

SG5:18

Overhead Power Sources and Earthing of Scaffold Structures

1. INTRODUCTION

This document has been produced to help the UK scaffolding industry to understand and apply safe working practices when working around overhead power lines and the procedures for earthing scaffold structures. The document is in two parts:

- Part 1 covers overhead power lines
- Part 2 covers the earthing of scaffold structures.

Part 1: Overhead Power Sources

There are Overhead Lines (OHL) criss-crossing most cities, towns and villages. They are essential to provide everyday electricity requirements to commercial and non-commercial premises. These OHL carry voltages ranging from 230 volts to 400,000 volts. Voltage may be stated in volts or kilo-volts – e.g. 11kV = 11,000 volts.

Overhead Electrical Power Sources could include:

- Transmission OHL (National Grid)
- Local Distribution OHL
- Domestic premises OHL supply (pole to pole, pole to house)

Types of OHL – examples below

- Transmission: Extra High Voltage (EHV) over 33kV
- Distribution: Extra High Voltage (EHV) over 33kV
High Voltage (HV) between 1kV and 11kV
Low Voltage (LV) less than 1 kV



275kV Transmission EHV



11kV Distribution Line HV
Conductors generally horizontal



400v LV
Conductors generally vertical

On average over the last ten years 10 people have died due to accidental contact with overhead lines, and it is important that trades (including scaffolding contractors) that work in the vicinity of the OHL have a clear understanding of the associated risks and precautions that need to be taken.

An overhead line **does not need to be touched to cause serious injury or death** as electricity can flash over or arc, across gaps. The higher the voltage, the larger the gap it will jump.

Always assume that a power line is live unless and until the owner of the line has confirmed and proven that it is dead. When OHL have been powered down by use of isolation switches the owner will need to both disconnect the supply and connect earthing wires to each conductor. Until this is done the OHL is not safe to approach or touch. Fatal accidents have occurred where an OHL has been isolated but not disconnected and earthed. In some cases, the supply has been accidentally re-energized; or someone has started a generator to power their building which has made the isolated OHL live.

Most people are naturally more weary of very high voltage supplies on pylons. One of the other reasons why more injuries occur on lower voltage OHL systems is that, to prevent long power outages, most OHL systems that trip out have a system to automatically re-energize them. 230-volt systems may try repeatedly to re-energize whereas most high voltage systems will usually need the cause of the trip to be identified before they are re-energized. Note however that a very high voltage supply that has been damaged or is arcing to the ground will take quite a while once it has tripped out or been isolated for the voltage to decay sufficiently for the area to be approached.

Due to the nature of their work, scaffold contractors in particular need to consider carefully any work that will be carried out in the vicinity of OHL, as direct contact with electrical conductors is not the only concern. If a scaffold tube approaches the OHL it may cause a flashover to occur. The risk of flashover increases as the line voltage increases. Humid air also increases the arc range. Contact with an OHL can not only cause electrocution and death of someone holding a scaffolding tube but a flashover can also cause severe burns to anyone in the vicinity.

CASE STUDY

In a recent incident a scaffolder received an electric shock when he came into contact with a live 33kV overhead line. The electric shock resulted in the amputation of his left arm above the elbow, right arm below the elbow, and both of his feet. He also suffered severe burns to his legs and back, damage to his vocal cords and was in an induced coma for six weeks.

This unfortunate incident could have been avoided if suitable steps had been implemented to work within the safety distances for a 33kV cable.

The purpose of the guide is to provide advice and guidance to persons involved in organising, planning, managing or undertaking scaffolding work in the vicinity of OHL with the intention of preventing possible contact with live electrical conductors and thereby reducing the risk of injury.

This guidance is not intended to be used where scaffolding works are taking place for electrical transmission or distribution companies or on Network Rail property, where stringent specific safe systems of work and robust training regimes for scaffolders are necessary. Where operations are carried out adjacent to Network Rail property such as in a yard underneath railway lines, guidance should be sourced from the network owners or electricity authority.

