

FOREWORD

Earthing of **High Voltage Apparatus** is carried out as part of the safety precautions to protect **Persons** working on or testing such **Apparatus** against the effects of inadvertent re-energisation, induced or impressed voltages. The protection afforded by earthing is dependent upon the combination of:

- (i) The efficiency of the connection of **Primary Earths** and their capability to carry the fault current until the electrical protective devices operate;
- (ii) The speed of operation of electrical protective devices in service called upon to operate in such circumstances;
- (iii) The **System** voltage, voltage gradient to the point of earthing and the fault level at the point of work.

1. SCOPE

This Safety Instruction applies the principles established by the ScottishPower Safety Rules (Electrical and Mechanical) and **Company** Safety Instructions to give guidance on the positioning of **Earthing Devices** to achieve **Safety from the System** for personnel requiring to work on or test **High Voltage (HV) Apparatus**.

2. ISSUE RECORD

This is a **Reference** document. The current version is held on the EN Document Library.

It is your responsibility to ensure you work to the current version.

Issue Date	Issue No.	Author	Amendment Details
Dec 2007	3		Update to accommodate new types of Switchgear
September 2015	4	Phil Currie	Title amended to clarify application. Additional Danger identified. 10 – Sentence added referring to content of other PSSIs for specific earthing guidance. 10.5 – 9m rule shall not be applied to overhead line conductors. Diagrams added. 10.21 – Added requirement to observe Safety Distance while applying Portable Primary Earths .

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

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

8. PLANT AND APPARATUS IDENTIFICATION

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

9. DANGERS

The main **Dangers** to personnel applying earths to **HV Apparatus** are electric shock, burns or falling, arising from:

- (i) The application of earths to **Live HV Apparatus**;
- (ii) Badly connected or insecure **Earthing Devices**;
- (iii) The incorrect sequence or method of application or removal of **Portable Earths**;
- (iv) The inadvertent earthing of **Live HV Apparatus** by the loss of control or difficulty in the handling of portable earthing equipment;
- (v) The encroachment of **Safety Distance** to **Live HV Apparatus** during the application or removal of earths.

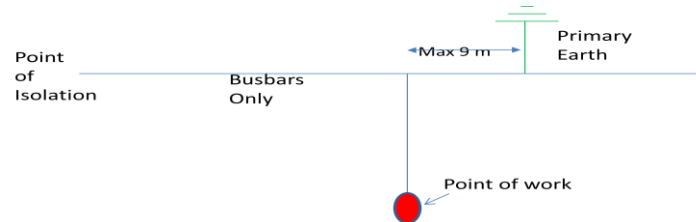
10. GENERAL EARTHING REQUIREMENTS

The requirements detailed below shall be met with regard to the earthing of **HV Apparatus**. For detailed guidance refer to the appropriate PSSI, for example PSSI 4 covering work on the phase conductors of **HV** overhead lines.

- 10.1 **Primary Earths** shall be applied within the **Isolated** zone and, where reasonably practicable, between the point of work and all **Point(s) of Isolation** excluding **Low Voltage (LV)** connections but including, where applicable, the **Point of Isolation** from common neutral earthing equipment.
- 10.2 **Primary Earths** shall be of adequate cross-sectional area and be efficiently connected between earth and the **Isolated HV Apparatus** so as to discharge safely the resultant fault current due to any inadvertent energisation. The Energy Networks policy with regard to the cross-sectional area of **Portable Primary Earths** for use in substations and on overhead lines is stated in OPSAF-11-008 (MSP 1.6).
- 10.3 Where reasonably practicable, a circuit breaker or specially provided earth switch or fixed **Earthing Device** shall be used to make the first earth connection. When removing earths the last earth to be removed shall, where reasonably practicable, be via a circuit breaker or specially provided earth switch or fixed **Earthing Device**. At voltages of 132kV and above any **Portable Earths** applied on the line side of the line isolator shall, where reasonably practicable, be applied and removed with the associated line earth switch closed.
- 10.4 When compliance with the above requirements does not give adequate protection from induced voltages, impressed voltages or inadvertent backfeeds, **Drain Earths** shall be applied in accordance with an **Approved** procedure, which may include the use of an **Earthing Schedule**.

