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| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

NR/L3/ELP/29987

Module 11

Working On Overhead Line Equipment

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Published and Issued by Network Rail, 2nd Floor, One Eversholt Street, London NW1 2DN.



| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

Contents

| | |
|--|----|
| 1 Purpose | 3 |
| 2 Scope | 3 |
| 3 Assessment of Risk Before Attempting Work | 3 |
| 4 Use of Live Line Tools and Live Line Measuring Devices | 3 |
| 4.1 General | 3 |
| 4.2 Live Line Tools | 3 |
| 4.3 Live Line Measuring Devices | 4 |
| 4.4 Removal of Objects From and Near To the Overhead Line Equipment | 4 |
| 5 Use of Aluminium Triple Extension Ladders | 4 |
| 6 Earthing Facilities Provided on OLE Access Vehicles | 5 |
| 7 Work On 25 kV A.C. Electrification Equipment | 5 |
| 7.1 Requirements for Pre-planning | 5 |
| 7.2 Access to Switching Stations and Compounds | 5 |
| 7.3 Continuity of OLE between Earths | 5 |
| 7.4 Disturbance of, Interference with or Removal of Earths | 6 |
| 7.5 Minor Alterations to the OLE | 6 |
| 7.6 Working On Connections to Bushings or Cable Sealing Ends | 6 |
| 7.7 Working On Feeder Disconnectors | 6 |
| 7.8 Working On Structure-Mounted 25 kV Auxiliary Supplies Transformers and Associated Voltage Regulators | 7 |
| 7.9 Working On Structure-Mounted Earthing Devices | 7 |
| 7.10 Working On Structure-Mounted Harmonic Dampers | 7 |
| 7.11 Isolating Autotransformer Feeding Systems | 8 |
| 7.12 Working On or Near Earth Wires, Return Conductors and Booster Transformers | 8 |
| 8 Work At or Adjacent to Isolating Sections | 14 |
| 8.1 General | 14 |
| 8.2 Isolating Neutral Sections and Section Insulators and/or Overlaps | 14 |
| 8.3 Protection Wires | 14 |
| 9 Connections Between a Return Current Busbar and Rail | 14 |
| 10 Connections Between Structures Carrying 25 kV Auxiliary Supplies Transformers and Rail | 15 |
| 11 Risk of a Lightning Strike | 15 |

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

1 Purpose

This module provides a consistent approach to working on the overhead line equipment of 25 kV a.c. electrified lines.

NOTE: Further requirements for working on or about the electrified lines are contained in the Rule Book Module AC (GE/RT8000/AC) and Handbook HB16 (GE/RT8000/HB16).

2 Scope

This module states the requirements to be met when working on the overhead line equipment on 25 kV a.c. electrified lines.

It is applicable to Network Rail personnel and to Network Rail's contractors.

To provide a consistent approach to working on or about 25 kV a.c. electrified lines, Train Operating Companies may, as best practice, apply this standard to infrastructure they control.

This Standard also includes:

- Work on or about any future sections of electrification on Network Rail controlled infrastructure and areas required to adopt a process for securing points of disconnection to form points of isolation to use the Supplementary Isolation Process (Module X).
- Planning of isolations, testing and earthing of overhead line equipment on Network Rail controlled infrastructure equipped with 750V d.c. overhead line system (Sheffield Tram Train - Module Y).
- Planning of isolations, testing and earthing of overhead line equipment on Network Rail controlled infrastructure equipped with 1500V d.c. overhead line system (Sunderland Metro Systems Operating Area – Module Z).

3 Assessment of Risk Before Attempting Work

Before any work is carried out on or about the electrified lines, the proposed work shall have been subjected to risk assessment in accordance with Module 2 and the risks managed in accordance with Module 3.

4 Use of Live Line Tools and Live Line Measuring Devices

4.1 General

Live line tools and live line measuring devices shall be product approved.

They shall be used only by persons who have been trained and, are competent in their use.

4.2 Live Line Tools

Where it is necessary to carry out work on or adjacent to live overhead line equipment, such work may be carried out using live line tools.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

These tools shall be fitted to an earthing pole and used in accordance with Network Rail standard NR/L3/ELP/27237.

4.3 Live Line Measuring Devices

Where it is necessary to measure the dimensions of the overhead line equipment, or the overhead line equipment relative to the running rails, overbridges, adjacent structures, etc. on or adjacent to live overhead line equipment, such work may be carried out using live line measuring devices. These devices include insulated height and stagger gauges, insulated height sticks and system height poles.