In the case of electrical assets, National Grid does not authorise or agree safe systems of work with developers and contractors. However, they will advise on issues such as electrical safety clearances and the location of towers and cables. They also work with developers to minimise the impact of any National Grid assets that are nearby. Please refer to the National Grid Technical guidance document 287, Third Party Guidance for working near National Grid Electricity Transmission equipment.

Impressed Voltage

Any conducting materials installed near high-voltage equipment could be raised to an elevated voltage compared to the local earth, even when there is no direct contact with the high-voltage equipment. These impressed voltages are caused by inductive or capacitive coupling between the high-voltage equipment and nearby conducting materials and can occur at distances of several metres away from the equipment. Impressed voltages may damage your equipment and could potentially injure people, depending on their severity. Third parties should take impressed voltages into account during the early stages and initial design of any development, ensuring that all structures and equipment are adequately earthed at all times.

Micro Shocks

High-voltage overhead power lines produce an electric field. Any person or object inside this field that isn't earthed picks up an electrical charge. When two conducting objects – one that is grounded and one that isn't – touch, the charge can equalise and cause a small shock, known as a micro shock. While they are not harmful, they can be disturbing for the person that suffers the shock. For these reasons, metal-framed and metal-clad buildings which are close to existing overhead lines should be earthed to minimise the risk of micro shocks. Anything that isn't earthed, is conductive and sits close to the lines is likely to pick up a charge. Further information on micro shocks can be found by visiting www.emfs.info

2. LEGAL OBLIGATIONS

All scaffolding work involving OHL, may be subject to a range of Legislation, Approved Codes of Practice and / or Industry best practice, such as:

- The Health and Safety at Work etc Act 1974 requires that employers provide 'systems of work that are, so far as is reasonably practicable, safe and without risks to health'
- The Management of Health and Safety at Work Regulations 1999 require a risk assessment to be carried out to identify the necessary precautions and to implement them.
- The Construction (Design and Management) Regulations 2015 place obligations on clients, designers, those planning the work and contractors to prevent or reduce risks in those places where these Regulations apply. These obligations include risks from working near overhead lines.
- Electricity at Work Regulations 1989 Reg 4 which requires all work on or near an electrical system to be carried out so as to prevent danger, so far as is reasonably practicable. Reg 14 specifically prohibits work on or near to uninsulated live conductors unless specific precautions are in place.
- HSE Guidance Note GS6 Avoidance of Danger from Overhead Electrical Lines.

For work at or near OHL, application of a hierarchy of control suggests the following actions:

- find out if the work has to be carried out under or near OHL can it be avoided altogether or, if this cannot be done;
- divert all overhead line circuits clear of the work area or, if it is not reasonable for this to be done;
- make lines dead while the work is in progress or, if this cannot be done;
- work around the live overhead lines using the precautions outlined in this guidance.

In some cases, it may be necessary to use suitable combinations of these measures, particularly where overhead lines pass over permanent work areas.

3. RISK MANAGEMENT IN THE WORKPLACE

The precautions depend on the nature of the work at the site. It is essential that the same precautions are taken even when work near the OHL is of short duration. There are broad categories of this work.

- (a) Work areas where there will be no scheduled work or passage of plant under the OHL, barriers can prevent close approach, particularly for construction or scaffolding work.
- (b) Work areas where plant or vehicles will pass under the OHL, for example defined passageways should be made up and maintained for the duration of the work, including during demobilisation.
- (c) Work areas where work will be carried out beneath the OHL, further precautions must be taken in addition to the erection of barriers with passageways with safe height limiting cross bars being constructed.



Typical example of height restriction barriers in place

- (d) Consider a Permit to Work which documents the control measures implemented to protect the asset and people.

Any work with plant or scaffold tubes in the vicinity of a live OHL must be limited to the minimum necessary. A written risk assessment should be undertaken specifying the dangers, minimum safety clearances and precautions to be taken so as to avoid danger. This should be worked up into a step-by-step method statement, which includes physical restraints to avoid breaching the safety clearance (as relying only on supervision is unsafe).

4. GENERAL MANAGEMENT OF WORKPLACE ACTIVITIES

During the planning process, consultation must take place between the client, principal site contractor, scaffold contractor and the OHL provider or OHL owner. Formal records should be kept of the discussions and the safe working systems agreed.

