device. The voltage testing device shall be proved before and after use. Where **Approved** shorting kits are applied, the first clamp shall be connected to the earth or neutral/earth conductor.

During the testing and the application of shorting kits described above, flame retardant coveralls, **Approved** rubber gloves and a minimum of light eye protection shall be worn.



12.2.3.2 Selected work on or adjacent to ABC whilst **Isolated** and **Earthed** with a minimum of one Earth (see Diagram 2)



The following categories of work may be carried out with the conductors **Isolated** and **Earthed** with a minimum of one earth, but not **Earthed** in accordance with 12.2.3.3 below.

Note: a minimum of one set of shorts shall be applied, using one of the techniques listed in 12.2.3.1 above. Whether more than one set of shorts is required shall be subject to the on-site risk assessment which needs to take account of, for example, the presence of open-wire services or branch distributors.

- Work adjacent to the line e.g. tree cutting;
- Pole erection – Note: this does not preclude the erection of poles with the line **Live** which may be carried out in accordance with OPSAF-12-017 (LWM 5.5);
- Work that does not involve making or breaking connections or exposing uninsulated conductors.

The requirement to wear **Approved** rubber gloves and full face protection or light eye protection for these categories of work is subject to individual on-site risk assessment.

### 12.2.3.3 Work on *ABC* whilst **Isolated** and **Earthed** (see Diagram 1).

This section covers any work on **Isolated** *ABC* not covered by categories in Section 12.2.3.2 above.

The *ABC* shall be **Earthed** by one or more of the techniques listed in 12.2.3.1 above. Subject to the provision in the Note immediately below, **Approved LV** shorting kits shall be applied between the point of work and all potential in-feeds from the **System**, branch distributors and connected services.

Note: The application of shorting kits is not required between the point of work and branch distributors and services when:

- cutout fuses have been removed and **Points of Isolation** established at each cutout; or
- services and/or branch distributors have been disconnected and shrouded using **Live** working procedures.

### 12.2.3.4 Work on *ABC* that is not part of the **System**

Work on a section of *ABC* that is not part of the **System** does not fall under the remit of these Safety Rules. It is however still necessary to control any **Danger** arising from the proximity of **Plant** and **Apparatus** to the **System**.

Where the section of *ABC* is not subject to **Danger** from induced or impressed voltages, backfeed or generation then there is no requirement to implement electrical precautions such as the application of **LV** shorts or the use of rubber gloves.

Where the section of *ABC* is subject to **Danger** from induced or impressed voltages, backfeed or generation then it is recommended that any work on the line shall be carried out in accordance with Section 12.2.3.2 or 12.2.3.3 as appropriate.

## 12.3 Meters, Meter Wiring and Associated Metering Equipment

12.3.1 Before work commences associated with the installation or disconnection of a meter, meter wiring and associated equipment, checks and tests shall be completed as required by the Live Working Manual. The **Apparatus** shall, where reasonably practicable, be **Isolated** from the **System** and disconnected from the customer's connected equipment. As soon as practicable following completion of work, checks shall be made to confirm correct polarity and, where appropriate, phase rotation and any other checks carried out as required by the Live Working Manual.

12.3.2 Where isolation has been created for a Meter Operator/Customer, connection of supplies shall only commence with consent from that same Meter Operator/Customer. Where formal agreement is deemed necessary, reference shall be made to PSSI 17.

### 12.4 Work on Handheld, Portable, or Fixed Apparatus Connected by a Plug and Socket

Where work or testing is to be done on portable, handheld, or fixed **Apparatus** connected by a plug and socket, isolation may be achieved by the removal of the plug from the socket outlet, provided that the plug remains under the control of the **Person** doing the work or testing, or the plug has a lockable device applied to it which prevents it being inserted into a socket outlet.

### 12.5 Mobile and Portable Generators

Any work or testing on a mobile or portable generator, other than routine refuelling or running adjustments, shall be carried out with the generator disconnected from the **System** either by the removal of the supply connection leads or in accordance with an **Approved** procedure. When disconnected from the **System** the Safety Rules no longer apply, but all work or testing shall be carried out by, or under the **Immediate Supervision** of, a suitably competent person.

### 13. WORK, TESTING OR ADJUSTMENT ON LIVE APPARATUS

13.1 Before any work, including testing or adjustment, is undertaken on **Live Apparatus**, a **Person** possessing appropriate knowledge and experience shall carry out a risk assessment.