The system height pole shall be fitted to an earthing pole and used in accordance with Network Rail standard NR/L3/ELP/27237.

4.4 Removal of Objects From and Near To the Overhead Line Equipment

Removal of objects may be undertaken by staff trained and certificated in the use of live line tools conforming to, and used in accordance with, the relevant Network Rail standards.

The procedure to be followed for removal is stated in Module 5 clause 7.

5 Use of Aluminium Triple Extension Ladders

When work on high overhead line equipment requires the use of a triple extension ladder of aluminium construction, it shall only be used when an overhead line permit is specifically issued by a Nominated Person in accordance with Module 7.

In addition the ladder shall:

- a) be kept under lock and key at a depot or other secure premises except when it is issued for a specific task(s);
- b) be issued only to a Nominated Person who shall sign a register on receipt of it. The Nominated Person shall be responsible for seeing that the ladder is handled in a safe manner and that it is used only for the task(s) for which it was issued;
- c) be carried at all times by two or more persons in an underarm position when close to the track;
- d) not be erected to the working position until the overhead line permit has been received. The overhead line permit shall be endorsed 'use of aluminium ladder';
- e) be lowered to the ground before the overhead line permit is cancelled; and
- f) be returned to the depot or other secure premises as soon as practicable after the task(s) for which it was issued has been completed.

If the Nominated Person responsible for the ladder is relieved, the relief shall assume responsibility for the ladder and record the fact on the overhead line permit.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

6 Earthing Facilities Provided on OLE Access Vehicles

When an overhead line works train fitted with an earthed pantograph at each end is used, work may be carried out on or near the overhead line equipment between the raised earthed pantographs without additional intermediate portable earths being applied.

However, if one or both pantographs are to be lowered, the matter shall be referred to the Nominated Person.

When an on-track overhead line access vehicle is used and an earthed pantograph is provided on the vehicle, the earthed pantograph shall be raised before the working platform is raised. Work shall then be carried out on or near the overhead line equipment from the vehicle without additional intermediate earths being applied, provided that the earthed pantograph continuously and effectively earths all the equipment being worked on or being approached within 600 millimetres (2 feet).

The application of additional portable earths shall only be undertaken by a person(s) authorised for such activities, and then only on the instruction of the Nominated Person.

7 Work On 25 kV A.C. Electrification Equipment

7.1 Requirements for Pre-planning

Where the risk assessment, carried out in accordance with Modules 2 and 3, determines that the work requires a pre-arranged isolation of the overhead line equipment and an overhead line permit to be issued, then the work shall be planned in accordance with Module 6.

7.2 Access to Switching Stations and Compounds

Access to the equipment and into buildings at switching stations, and any compounds surrounding them, shall be restricted to only those persons so authorised in accordance with local instructions.

All work on such equipment shall be carried out by persons competent and authorised for such work, and where necessary the work on such equipment shall be carried out in accordance with Network Rail standard NR/L2/CTM/018.

Access shall be planned in accordance with Module 6. The appropriate Infrastructure Maintainer's staff shall be engaged to undertake the activities concerned, and the necessary contractual and logistical arrangements made.

7.3 Continuity of OLE between Earths

The electrical continuity of the overhead line equipment shall be maintained uninterrupted between successive earths.

If it is necessary to carry out work which would interrupt the electrical continuity of the OLE, a temporary continuity jumper shall first be applied across the position of the proposed break and it shall not be removed until the continuity of the OLE has been restored.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

Where the continuity of the OLE is not to be restored (e.g. when cutting in a section isolator), earths shall be applied as for discontinuous OLE in accordance with Module 7.

7.4 Disturbance of, Interference with or Removal of Earths

Work on the overhead line equipment itself shall not disturb, interfere with or remove any of the earths that have been applied.

Where work disturbs or interferes with the earths, alteration to the earthing of the OLE may be required such that the locations of earths remain compliant with Module 6 and 7.

NOTE: If there is a need to disturb or interfere with or removal of earths this should be considered at the planning stage.

If OLE work is required at the structures at which the earths are applied forming the safe working limits of the overhead line permit, and this work would disturb or interfere with the earths, additional isolation and/or earthing shall be carried out to extend the limits.

Such additional application and removal of earths shall only be undertaken by a person(s) authorised for such activities, and then only on the instruction of the Nominated Person.

7.5 Minor Alterations to the OLE

Installation of new cut-in insulation, section insulators, neutral sections, etc. which introduces a new discontinuity into the overhead line equipment shall be treated by the Nominated Person in accordance with Module 7.