Where the overhead power source or OHL cannot be made dead the following precautions are recommended:

- The owner/provider of the OHL should be consulted about proposed working methods.
- The work should be supervised by a competent person.
- Your local distribution company will carry out shrouding of low voltage OHL free of charge but must be notified well in advance – several weeks' notice may be needed. It may be acceptable to the supplier for the scaffold to be in contact with the shrouding. Scaffold must not be in contact with an insulated OHL – eg a single insulated cable containing live, neutral and earth conductors. Scaffold and scaffolding works must not be carried out close to lightly insulated OHL as this is not intended to protect a person and is only intended to reduce the frequency of spurious tripping out caused by bad weather or contact with tree branches etc.
- No person or part of any vehicle, plant or equipment may work in a position where they are liable to be within 10m of an OHL suspended from steel towers. *N.B.* High voltage cables cannot be shrouded.

- Only use short scaffolding tubes that are not long enough to reach the overhead line or get close enough to cause flashover. If long tubes are needed for use as ledgers and edge protection they should be carried by two persons, one at each end, as near to the ground as reasonably practicably and passed up at as low an angle as possible. If necessary the scaffold should have no protruding transoms so that tube can be raised horizontally using a rope at each end.
- Storage areas and racks must be located outside the restricted areas.
- The work should be supervised by a competent person who fully understands clearance distances, arc issues and tube & fitting movement envelopes including planned and unintended tube rotation paths and falling object issues.

The arrangements made and management of work under or in the proximity will usually be under the control of the main or principal contractor on site however, the scaffolding contractor has a duty to ensure that their employees are not exposed to an uncontrolled hazard or risk.

5. SIGNAGE

These are typical signs warning of electrical dangers.



6. GENERAL KEY SAFETY POINTS

Electrical power source lines are erected above a statutory minimum height that, in normal circumstances, places them safely out of reach. However, anyone carrying long scaffold tubes or erecting / working on tall structures is at increased risk of danger from live conductors. To minimise the risk, ensure the workforce adhere to the following key safety points:

- Always **LOOK OUT** and **LOOK UP** before carrying out any scaffolding operation!
- Understand and comply with your Risk Assessment/Method Statement (RAMS) and safety instructions.

Note: The RAMS should take into account safety distances when designing scaffolding to ensure that at no point a tube lifted vertically for the purpose of installation has any potential to encroach the safety distances. As a scaffolder, YOU should make sure you work to the RAMS and only use the length of tube specified.

- Always **LOOK OUT** and **LOOK UP** before carrying out any scaffolding operation!

- **Never** carry long scaffold tubes vertically. Always carry them horizontally, as low to the ground as practicable. Take into account safety distances when designing scaffolding to ensure that at no point a tube lifted vertically for the purpose of installation has any potential to encroach the safety distances including if it moves in an unexpected way or falls.
- **Never** attach or tie any scaffolding to power line wooden poles, tubes, pylons or electrical equipment.
- **Never** attempt to cover, remove or re-site power lines yourself if they are in the way of your scaffolding – **THIS MUST ONLY BE DONE BY ELECTRICITY COMPANY PERSONNEL.**
- **Never** erect scaffolding within 3 metres of an overhead power line that is feeding houses or within 15 metres of a high voltage overhead line unless you have checked with your local Electricity Company and they have confirmed it is safe to do so by, for example, isolating the power at source or shrouding the cables.
- Even if erecting scaffolding outside of these distances, **take great care** when carrying and erecting long scaffold tubes in the vicinity of overhead power lines.
- Safety zone distances given below should be used as follows then if a tube is dropped, let go of, passed to another person or rotated for any reason, , no part of it or of any person attempting to control, catch or recover it should be able to enter the safety zone. If control of a tube is lost, let it go and move clear.
- If you see lines which MIGHT be power lines STOP WORK and ASK.

Safety zones varies according to the voltage of the line, as follows:

- low-voltage line 1 m;
- 11 kV and 33 kV lines 3 m;
- 132 kV line 6 m;
- 275 kV and 400 kV lines 7 m.