This risk assessment shall consider:

- (i) The need to work **Live** as detailed in Section 10.2 of this Safety Instruction;
- (ii) The requirements of other related legislation, e.g. New Roads and Street Works Act, Work at Height Regulations, etc.;
- (iii) Additional risks imposed by the specific working environment.

13.2 **Live** work shall be carried out in accordance with the Live Working Manual.

13.3 When it is unreasonable for **Apparatus** to be **Isolated**, work, including testing or adjustment, may be done with the **LV Apparatus Live** under the following conditions:

- (i) The work, testing or adjustment shall only be done by an **Authorised Person** who has received appropriate training. Where an assessment of the risks shows that being accompanied by another **Authorised Person** will substantially contribute towards the implementation of a safe system of work, a second appropriately **Authorised Person** shall be present and provide accompaniment in accordance with OPSAF-01-001 (LWM 1.1);
- (ii) The **Authorised Person** who is to do the work, testing or adjustment shall first remove any metallic objects that may cause a hazard, e.g. pendants worn on the body, attached to clothing or in pockets;
- (iii) Where it may introduce **Danger**, adjacent metal or conductors which are at a different potential to that on which work, testing or adjustment is to be carried out, shall be screened with **Approved** insulating material;
- (iv) Only **Approved** insulated tools and/or **Approved** test instruments shall be used;
- (v) Where necessary to reduce **Danger** to the **Authorised Person** undertaking the work, testing or adjustment or other persons in the vicinity, access to the work area shall be controlled by suitable means;
- (vi) Where necessary to prevent **Danger**, **Approved** rubber gloves and, where appropriate, **Approved** insulated mats shall be used;
- (vii) Before commencing work, testing or adjustment in ducting, trenches or underground distribution boxes where the risk assessment indicates a concern, e.g. the presence of gas, reference shall be made to PSSI 36. Where necessary a **Selected Person's** report shall be obtained;
- (viii) When work, testing or adjustment is carried out on **Live LV Apparatus**, adequate working space and a safe means of access and egress shall be provided. The working space, access/egress route and the **Apparatus** shall be adequately lit.

13.4 Where work is carried out on **Live** overhead lines, any unearthed steelwork such as an offset bracket or the portion of a stay above the insulator shall be tested for the absence of voltage using an **Approved** device.

13.5 When work is carried out on insulated but unscreened **Live Low Voltage** overhead lines (e.g. ABC) **Approved** rubber gloves shall be worn and **Approved** insulated tools used to prevent **Danger** that may arise if the insulation has deteriorated or is damaged.

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## APPENDIX 1 – IDENTIFICATION OF LV CABLES CONNECTED TO THE SYSTEM

- (i) The appropriate cable records shall be consulted to indicate the position of the relevant cable(s) in relation to all other cables, pipes or ducts at the points of work;
- (ii) Where necessary to contribute to safe excavation, use shall be made of **Approved** detection instruments to determine the position of the cables and services;
- (iii) Allowances shall be made for the possibility of errors or inaccuracies in the records, or changes in local topography which have not been recorded, and for the possibility of unauthorised movement of cables;
- (iv) If cable tiles, markers or protectors are exposed during the excavation, it shall not be assumed that they are in their original position directly above the cables. Previous excavations and careless backfilling may have displaced such cable markers or protectors. The position of a cable is not certain until it is uncovered and identified;
- (v) Whenever reasonably practicable, sufficient excavation shall be carried out at the point of work to expose all cables, pipes and ducts to establish the position of the required cable(s);
- (vi) Past and present practices in regard to cable types, armouring, jointing and depth of laying may provide some degree of identification;
- (vii) If there is only one cable in the track and (i) to (vi) above do not provide conflicting evidence, the cable may now be taken as identified;
- (viii) If doubt remains as to the identity of cables exposed, the use of an **Approved LV** cable identification device may assist in positive identification, e.g. Grumbler. Alternatively, or in addition to this, it may be necessary to identify suspected **HV** cables in accordance with PSSI 5. If doubt still remains, the cable shall be spiked in accordance with PSSI 5 (redundant cables section) and if identification remains inconclusive, the cable shall be treated as a **Live** damaged **LV** cable, in accordance with Appendix 2 of this Safety Instruction;
- (ix) Where reasonably practicable, opening ducts shall be avoided. If there is a need to access a cable within a bank of ducts then sufficient ducts shall be opened to establish the position of the required cable(s). Colour is not a reliable indicator of the duct's contents. Note that red **HV** cables have been misidentified as ducts in the past.