Modules 6 and 9 state the requirements for planning when constructing or dismantling OLE that might affect isolation documentation, etc.

7.6 Working On Connections to Bushings or Cable Sealing Ends

The Nominated Person shall isolate and earth the overhead line equipment and the connection(s) from it to the bushing(s) or cable sealing end(s) as appropriate in accordance with Module 7, and where applicable Network Rail standard NR/L3/ELP/21067, and an overhead line permit and/or a permit to work on high voltage electrical equipment (Form 21067/P) as appropriate shall be issued for such equipment.

Where cable sealing ends are insulated from the overhead line structure, and therefore a dangerous voltage is likely to arise, a temporary continuity jumper shall be connected across the insulation.

7.7 Working On Feeder Disconnectors

The Nominated Person shall isolate and earth the overhead line equipment and the connection(s) from it to the feeder(s), bushing(s) or cable sealing end(s) as

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

appropriate in accordance with Module 7, and where applicable Network Rail standard NR/L3/ELP/21067, and an overhead line permit and/or a permit to work on high voltage electrical equipment (Form 21067/P) as appropriate shall be issued for such equipment.

If it is necessary to open the disconnector being worked on, which would interrupt the electrical continuity of the OLE, a temporary continuity jumper shall first be applied across the disconnector and it shall not be removed until the disconnector has been closed.

7.8 Working On Structure-Mounted 25 kV Auxiliary Supplies Transformers and Associated Voltage Regulators

7.8.1 Minor Work

Infrastructure Maintainer's staff are authorised to undertake minor external work, such as oil sampling and painting within certain specified limits, with the transformer live and, if required, on load, in accordance with Modules 2 and 3.

Where this work is to be carried out by other than the Infrastructure Maintainer, the limits shall be specified by the DUE&PME.

7.8.2 Other Work

When any other external work is to be done beyond as specified in 7.8.1, or where any internal work is to be done on the transformer or the voltage regulator, it shall be performed under a Permit-to-Work or Sanction-for-Test on High Voltage Electrical Equipment issued in accordance with Network Rail standard NR/L3/ELP/21067, irrespective of whether the OLE is isolated or not.

In this case, the appropriate Nominated Person shall be engaged to undertake the activities concerned, and the necessary contractual and logistical arrangements made.

The requirements of Modules 2, 3, 6 and 7 shall be followed and, where necessary, the adjacent OLE and bare connections shall be isolated and earthed and an overhead line permit additionally obtained for such equipment.

7.9 Working On Structure-Mounted Earthing Devices

The Nominated Person shall isolate and earth the overhead line equipment to which the earthing device is connected in accordance with Module 7 and Network Rail instructions, and an overhead line permit shall be issued for such equipment.

Any other live equipment not at a safe working distance shall also be earthed by the Nominated Person.

7.10 Working On Structure-Mounted Harmonic Dampers

The Nominated Person shall isolate and earth the overhead line equipment and/or other equipment to which the harmonic damper is connected in accordance with

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

Module 7 and Network Rail standard NR/L3/ELP/21067, and an overhead line permit and/or a permit-to-work on high voltage electrical equipment (Form 21067/P) as appropriate, shall be issued for such equipment.

Any other live equipment not at a safe working distance shall also be earthed by the Nominated Person.

Harmonic dampers shall be taken out of service only as permitted by Network Rail instructions.

7.11 Isolating Autotransformer Feeding Systems

Autotransformer feeders are part of the OLE and the ECO shall arrange for these to be isolated and earthed accordingly.

Equipment at autotransformer switching stations shall be isolated and earthed in accordance with Module 6, 7 and Network Rail instructions, and an overhead line permit and/or a permit-to-work on high voltage electrical equipment (Form 21067/P), as appropriate, shall be issued for such equipment.

If there is any doubt as to how to isolate any feature of the OLE related to autotransformer feeder systems or associated equipment, further advice shall be sought from the DUE&PME, RAM (E&P) or other competent authority appointed in writing by the DUE&PME or RAM (E&P).

7.12 Working On or Near Earth Wires, Return Conductors and Booster Transformers

NOTE: For the purpose of this clause, use of the abbreviation 'OLE' refers to those parts of the overhead line equipment normally live at 25 kV.