Note: electrical terminology classes voltage between 50 and 1000 volts a/c as low voltage. This relates to electrical qualifications and designs standards. In this context ‘low’ does not mean not dangerous.

Under no circumstances must any part of plant or equipment such as people, ladders, tubes and hand tools be able to encroach within these zones. Allow for uncertainty in measuring the distances and for the possibility of unexpected movement of the equipment due, for example, to wind conditions. Note also that long overhead lines will swing in the wind so the safety zone must be taken from the worst-case location of the OHL.

The outer edge of the safety zone should be considered as the limit for worst case movement of personnel, tools, equipment, boards, fittings and especially tube. This means that if a tube is dropped or rotates whether under control or falling, or a person stretches up or reaches out, or trips and falls, then it should not be possible for part of them or of any item to enter the safety zone.

Many power cables to domestic properties are carried on wooden poles and then connected to the property on an external connection often just below the eaves. The photograph below shows a typical connection to property. These can easily be mistaken for telecommunication cables as they are often carried along the same power cable. When confronted with this type of situation we advise you to contact your local power distributor for your region who will confirm if it is a live power cable and then provide a cable shrouding service to make the area safe. **ONLY AFTER THE CABLE HAS BEEN SHROUDED AND THERE IS NO LONGER A RISK SHOULD YOU CONTINUE WITH THE ERECTION OF THE SCAFFOLD.** A list of all the UK regions and distributors along with contact details are provided in the reference section at the end of this guidance document. *NOTE:* response times may vary among the different distributors.



Overhead power line connected to domestic property



Overhead power lines made safe with shrouding

7. EMERGENCY PROCEDURE

What to do if your scaffold comes into contact with an overhead power source or OHL:

- Never touch OHL even with something you believe to be non-conductive.
- Assume the conductors are live, even if they are not sparking.
- Remember that, even if they are dead, the conductors can become alive again with no notice. This may happen automatically after a few seconds or may be re-energised remotely up to several hours later if the Electricity Company is not aware that the line has been damaged.
- The risk assessment should identify and contain emergency contact numbers of the local distribution company.
- If you can, use your mobile telephone to call the emergency services. Give them your location as accurately as you can. Tell them that there are electricity lines / wires involved and ask them to inform the Electricity Company. If arcing is occurring you may need to move a considerable distance before a mobile phone or 2-way radio will work. This is due to electromagnetic interference caused by the arcing.
- If any of your equipment or vehicles are in contact with an electricity line / wire or close to a damaged overhead line / wire then move away as quickly as you can, and stay away, until the emergency services or Electricity Company arrive.
- Once a wire is on the ground you do not have to touch it to be killed. The current may travel a significant distance through the ground and even further if the wire has fallen on a fence or other metallic objects. **BE AWARE, KEEP CLEAR.**
- If someone is standing on a scaffolding structure that is in contact with a line, it is best for them to remain stationary and not touch any metal part of the scaffold. Keep everyone else clear.
- If staying on a scaffold structure or vehicle would put you in serious danger – for example if it is likely to collapse / or catch fire and you have to get off, then always jump well clear. Make sure you do not touch the scaffolding and the ground at the same time.
- If you become aware that uninsulated, lightly insulated or unshrouded OHL are touching a scaffold you must ensure that no one touches the scaffold as it may be live – whether or not there is arcing or smoke. The electricity supplier emergency number should be contacted and immediate attendance requested. If there is risk to the public the supplier may power down the supply, especially if this is requested by the police.

IF YOU ARE UNSURE, STOP WORK AND ASK

Part 2: Earthing of Scaffold Structures

1. INTRODUCTION

This NASC Guidance Note addresses the issue of earthing temporary scaffolding and the protection of scaffolding from lightning.

In almost all circumstances scaffolding structures will have low electrical resistance.

Although the scaffolding structure is usually in contact with the ground and may have base plates and sole boards, it should never be assumed that the structure is effectively earthed.

