



Facilities, Residential and Commercial Services

HV Underground Cables Guidance

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1. Introduction

The University owns and operates a large, complex high voltage electricity distribution system which, from time to time, requires work to be undertaken upon it. This document details the procedures which must be adopted to ensure that work on high voltage cables forming part of the distribution system can be completed in a controlled manner whilst limiting risk to all persons involved.

2. Scope

To ensure that, following appropriate risk assessment, any work on high voltage cables is undertaken safely with correct equipment and PPE, and is in compliance with the relevant legislation, this policy applies to the following:

2.1 All University employees and contractors working for the University authorised to work on high voltage cables forming part of the high voltage electricity distribution system.

2.2 All Conductors used in the high voltage electricity distribution system.

3. Definitions

The definitions for words used in this document are to be found in Section 3 of the current Electrical Safety Rules for High Voltage Systems (SOP).

4. Identification

Equipment on which work or testing is to be carried out, must be readily identifiable at the point of work, or have fixed to it, a means of identification that will remain effective throughout the course of the work. Cables must be identified at their terminations by means of the permanent identification label on the equipment to which they are connected or by their appropriate circuit identification. Section 9 of this document provides further information.

5. Dangers

The main dangers to personnel working on high voltage cables are electric shock, burns, asphyxiation or falls, arising from:

- Mistaking high voltage cables on which it is unsafe to work for those on which it is safe to work using the procedures detailed in this policy.
- Voltage difference between cables with separate earthing zones when a fault occurs in one of these earthing zones.
- Induced voltages appearing on the cable being worked on.

- Contact with adjacent exposed live conductors, other cables or services.
- Physical conditions in the vicinity of the point of work due to deep excavations, or working at a height.
- Chemicals and fumes from fluxes and other sources.

6. Excavation close to exposed high voltage cables

6.1 All excavations to expose cables should be carried out in accordance with Health and Safety Executive Publication HS (G) 47 'Avoiding Danger from Underground Services'.

6.2 Excavations on private land may require compliance with additional local procedures

6.3 Appropriate PPE shall be used.

6.4 Caution must be exercised to ensure that the cable to be worked on is correctly identified where plain lead and tape armoured high voltage cables exist with similarly sheathed low voltage cables,

6.5 Where additional hazards exist, the Authorised Person may issue a Limitation-of-Access prior to excavation commencing or seek advice from selected person if necessary.

6.6 Where the University is not the relevant land occupier, consideration should be given to a possible requirement by the occupier for other documents to be obtained. Other safety procedures and rules may apply in addition to those that are necessary to comply with the University rules and procedures (e.g. on railway property).

6.7 If cable tiles or other cable markers or protectors are exposed during excavation, it should not be assumed that they are in their correct position directly above the cable(s) that they were originally intended to protect. Previous excavations and backfilling may have misplaced them and the position of a cable is not certain until it is exposed and identified.

6.8 As excavation progresses, precautions should be taken to prevent collapse of the trench or hole by shuttering or similar means. Attention should be given to supporting excavations in the vicinity of cables, where a landslip, whether it is initiated by the digging of a trench or not, may cause danger. Where shuttering is required, it shall be installed and inspected in accordance with an approved procedure.

6.9 When excavating adjacent to street furniture or poles, care shall be taken to ensure that sufficient ground remains around the base so that there is no risk of the street furniture or pole falling. Additional control measures may be required.

6.10 When excavating in close proximity to a cable, a personal ongoing risk assessment should be made to identify the tools to be used.

6.11 The person in charge of the excavation shall, at the point of work, ensure that the excavation is of adequate size to expose all the cables, pipes and ducts necessary to allow the Authorised Person to identify the required cable(s) at the time the work commences and also throughout the duration of the required work. Where necessary, confirmation by the Authorised Person may be sought.

7. General requirements for work on high voltage cables

7.1 All persons who work on high voltage cables shall:

- Have received basic first aid training within the last 3 years
- Have available an approved first aid kit
- Wear and make use of the appropriate PPE.

7.2 Work must not commence on any high voltage cable unless the person in charge of the work is in receipt of an appropriate safety document and is personally instructed at the point of work by the Authorised Person issuing the safety document. Unless the work is restricted to that which can be done under a Limitation-of-Access or the cable has not yet been connected to the system (or has been disconnected from the system), the circuit must be:

- a) Isolated,
- b) Earthed in accordance with the current HV Safety Rules, and
- c) Identified in an approved manner at the point of work

The above shall be prior to the issue of a Permit-to –Work.