7.12.1 Description

The following arrangements of earth wires, return screening conductors, return conductors and booster transformers are installed:

- a) Return conductors electrically connected to structures
These are in electrical contact with the supporting structures and additionally can act as earth wires. They do not have booster transformers. See clause 7.12.3.
- b) Return conductors carried on insulators
These are insulated from the supporting structures and might or might not have booster transformers. At certain locations they are sheathed with insulating material. See clauses 7.12.3 to 7.12.9.
- c) Earth wires
These are in electrical contact with the supporting structures. See clause 7.12.3
- d) Return screening conductors
This is a sheathed cable installed in autotransformer areas, ideally in close

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

proximity to S&T cables, to provide immunisation. The cable is typically bonded to rail every 400 m. See clause 7.12.144.

7.12.2 General Precautions to be Taken When Working On Return Conductors and Earth Wires

Where live OLE is not at a safe working distance, this shall be isolated and earthed in accordance with Module 7 and an overhead line permit obtained for such equipment.

When the electrical continuity of a return conductor or earth wire has to be interrupted, a temporary continuity jumper fitted with screw clamps shall first be applied across the position of the proposed break and shall not be removed until the return conductor or earth wire is again electrically continuous.

7.12.3 Bare Earth Wires and Return Conductors Electrically Connected to Structures

An overhead line permit is not required to be obtained for work on or close to earth wires or return conductors electrically connected to structures.

7.12.4 Bare Return Conductors Carried on Insulators

Where work is to be carried out on or close to the return conductor, or where there are two or more return conductors in close proximity, and either;

- a) the adjacent OLE **IS NOT** at a safe working distance; **or**
- b) a booster transformer **IS** within the worksite or within the section of return conductor on which work is to be carried out;

the OLE shall be isolated and earthed and the return conductor(s) shall be earthed in accordance with Module 7 and an overhead line permit obtained for such equipment. The relevant details in respect of the return conductor(s) shall be entered on the Form C by the Nominated Person.

Where work is to be carried out on or close to the return conductor, or where there are two or more return conductors in close proximity, and,

- a) the adjacent OLE **IS** at a safe working distance; **and**
- b) **NO** booster transformer is within the worksite or within the section of return conductor on which work is to be carried out,

the return conductor(s) shall be earthed in accordance with Module 7 and an overhead line permit obtained for such equipment.

The relevant details in respect of the return conductor(s) shall be entered on the Form C by the Nominated Person.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

7.12.5 Sheathed Return Conductors

The arrangements for work on return conductors carried on insulators and sheathed with insulating material are specified below.

- a) Where the adjacent OLE **IS NOT** at a safe working distance, an overhead line permit shall be obtained for the OLE.
- b) Where the work involves the removal or cutting of the sheathing or the insulating material is damaged, an overhead line permit shall be obtained in accordance with clause 7.12.4. Where the adjacent OLE **IS** at a safe working distance and the insulating material is undamaged and is not to be removed, an overhead line permit is not required to be obtained for work on or close to the sheathed return conductor.

Where the adjacent OLE **IS** at a safe working distance and the insulating material is undamaged and is not to be removed, an overhead line permit is not required to be obtained for work on or close to the sheathed return conductor.

Where the extent of the sheathing prevents the Nominated Person from applying earths as specified in Module 7, an overhead line permit may be issued for the OLE associated with all return conductors on that side of the track.

The work may be performed under these conditions or sufficient sheathing shall be removed to enable earths to be applied as specified in Module 7.

In this case a new overhead line permit may be issued for the return conductors only in accordance with clause 7.12.4.

Where there are two or more return conductors in close proximity, they shall be similarly treated by the Nominated Person, even when work has to be done on only one of them.

When the work has been completed and it is necessary to restore the sheathing, another overhead line permit may be issued by the Nominated Person for all the associated OLE whilst the insulation is restored.

7.12.6 Broken Bare Return Conductor Carried on Insulators

If a broken return conductor is to be repaired, an overhead line permit shall be obtained in accordance with clause 7.12.4. Where there are other return conductors in close proximity they shall be similarly treated by the Nominated Person. The relevant details in respect of the return conductor(s) shall be entered on the Form C by the Nominated Person.

The broken ends of the return conductor shall be pulled together using rope blocks or other equipment which will not conduct electricity. When the broken ends are close enough together, a temporary continuity jumper fitted with screw clamps shall be applied. The jumper shall not be removed until the return conductor is repaired and is again electrically continuous.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

7.12.7 Broken Return Conductor Carried on Insulators and Broken Earth Wire, Where Both are Installed

Where an earth wire is installed in addition to the return conductor and both the earth wire and return conductor(s) are broken, no attempt to repair the return conductor(s) shall be made until the earth wire has been made continuous, either by repair or the fitting of a temporary continuity jumper. An overhead line permit for all OLE, including the return conductors, shall be obtained in accordance Module 7 before any repair work is commenced.