## APPENDIX 2 – WORK ON LOW VOLTAGE UNDERGROUND CABLE FAULTS OR DAMAGED CABLES

Work on or adjacent to damaged or faulty cables on **Live** underground **LV** networks is potentially a high risk activity, the main risk being burns from the release of fault energy (arc flash). In order to reduce this risk to acceptable levels it is important that fault and damage situations are effectively managed by competent, experienced personnel and that adequate supervision is provided to all other personnel involved.

### 1 General Precautions

The following precautions shall be taken in addition to the requirements of Sections 10, 11, 12, 13 and Appendix 1 of this Safety Instruction.

### 2 Site Specific Risk Assessment

The **Authorised Person** in charge of the work shall ensure that an on-site risk assessment(s) has been completed and members of the **Working Party** briefed before work commences. The risk assessment(s) shall make particular reference to the justification for work to be undertaken whilst the cables are **Live**. If the risks change significantly during the course of the work, the risk assessment(s) shall be updated and all personnel briefed on the changes.

### 3 Consideration of customer inconvenience, whilst important, shall not in any way be allowed to compromise safety.

### 4 Managing Fault Level

On interconnected **LV Systems**, consideration shall be given to the possibility of temporarily lowering the fault level by reducing the number of in-feeds to the part of the **System** upon which work is to be carried out.

#### 4.1 Recording of **LV Switching** under fault conditions

Under fault conditions, all **LV Switching** shall be recorded in accordance with OPSAF-11-010 (MSP 1.8). In addition, as the work proceeds, the following information shall also be recorded on a **SAFL**:

- (a) Initial fault conditions;
- (b) Details of polarity and phasing tests;
- (c) Changes to fault conditions.

### 5 Briefing and Supervision

The **Authorised Person** in charge of the work shall ensure that all personnel involved in the location and repair of faulty or damaged cables are briefed on the fault conditions and intended approach to work. All personnel shall be appropriately supervised. This is particularly important for excavation teams.

### 6 Personal Protective Equipment

**Approved** personal protective equipment as below shall be worn as appropriate during the course of the work.

Ensure that skin exposure is kept to a minimum:

- (a) Flame retardant outer clothing is worn correctly;
- (b) Hands are protected by **Approved** gloves that are appropriate to the task. Consideration shall be given to the performance of the glove under electrical arc e.g. gloves shall not be of a type where the material from which they are made would melt onto the skin;
- (c) Appropriate face and/or eye protection is worn.

## 7 Selecting a **Location** for Excavation

To avoid **Danger** from excavating at the position of a fault, the following shall, where reasonably practicable, be avoided:

- (a) Excavating in ground with evidence of previous disturbance;
- (b) Excavating at the suspected position of a fault or damage, as determined by fault location techniques including, where reasonably practicable, use of a 'Sniffer';
- (c) Excavating around joints which may be faulty.

7.1 The choice of excavation position shall take into account potential inaccuracies in the fault location due to factors such as the fault location instrument and interpretation of its results, inaccuracies in cable records, etc.

7.2 A minimum of 1.5m of ground shall, where reasonably practicable, be left unexcavated between the suspected fault position on a **Live** cable and the nearest part of any excavation. This is considered to be a sufficient barrier to protect personnel from the release of fault energy.

7.3 If at any time during excavation there are indications of a fault, e.g. smell, heat, noise, damage etc. then excavation shall cease immediately. The **Authorised Person** in charge shall assess the conditions and either:

- (a) Continue work at this position if safe to do so and the suspected location of the fault is not within 1.5m of the excavation; or
- (b) For an active fault in the excavation, excavate at an alternative location and consider the need to make the cable not **Live**; or
- (c) For a stable fault in the excavation, excavate at an alternative location.

7.4 If a faulty or damaged cable has been exposed in an excavation, then 1.5m of undisturbed ground is not available to act as a barrier. The following measures shall be considered to avoid **Danger** from the release of fault energy:

- (a) Open an additional excavation along the cable route, leaving a minimum of 1.5m of undisturbed ground intact, as detailed above;
- (b) Having marked the cable to enable subsequent identification, carefully reinstate a minimum of 1.5m of ground to form a barrier between the damage/fault and the point of work;
- (c) Increase the separation between the fault/damage and the point of work to protect personnel and reduce the risk of disturbing the cable at the point of fault/damage – the increased distance shall be the subject of a risk assessment and shall be a minimum of 2m.