The Construction (Design and Management) Regulations (CDM) outline that clients, CDM co-ordinators and designers should consider hazards at the planning stage. This should include any requirement for earthing. For instance, there may be a requirement for earthing to be run under the baseplates and therefore it is important that the risk of lightning be assessed at design and pre-tender stage, prior to the erection of scaffolding.

Electrical hazards in the form of lightning, overhead electrical lines and integral lighting and alarm systems can affect all types of structures and if scaffolding is not properly earthed people can be killed or seriously injured and buildings damaged.

The client or user of the scaffolding structure is responsible for ensuring that it is safe for use. The client should ensure that expert advice is obtained as to whether the scaffold requires earthing from a competent person (i.e. a suitably qualified electrical engineer) and suitable protection is installed as not all scaffolds require earthing.

2. EARTHING OF TEMPORARY SCAFFOLD

Where the scaffolding carries lighting, alarm or similar small power circuits, it is recommended that the structure should be electrically bonded to the protective conductor(s) of the circuit(s) that it carries.

Bonding is not required if the operating voltage of a circuit is below 50V a.c.

For higher power circuits where bonding is required, such as goods and passenger hoists, this should be carried out in accordance with the latest IET regulations (BS7671) by a competent person in line with the risk assessment, to ensure there is no risk of scaffold operatives being electrocuted while the scaffold is dismantled.

Except where it is necessary for lightning protection purposes, scaffolding external to a structure should not be connected to the means of earthing within the structure that is provided by the supply authorities. If Earthing Spikes are required, the area must be CAT Scanned by a competent person to detect underground services etc, using equipment that has been calibrated appropriately. This will also help to ensure that any permit conditions are complied with when in place.

It should be noted that individual scaffolding structures if not connected, must be earthed separately.

3. LIGHTNING PROTECTION

The client/main contractor is responsible at design and pre-tender stage for assessing the requirements for earthing (in consultation with a suitably qualified electrical engineer) and for arranging earthing where required.

If scaffolding is next to an existing structure which has an external lightning protection system it should be bonded to the earth termination and the air termination network of the lightning protection system by a suitably qualified electrical engineer arranged by the client.

Lightning protection is a complex topic and advice should be obtained from a person who specializes in this subject. If the adjacent building does not have lightning protection but the scaffolding will be significantly taller than the building then enhanced earthing to protect against lightning may also be needed. A lightning strike causes an extremely rapid rise in the potential difference (voltage between the metalwork that has been struck and adjacent or internal metalwork, wiring and IT cables and equipment). To prevent fire, explosion and other damage inside the building it is often necessary to cross bond lightning conductors to internal metalwork and the electrical system earth. This may need to be done at high level as well as ground level earthing points to prevent a potential difference developing.

Where scaffolding is erected next to a building or structure which is readily accessible to the general public and used as a working platform or erected over or as part of the common highway, the client should seek the advice from a suitably qualified electrical engineer to ensure the scaffold does not pose an electrical risk to the user and general public

A simple method of bonding such structures consists of running a strip of metal, other than aluminium, 20mm x 2.5mm in section, underneath and in contact with the base plates and ground carrying the vertical members of the scaffolding and earthing this strip at intervals not exceeding 20m. With public seating accommodation, only the peripheral members of the structure need to be bonded to earth. Other steel structures, such as those used for pedestrian bridges over main trunk roads, are frequently cited in isolated situations where they may be prone to lightning strikes and should therefore be bonded to earth, particularly at the approach points to the structure. It is important to ensure that touching or continuous structures have a continuous earth bond rather than isolated separate earth connections. This ensures that any voltage rise due to lightning is the same across all connected metalwork, including the scaffold, the building structural frame/ steelwork and earth wiring.

4. SCAFFOLDING STRUCTURES AND SENSITIVE BUILDINGS

Scaffolding contractors are often asked to erect scaffolding to sensitive buildings or sites such as historic buildings and monuments and in industrial facilities (i.e. power stations, petro-chemical installations etc). These places often have their own rules for Earthing or Bonding and advice must be obtained from the owners of the building or the Principle Contractor to ascertain local policy, prior to the erection of scaffolding.