The broken ends of the earth wire shall be pulled together using rope blocks or other equipment which will not conduct electricity. When the broken ends are close enough together, a temporary continuity jumper fitted with screw clamps shall be applied across the break. The jumper shall not be removed until the earth wire is repaired and is again electrically continuous.

With the earth wire continuity established, the Form C may be cancelled and arrangements made to repair the return conductor(s) in accordance with clause 7.12.6.

7.12.8 Broken Earth Wire or Return Conductor Electrically Connected to Structures

If a broken earth wire or return conductor electrically connected to structures is to be repaired, or in the case referred to in clause 7.12.7 where only the earth wire is broken, an overhead line permit is not required to be obtained unless the conditions of clause 7.12.6 apply.

The broken ends of the earth wire or return conductor electrically connected to structures shall be pulled together using rope blocks or other equipment which will not conduct electricity. When the broken ends are close enough together, a temporary continuity jumper fitted with screw clamps shall be applied across the break. The jumper shall not be removed until the earth wire or return conductor electrically connected to structures is repaired and is again electrically continuous.

7.12.9 Broken Sheathed Return Conductor Carried on Insulators

Where the return conductor is sheathed and is required to be repaired, it shall be treated as a broken bare return conductor in clause 7.12.6.

Where the extent of the sheathing prevents the Nominated Person from applying earths as specified in Module 7, either:

- a) sufficient insulation shall be removed to enable local earths to be applied in accordance with Module 7 and an overhead line permit shall be issued in accordance with clause 7.12.6 **or**,
- b) an overhead line permit shall be issued for the OLE associated with all return conductors on that side of the track.

Where there are two or more return conductors in close proximity, they shall be similarly treated by the Nominated Person, even when work has to be done on only one of them.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

When the repair has been completed and it is necessary to restore insulation, another overhead line permit may be issued by the Nominated Person for all the associated OLE whilst the insulation is restored.

7.12.10 Connections between Return Conductors Carried on Insulators and Rail or a Return Current Busbar

7.12.10.1 General

When it is necessary to repair a broken connection or detach a connection between the return conductor and rail or return current busbar, the following procedure shall be adopted.

7.12.10.2 Where Spider Plates are fitted

Where a spider plate is fitted, and there is an intact electrical connection remaining between the return conductor and its associated traction return rail via the spider plate, then work may be undertaken to repair the other broken connection, or to disconnect it completely from the spider plate, or traction return rail, without the need for an overhead line permit to be issued for the work.

The integrity of the remaining electrical connection shall be verified before undertaking the work. During the course of the work do not attempt to disturb, or interfere with, the remaining electrical connection between the return conductor and its associated traction return rail.

7.12.10.3 Where Spider Plates are NOT fitted

Where spider plates are NOT fitted, then an overhead line permit shall be issued for the work in accordance with clause 7.12.4.

Temporary duplicate connections shall be installed between the return conductor and the nearest suitable traction return rail. The temporary connections shall not be removed until the original connection is again electrically continuous.

Where a connection to the return current busbar is installed, the return current busbar-to-rail connections shall be electrically continuous before commencing work on the return current busbar to return conductor connection.

7.12.11 Booster Transformers

When it is necessary to render a booster transformer ineffective, e.g. by disconnection or by the jumpering out of windings, the requirements of Network Rail standard NR/L2/ELP/24011 shall be followed.

Where work is to be carried out on or adjacent to a booster transformer, an overhead line permit shall be obtained in respect of the OLE, the booster transformer and return conductors.

Any other OLE not at a safe working distance shall also be isolated and earthed by the Nominated Person.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

Any other booster transformer or return conductor not at a safe working distance shall also be earthed as appropriate by the Nominated Person.

Where the work necessitates the disconnection of either the primary or secondary connections of the booster transformer, one of the following procedures shall be followed:

- a) a temporary continuity jumper fitted with screw clamps shall be applied both between the OLE connected to each side of the booster transformer and also between the return conductors connected to each side of the booster transformer before making the disconnection.

If this procedure is followed, the jumpers shall not be removed until all the connections to the booster transformer are again electrically continuous; or alternatively,

- b) the booster transformer shall be completely disconnected. Work shall then be performed on the booster transformer with the OLE live, provided the requirements of Modules 2 and 3 are met.

