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NATIONAL SAFETY INSTRUCTION

**UK BP/SE/NSI 24
EARTH SYSTEMS**

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EARTH SYSTEMS

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1. SCOPE

This National Safety Instruction sets out the principles for approaching and working on earth **Systems** or other associated conductive parts. It incorporates the principles contained in TGN (E) 114 'Replacement of Stolen Earth Tape'. There are additional procedures available for work on railway operator connections.

2. DEFINITIONS

For the purpose of this document the following definitions apply:

Earth Bond – Bonds for the purpose of providing earth continuity on earth connections.

Approved Earth Bond and Pole – are detailed in TGN (E) 114 and are used in making or breaking connections in *Main Earth Systems*. They are not fully rated for the **System** fault level.

Main earth System – an arrangement of interconnected buried or surface conductors in intimate contact with, or providing an electrical connection, to true earth, which are intended to carry **HV Equipment** fault current.

Other Earth System – Earth conductors which are part of the **System** but which are not part of the *Main Earth System*.

Intact System – any Main Earth System or Other Earth System in which there are no breaks or disconnections in any of the earth conductors.

Inadequate System – any *Main Earth System* or *Other Earth System* in which there are breaks or disconnections in any of the earth conductor.

Poor Weather Conditions – Lightning snow storms, heavy or persistent rain fog or mist.

Terms printed in bold type are as defined in the Safety Rules.

3. DANGERS

The main **Dangers** to personnel working on earth **Systems** are electric shock, burns or other injuries arising from

- differences in potential, including step, touch and transferred potentials (both steady state and under fault conditions) across parts of the earth **System** which are incomplete, segregated or without earth continuity.
- being struck by flying debris as a consequence of faults occurring on *Equipment* which is inadequately earthed.
- rise of earth potential from earth faults on adjacent systems currents which flow in earth **Systems**

4. GENERAL PRINCIPLES

Any part of the earth **System** must be considered as an electrical conductor.

The general principles for avoiding **Danger** when working on earth **systems** are one or more of the following measures:

- the work must be carried out by a **Competent Person** under an appropriate **Safety Document**.
- disconnect associated **Equipment** from sources of electrical energy which could give rise to **Danger**.
- bonding across before making or breaking any earth **System** connections.
- insulated working.
- ensuring that remote earths are not introduced into the work area which could be at a different potential to the local earth.

5. APPROACHING AND WORKING

Before any work is carried out on an earth **System** it must be planned, sufficiently in advance of the work to avoid **Danger**. The full extent of the work including any equipment used to carry out repairs must be considered and a risk assessment (Appendix 1) must be carried out.

MAIN EARTH SYSTEMS

5.1 Approaching *Intact Main Earth System(s)*

There is no restriction when approaching *Intact Main Earth System(s)*.

5.2 Approaching *Inadequate Main Earth System(s)*

5.2.1 Concrete structures supporting **Equipment** where the electrical connection to the *Main Earth System* is missing or suspect.

- a No approach is allowed, closer than 10 metres to a structure, where there is an increased risk of **System** fault. This could include *Poor Weather Conditions*, or when water washing of insulators is taking place.
- b Approach up to 1 metre from the structure is permitted where none of the conditions in (a) above exists.
- c In the event of an emergency, involving personal safety, it is permissible to approach within 10 metres, but no closer than 1 metre, to the structure.

5.2.2 Metallic structures supporting **Equipment** where the electrical connection to the *Main Earth System* is missing or suspect.

- a Where the connection from the base of the structure to the *Main Earth System* is in doubt approach closer than 1 metre to the structure is prohibited.
- b In the case of structures supporting surge arrestors or cable sealing ends approach closer than 1 metre is prohibited. This is due to the surge arrestor base or cable sealing end being independently earthed from the structure (see TGN (E) 114 for more details).

5.2.3 Buried earth tape

Before approaching closer than 1 metre to any disturbed earth tape the **Senior Authorised Person** must assess the risks and identify the precautions that need to be taken to prevent **Danger**. Where appropriate, further assistance can be obtained from specialists at **Asset Strategy**.

5.3 Work on *Main Earth Systems*

Making or breaking connections on *Main Earth Systems* must only be carried out after they have been bridged using a connection of equivalent current carrying capacity, unless a risk assessment indicates no significant hazard.

5.4 Work on Other *Earth Systems*

In all applications, the general principles and the requirement for risk assessment apply, and any Earth Bond must be appropriate for the duty it has to perform.

5.5 LIMITATIONS

The existing NSI 24 initial bond equipment is not considered suitable for use on the following earthing arrangements:

Attachment to copper braided / multi-stranded copper conductor as used in some NG earthing installations.

Repair / disconnection / connection to the earth tape between a terminal tower and the substation main earthing system. The reasons for this are as follows:

- The possibility of establishing high induced currents which may over stress the initial bond.
- A significant electrical hazard could exist when the bond for any reason is broken.
- Significant touch potentials could exist around the tower base at ground level.
- A system related fault in the substation or the overhead line might produce significant localised step, touch and transfer potentials at the point of work.
- The initial bonding equipment will not reliably penetrate the paint layer on the tower leg to provide a good electrical connection.

Where work is planned which involves either of the above, it is recommended that guidance be obtained from **Asset Strategy** prior to this work being carried out.

6. APPLICATION OF EARTH BONDS TO MAIN EARTH SYSTEMS

6.1 The application or removal of an *Earth Bond* must not be carried out where there is an increased risk of a **System** fault (see paragraph 5.2.1a)

6.2 The initial bond must be made using an **Approved Earth Bond and Pole**. Where the work involves disconnections from a *Main Earth System* the final break must be made using an **Approved Earth Bond and Pole**.

6.3 One end of the **Approved Earth Bond** must be connected to an intact earth **System**. This must always be the first connection of the *Earth Bond*. The second connection can then be made. Approach closer than 1 metre, specified in paragraph 5.2.1, 5.2.2 and 5.2.3, is

permitted to make this connection, but only if the end of the *Earth Bond* is between the person applying it and the second point of connection.

- 6.4 *Earth Bonds* must not normally be relied upon for periods greater than two months due to possible contact deterioration. Longer periods may be permitted only after referral to specialists at Asset Strategy for advice.
- 6.5 Where below ground earth tape has been disturbed advice from specialists at Asset Strategy about the bonding and replacement procedure must be obtained.
- 6.6 Once appropriate connections have been applied no other special safety precautions are necessary, and further repairs can be undertaken.

7. APPLICATION OF EARTH BONDS TO OTHER EARTH SYSTEMS

The risk assessment for the work to be carried out and subsequent control measures will identify the type of *Earth Bond* and method of application. They will also indicate the order in which *Earth Bonds* will be applied or removed during the course of work.

8. TESTING

Testing of earth **Systems** must be carried out in accordance with a written method statement, supported by a risk assessment.

APPENDIX 1

RISK ASSESSMENT GUIDANCE

The following are examples of situations which may give rise to a significant hazard and a written risk assessment is required:

Where earth tape has been removed from a structure or a tower

Where buried earth tape has been disturbed

Where the *Main Earth System* is not intact

The following are examples of situations which may give rise to less significant hazards and where a risk assessment is required. But may not need a written record:

Where the earth has been removed from a lighting column

Where the earth tape has been removed from a cable tray

Note: The above list is not exhaustive

The risk assessment shall identify

- a whether the equipment needs to be switched out
- b whether *Earth Bonds* need to be applied and
- c the order in which *Earth Bonds* are applied/removed.

Appendix 2 - NSI 24 Flowchart