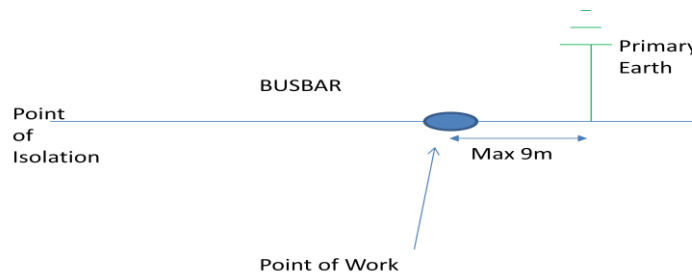
- 10.5 Where it is not reasonably practicable to apply **Primary Earths** to busbars between the point of work and the **Points of Isolation**, they may be placed in an alternative position so as to have a similar electrical effect to that which would occur if they were placed between the point of work and the **Points of Isolation**. Such a position could be:

(i)



On busbars, a permanent connection tee between the point of work and the nearest **Point of Isolation** at a distance not exceeding 9m from the tee point; or

(ii)



On a busbar, a connection at a point no more than 9m beyond the point of work from the **Point of Isolation**; or

- (iii) For work on metal-enclosed switchgear or for work on circuits terminated at metal-enclosed switchgear, as detailed in PSSI 3; or
- (iv) As dictated in an alternative **Approved** procedure.

Note: the 9m rule as specified for busbars in 10.5(i) and 10.5(ii) shall not be applied to overhead lines.

- 10.6 It is not necessary to earth every part of the **HV Apparatus** within an **Isolated** zone provided that the requirements of the ScottishPower Safety Rules (Electrical and Mechanical) and **Company** Safety Instructions have been met.
- 10.7 The application and removal of fixed **Primary Earths**, including the closing and opening of earth switches and fixed **Earthing Devices** when used as **Primary Earths**, shall be carried out by the **Authorised Person** who has received the **Switching** instruction from the **Control Person**, or in the case of an **Authorised Person** under training, carried out in accordance with the requirements of PSSI 1. Under the terms of a **Sanction for Test**, however, the recipient of the **Sanction for Test** may remove or replace those **Primary Earths** defined on the **Sanction for Test**.
- 10.8 The application and removal of **Portable Primary Earths** shall be carried out by the **Authorised Person** who has received the **Switching** instruction from the **Control Person**, or by a **Person** acting under his **Personal Supervision**.