7.3 So far as reasonably practicable, all high voltage cables installed in the ground shall be backfilled with either sand or another approved aggregate and marked using an approved cable marking system (e.g. tiles or tape) before any part of the cable is energised from the high voltage system.

7.4 In addition to the above, the Authorised Person responsible for energising the high voltage cable shall:

- Ensure that the reinstatement is completed at the earliest opportunity.
- Consider the use of additional road signs and barriers to warn/ guard the general public.

- Use Danger Notices fixed to the cable at various intervals (no more than 10 metres apart) throughout the length of the open excavation.
- Decide if increased inspections of the work area are required.
- Consider on-site security if there is deemed to be an increased risk of interference.

8. Induced voltages on underground cables

Power and auxiliary cables, even when isolated from the system and earthed, can be subject to dangerous high voltages by induction from adjacent live cables, especially if high fault currents flow. During these conditions, differences in potential can occur at the point of work, between any conducting components such as conductors, sheaths, metallic pipes, etc., and also between these components and local earth. Voltage gradients can also appear across any break in a Conductor when that conductor is isolated and earthed at its remote ends. The application of Circuit Main Earths and Additional Earths in accordance with the Safety Rules and this document will minimise the danger arising from such induced voltages. However, when Circuit Main Earths or Additional Earths are removed associated with work carried out under a Sanction-for-Test, before making contact with the conductors, the Authorised Person carrying out the work must earth them using a suitable portable earth facility.

9. Cable identification and spiking

The Safety Rules require that when high voltage cables are to be worked on, they must either be identified and spiked in the approved manner at the point of work, or proved dead by other approved means. The following represents the approved procedure that must be followed.

Responsibility

The Senior Authorised Person supervising the work or testing to be carried out shall be responsible for:-

- (i) Before work or testing is commenced confirming that the cable to be identified is Isolated and Earthed and that all reasonable precautions to prevent unauthorised interference have been taken;
- (ii) Ensuring that he is clearly identified to all personnel involved and that his instructions are given personally.
- (iii) Ensuring that all reasonable safety precautions are taken;
- (iv) Issuing the relevant Safety Documents;

Personally identifying the cable to be worked on.

9.1 Identification

9.1.1 At points on high voltage cable routes where work or testing is to be carried out, an Authorised Person must identify the cable using the appropriate mains cable records and approved testing methods (see exemptions in 9.1.10). All adjacent cables in the work area should be exposed as necessary to aid positive identification.

9.1.2 The cable to be worked on must be isolated, earthed and a Sanction-for-Test issued before cable identification is commenced. The Circuit Main Earths may then be removed during the existence of the Sanction-for-Test.

9.1.3 A test of core insulation and continuity should then be carried out. This test can be omitted in cases where the cable was energised and has been switched out immediately prior to identification. The test can also be omitted where the cable is recorded as abandoned or the cable cannot be identified.

9.1.4 If insulation and continuity values prove to be adequate, the cores of the cable can then be joined together at a place beyond the point of work. A Circuit Main Earth may be used for this purpose. A cable identifier can then be connected to the cable cores at a point before the point of work and the cable identified at the point of work.

9.1.5 Identification by the clear detection of a 'rise and fall' in the signal found by moving the detector along the length of the cable and around its circumference, is essential before the spiking gun is fixed to the cable.

9.1.6 Where other cables have been exposed at the point of work, the detector shall be used on each cable to provide further confirmation that the correct cable has been identified.

9.1.7 Where it is still not possible to identify the cable:

- At the remote end, two of the phase conductors should be connected together and the third phase connected to earth using at least a 16mm² copper equivalent cross sectional area conductor.
- Following the application of these connections, all other Circuit Main Earths should be removed.
- Then, the approved cable identifier can be connected to the two cable cores free from earth (but connected together), and the cable identified at the point of work.

9.1.8 The cable, having been identified at the point of work, shall be suitably marked, i.e. with coloured tape, by the Authorised Person issuing the safety document.

9.1.9 Danger Notices may be attached to the other exposed cables and additional mechanical protection may be applied where considered necessary.

9.1.10 Exceptions - Identification by injected tone signal (cable identifier) is not required when:

- The cable can be physically traced along its entire length from the intended point of work to a termination where a Circuit Main Earth or Additional Earth has been applied.
- The cable can be physically traced along its entire length from the intended point of work to a point on the cable that has recently been identified, where the conductors worked on and the points of isolation have not been disturbed.
- It is known that at least two cores of the cable are damaged or it has a capped or pot ended, making it unsuitable for identification. In these cases the cable must be spiked in accordance with the spiking procedure in 9.2.5.
- The cable is abandoned or cannot be identified. In this case the cable must be spiked in accordance with the spiking procedure in 9.2.5.