The work may, if necessary, extend over more than one working period without the restoration of the transformer to service between working periods.

7.12.12 Tie Wire Anchors

When it is necessary to disconnect a tie wire anchor from its anchoring structure for maintenance or renewal and where the adjacent OLE is live or where there is an adjacent overhead transmission power line, duplicate portable earths shall be applied and secured appropriately between the tie wire and the structure. The duplicate earths shall remain in place until the tie wire is reconnected, removed from both ends or all adjacent OLE and overhead transmission power lines are confirmed to be de-energised.

In the case where all adjacent OLE is isolated and there are no adjacent overhead transmission power lines, there is no requirement to apply earths between the tie wire being disconnected and its supporting structure.

7.12.13 Wires and Cables

When wires or cables on infrastructure connected to or adjacent to 25 kV overhead line equipment are planned to be disconnected, a full risk assessment shall be carried out in accordance with Module 2.

7.12.14 Return Screening Conductor (RSC)

In the event of a damaged or disconnected RSC, the cable or bond can be repaired but the defect prioritisation matrix for standard NR/L2/ELP/21087 shall be met. A Temporary Continuity Jumper shall be applied across the break before making the repair. This shall not be removed until the original connection is electrically continuous. If a Continuity Jumper can not be applied across the break, an overhead line permit shall be obtained for the OLE in accordance with clause 7.12.9.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

However, in accordance with the lifesaving rules, the 'test before touch' principle must first be applied.

8 Work At or Adjacent to Isolating Sections

8.1 General

The following clauses specify the general principles to be employed when work is to be carried out at, or adjacent to, isolating sections. These clauses supplement or amend stated requirements within this and other modules, as appropriate.

Network Rail instructions for isolating sections shall be in place to identify the locations where the special arrangements apply.

Where necessary, additional arrangements shall be made so that the electrical separation provided by the isolating section is not bridged out by trains, rail-borne plant, the work itself or any other means.

8.2 Isolating Neutral Sections and Section Insulators and/or Overlaps

Isolating neutral sections have three sets of beaded insulators and two sets of intermediate earthed sections. Work on an isolating neutral section requires that it is treated appropriately by the Nominated Person in accordance with Module 7.

The section insulators and/or overlaps at each end of the same isolating section, or the neutral section at one end and the section insulator and/or overlap at the other end, shall not be jumpered out simultaneously by any means.

8.3 Protection Wires

Protection wires shall be treated as return conductors carried on insulators and the requirements of the clauses 7.12.4 or 7.12.5 shall be complied with as appropriate.

The exception is that the associated OLE, normally live at 25 kV, shall always be isolated and earthed to allow the protection wire to be earthed to the traction return rail by the Nominated Person as specified in Module 7.

9 Connections Between a Return Current Busbar and Rail

At switching station locations, the traction return rails are connected to the return current busbar by a number of separate bonds. These bonds are 'red bonds'. If all the bonds are disconnected, the switching station enclosure, its fencing, the equipment within it and the broken bonds might be at a dangerous voltage.

Where work is to be carried out at these locations, provided that two or more bonds remain intact, work may be carried out without de-energisation.

If work requires all of the bonds between a return current busbar and rail to be disconnected or if only one of the return current busbar to rail bonds remains connected, the work shall be carried out under the precautions stated in Module 7. An overhead line permit shall be obtained for such equipment in accordance with clause 7.12.4, the return current busbar being treated as part of the return conductor.

| | |
|------------------|--------------------|
| Ref: | NR/L3/ELP/29987/11 |
| Issue: | 7 |
| Date: | 03 September 2022 |
| Compliance date: | 03 September 2022 |

10 Connections Between Structures Carrying 25 kV Auxiliary Supplies Transformers and Rail

At certain locations, the neutral of the primary winding of a 25 kV single-phase auxiliary supplies transformer is connected directly to the OLE structure on which it is mounted. This structure is then bonded to traction return rail by two separate bonds to two separate rails. One of these connections might be aerial. Both of these bonds are 'red bonds'.

Where work is to be carried out at these locations such that one of the bonds is intact, work may be carried out without isolating the transformer.

If work requires both of the bonds between a structure carrying an auxiliary supplies transformer and rail to be disconnected, the work shall be carried out under the precautions specified by the DUE&PME.

11 Risk of a Lightning Strike

Staff working on overhead line equipment, or any other 25 kV a.c. electrification equipment connected to it, shall be withdrawn if there is a significant risk of a lightning strike on the OLE.