## 7.5 Mechanical Excavation

During fault location work, there is an increased risk of inadvertently excavating in close proximity to the fault. This can result in the uncontrolled release of fault energy, with a potential for injury to personnel. Therefore, subject to rigorous risk assessment on site, mechanical excavators may be used close to and around the cable – this has the benefit of removing personnel from close proximity to any release of fault energy. The risk assessment shall include consideration of any risks arising from the presence of other utility apparatus in the vicinity of the excavation.

The risk assessment shall consider where the banksman is positioned – the banksman shall not be within the excavation whilst the mechanical excavator is digging and shall be as far as is reasonably practicable from the point of excavation whilst still being able to direct the machine operator. If the banksman has to enter the excavation, the machine shall stop work until he exits.

7.6 Before the excavation is extended towards the position of fault or damage, the cable shall have been made not **Live** by removal of fuses or links, cutting cores or breaking jumpers on all possible in-feeds to the fault/damage. See also 12 below. Where reasonably practicable this shall include the removal of fuses from cutouts in the case of services. Once the cable has been proven to be not **Live**, excavation towards the point of fault/damage may be carried out by tracing the cable along its route from the point at which it was proven to be not **Live**.

7.7 Once the fault/damage on the cable has been positively identified, no section of cable shall be re-energised until the fault has been disconnected from that part of the **System**, all remaining ends of the cable stripped back and cores fully insulated.

## 8 **Approved** Equipment

To assist in minimising risk, use shall, where appropriate and where reasonably practicable, be made of **Approved** equipment such as:

- (a) Cable location instruments (e.g. CAT and GENNY);
- (b) Fault location devices (e.g. pulse echo or fault “sniffer”);
- (c) Cable identification and/or core identification instruments (e.g. “Grumbler”);
- (d) Voltage indication equipment (e.g. **Approved** voltage pen).

Use shall, where reasonably practicable, be made of re-energising devices (e.g. Rezap or Fusemate).

## 9 Cable Identification

At each **Location** where cables are to be worked on, all cables shall, where reasonably practicable, be identified using the methods described in Appendix 1 of this Safety Instruction and OPSAF-12-011 (LWM 4.1).

## 10 Conductor Identification

Existing core colours or numbers shall not be relied on for phase and neutral identification. Cores shall where reasonably practicable be tested, marked up and the phasing and phase rotation conditions recorded as necessary before isolation. Where this is not reasonably practicable, phasing, polarity and rotation shall be tested as soon as reasonably practicable following re-energisation of the circuit, in accordance with OPSAF-12-061 (LWM 2.6). Only **Approved** identification tapes may be used to mark conductors.

11 Withdrawal of personnel from work **Location**

If it is required to re-energise the network at any time during the fault location or repair process, all personnel shall be removed from the point(s) of work until all **Switching** (including the connection of jumpers or cable cores) has been completed. This applies also when mobile generation is to be connected to the **System**.

Before recommencing work, the condition of that part of the **System** affected by the fault shall be checked to confirm it is as expected following the **Switching**.

12 Cutting **Live** Cores, Breaking Jumpers, or Removing Links

Before cutting **Live** cores, breaking jumpers, or removing links to isolate a damaged or faulty section, consideration shall be given to the possibility of fault current affecting the operation. If there is any doubt, the circuit shall be **Isolated** by removal of fuses and then re-energised after the operation is completed.

13 Minor Sheath Damage

When it is suspected that only minor damage has taken place to the outer covering/sheath of an **LV** underground cable, subject to a rigorous on-site risk assessment, the cable may be examined whilst **Live** to establish that the damage is confined to the extent suspected.

The appropriate PPE to be worn whilst carrying out this examination is defined in 6 above.

If additional ground is to be excavated to examine the full circumference of the cable, again subject to rigorous on-site risk assessment, this may be carried out **Live** using a mechanical excavator or manually whilst wearing the same PPE.

If at any stage during this examination or excavation it becomes evident that the damage is more severe, it shall be treated as a fault and dealt with as described in 7.4 above.

If it is established that the damage is confined to the sheath, an **Approved** repair shall be carried out, this may be done with the cable **Live**.

14 Re-energising repaired faulty or damaged sections

An **Approved** re-energising device shall, where reasonably practicable, be used to restore supply. Where this is not reasonably practicable, appropriately rated fuses may be used. The use of links, connection of jumpers, or jointing of cable cores to restore supply shall, where reasonably practicable, be avoided.