Note – Identification by physical tracing is NOT acceptable if the cable is hidden from view for any distance, no matter how short.

9.2 Cable Spiking

9.2.1 The cable must then be spiked by the Authorised Person issuing the safety document, using an approved spiking device which has been maintained in accordance with an approved procedure, at those points at which the cable has been positively identified and is to be cut.

9.2.2 Spiking can be omitted if it is established that there can be no error in the identification of the cable by it being physically traced over its whole length from the point of work to:

- A termination where either a Circuit Main Earth or Additional Earth has been applied or;
- A point on the cable that has recently been identified, where the Conductors worked on and the points of isolation have not been disturbed.

Note – Identification by physical tracing is NOT acceptable if the cable is hidden from view for any distance, no matter how short.

9.2.3 Spiking may be omitted when the cable is only to be physically moved.

9.2.4 Where the cable is to be spiked the following sequence must be followed:

- Where the cable has been identified by the identification procedure outlined above, the identifier signal should remain on the cable with the Sanction-for-Test in force whilst spiking is carried out.
- The Authorised Person must visually inspect the cable spiking gun before use and ensure that it is of an approved type and has been maintained in accordance with approved procedures.
- Cartridges should be in the custody of the Authorised Person prior to the operation.
- The Authorised Person will select the correct grade of cartridge for the type of cable being spiked.
- The spiking gun should be fitted under the Personal Supervision of the Authorised Person.
- Correct fitting of the spiking gun with the necessary packing for smaller cables and the correct choice of cartridge is essential to achieve the satisfactory spiking of all cores.
- The Authorised Person shall ensure that all personnel are at a safe distance before spiking the cable. With the identifier still connected, the Authorised Person will fire the spiking gun using a lanyard.
- The Authorised Person must confirm that spiking has been completed correctly by checking for the identifier signal on each side of the spike. The signal should disappear or diminish on the side of the spike remote from the identifier transmitter.
- Work on the cable, including the removal of the cable spiking tool, will commence only after the cable has been proved to have been positively spiked, all Circuit Main Earths have been replaced, and the Sanction for Test suspended or cancelled, and following the issue of a Permit to Work, unless the cable has been proven to be abandoned.

9.2.5 If the Authorised Person is in any doubt as to whether the spiking gun has correctly operated, the following procedure must be used:

- With the Sanction-for-Test still in force, ensure all earths and phase to phase connections are removed and test the insulation resistance of the cable.
- As the cable was shown to be healthy prior to identification, if the cores now indicate a connection to earth or are shorted together, it can be reasonably assumed that the spiking gun has operated correctly and the cable satisfactorily spiked.
- If such a connection is NOT indicated it must be assumed that the spiking gun has not operated correctly. The used spiking gun shall remain in place and the whole spiking procedure repeated using another spiking gun.

Note – When spiking has been carried out on an abandoned or unidentified cable it will not be possible to carry out the tests detailed above.

9.3 The Authorised Person is responsible for the reapplication of the Circuit Main Earths to all phase conductors at the circuit ends, the removal of the cable identifier and any test prods.

9.4 If phase identification tests are required, the Authorised Person shall suspend or cancel the Permit-to-Work, issue/ reissue a Sanction-for-Test and remove the minimum number of Circuit Main Earths required to complete the test.

9.5 Before work is resumed, the Authorised Person must ensure that all Circuit Main Earths are reapplied on all phase conductors and any test prods are removed.

9.6 The Authorised Person in charge of the work must then suspend or cancel the Sanction-for-Test used for cable and phase identification.

9.7 Before work can be resumed, the safety precautions taken to achieve safety from the system must be confirmed by the Authorised Person who is to issue the Permit-to-Work.

9.8 The conductor phase identity should be recorded on the rear of the appropriate Permit-to-Work and the Authorised Person confirms that the Competent Person who is to carry out the jointing understands the information.

10.0 Other FRCS Electrical Information.

<i>Design and Installation Guidance:</i>		
Project Electrical Briefing Document	V5.0	31 ST January 2019
Standard Specification for Electrical Installation Work	V3.1	11 th January 2019
High Voltage Underground Cables	V2.0	31 ST January 2019
High Voltage Switching & Earthing	V2.0	31 ST January 2019
<i>Standard Operation Procedures:</i>		
Low Voltage Safety Rules	V1.0	11 TH December 2017
Management of the Access to Low Voltage Switch rooms	V2.0	22 ND January 2017
High Voltage Safety Rules	V2.0	29 th November 2018