- 10.9 **Portable Earthing Devices** shall be examined immediately before use by the **Authorised Person** responsible for the application of such earths. A **Portable Earthing Device** which is defective or does not comply with requirements of OPSAF-11-009 (MSP 1.7) shall be withdrawn from service forthwith.
- 10.10 The **Authorised Person** responsible for the earthing shall take all reasonably practicable steps, including making arrangements with the **Control Person** for **Switching** out additional equipment if necessary, to ensure that earthing by means of a **Portable Earth** using an **Approved** pole is carried out in situations where clearances from adjacent **Live HV Apparatus** are adequate to prevent **Danger** should control of the pole be lost.
- 10.11 As an additional precaution the **Authorised Person** in charge of applying **Portable Primary Earths** shall, before doing so, ensure so far as is reasonably practicable that adequate protective devices are in service on busbars and circuits in the vicinity of the earthing operation in case of inadvertent earthing of adjacent **HV Apparatus**.
- 10.12 Where **Portable Primary Earths** are to be used, care shall be taken to ensure that the points at which the **Portable Primary Earths** are to be applied to the **HV Apparatus** are of adequate capacity so as to safely discharge the resultant fault current due to any inadvertent energisation after they have been secured in position.
- 10.13 The points of application of **Portable Primary Earths** shall not be such as to inhibit the operation of any protective devices or other ancillary equipment which is in service and which may be required to operate.
- 10.14 Two **Persons** shall be present during the application of **Portable Primary Earths**, one of whom must be an **Authorised Person** and the other a **Person** acting under the **Personal Supervision** of that **Authorised Person**.
- 10.15 If the **Primary Earths** through which the **HV Apparatus** is **Earthed** are not close to and visible from the point of work, the **HV Apparatus** shall be **Earthed** by means of **Drain Earths** at those points of work unless there can be no reasonable doubt that the correct **Apparatus** is to be worked on and that no **Danger** from induced voltages, impressed voltages or inadvertent backfeeds can arise at the points of work. However, in the case of metal-enclosed switchgear, PSSI 3 shall apply.
- 10.16 **Portable Drain Earths** shall have a cross-sectional area of not less than that specified in OPSAF-11-008 (MSP 1.6).
- 10.17 **Drain Earths** in connection with a **Safety Document** shall be applied and removed by an **Authorised Person** as instructed by the **Authorised Person** in receipt of the **Safety Document**.
- 10.18 Before commencing to apply **Portable Drain Earths**, an **Approved** voltage indicator shall, where practicable, be used to verify that the conductor to be **Earthed** is not **Live** at **System** voltage. If, from the position of application of **Portable Drain Earths**, the conductor can be seen to be **Earthed** and visibly traced to an **Earthing Device**, the use of a voltage indicator may be dispensed with.
- 10.19 When either the **Primary Earths** or **Drain Earths** would prevent access to the point of work, the **HV Apparatus** on which work is to be done must be efficiently connected to earth at the nearest points to the point of work where access can be obtained. **Drain Earths** shall also be applied at the point of work and these **Drain Earths** may be removed in turn when work is to be done but each earth so removed shall be replaced before another earth is removed.
- 10.20 When **HV Apparatus** has been disconnected from all supplies and bodily removed from its service position, the use of **Primary Earths** on that **HV Apparatus** is not necessary provided that the **HV Apparatus** is electrically discharged.

10.21 When applying or removing **Portable Primary Earths** the **Safety Distance** to all **HV Apparatus** shall be maintained. For guidance on the application of **Portable Drain Earths** to overhead line conductors, refer to PSSI 4.

11. TYPICAL EXAMPLES OF THE APPLICATION AND POSITIONING OF EARTHS

Examples of the application of **Primary Earths** and **Drain Earths** to **HV Apparatus** are given below.

11.1 Substations with Exposed High Voltage Conductors

Before work commences on the busbars and associated connections in substations with exposed **HV** conductors, **Primary Earths** shall be applied between the point of work and **Point(s) of Isolation** from the **HV System**. In some cases the most convenient point of application may be on a spur to the busbar. This is permissible provided the requirements of section 10 are met. Fixed **Earthing Devices** (where provided) or **Portable Earths** may be used for this purpose.

11.2 Indoor Type Substations

In some substations the layout of the busbars makes it dangerous to apply earths between the point of work and **Point(s) of Isolation**, because earthing positions are above circuits which may be **Live**. In such situations, the requirements of the **Company** Safety Instructions are not reasonably practicable and a minimum of one earth shall be applied to the busbar to meet the requirements of the Safety Rules and **Approved** instructions. In some cases the most convenient point of application may be on a spur to the busbar. This is permissible provided the requirements of section 10 are met.

11.3 Mesh Substations

When working on a mesh corner the operation of a switch or disconnector/isolator during maintenance may disconnect the **Primary Earth** from the point of work. This is permissible provided that the basic requirement of a **Primary Earth** being in place between the point of work and the **Point(s) of Isolation** is maintained and **Danger** from induced or impressed voltages is excluded. In some cases, the most convenient point of application may be on a spur to the busbar. This is permissible provided the requirements of section 10 are met.

11.4 Metal-Enclosed Switchgear

For the application of earths in connection with metal-enclosed switchgear, refer to PSSI 3.

11.5 Transformers and Reactors

Transformers and reactors shall be **Earthed** between the windings and all **HV Point(s) of Isolation**, but earthing is not required on **LV** connections of transformers. In some cases the most convenient point of application may be on a spur to the busbar. This is permissible provided the requirements of section 10 are met. See also PSSI 18.

11.6 HV Overhead Lines

For the application of **Earthing Devices** before work commences on overhead lines, see PSSI 4.