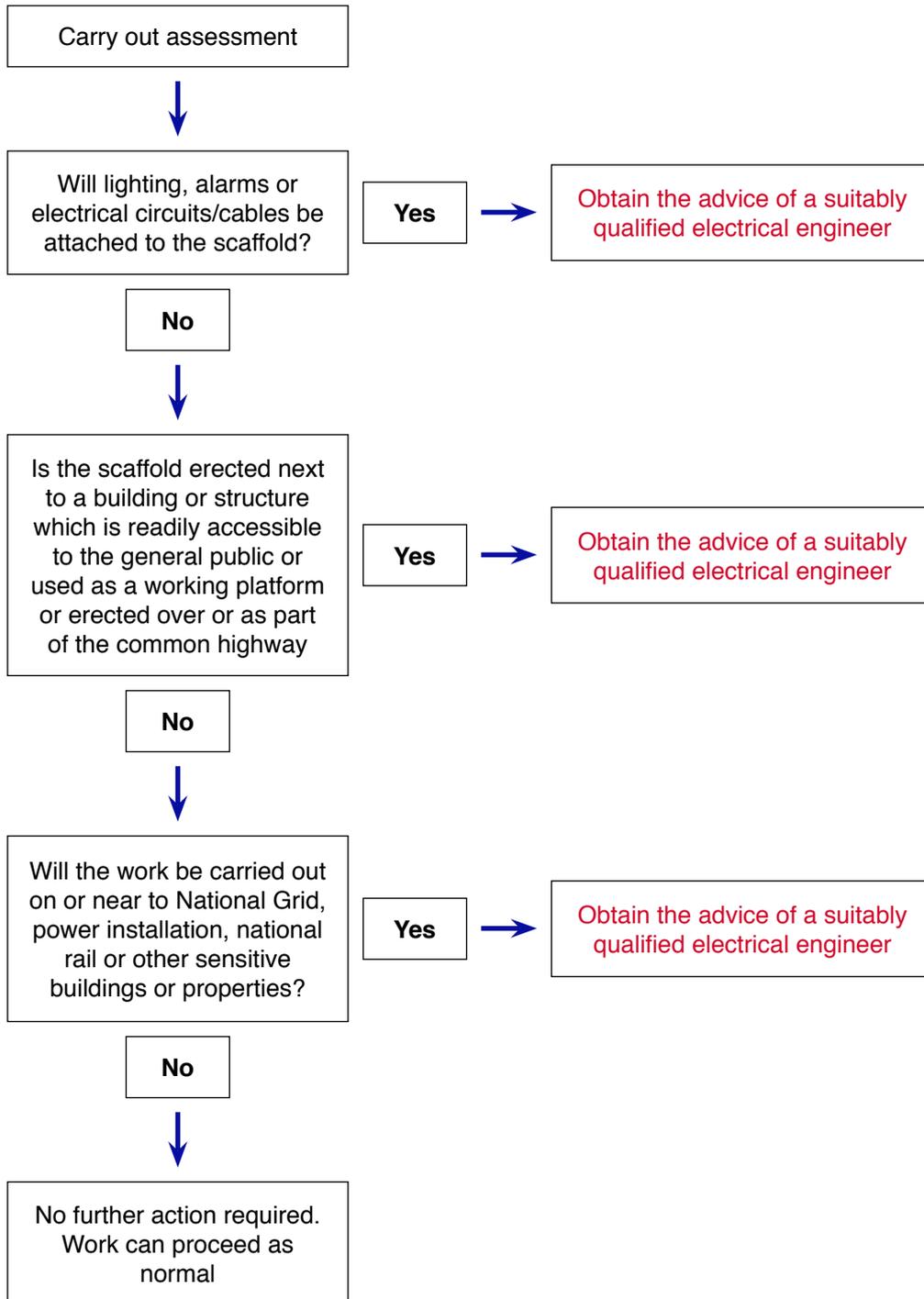
Additionally, special earthing requirements will be required when erecting scaffolding adjacent to power supplies such as National Grid stations and National Rail installations, and advice and instruction must be obtained from the client, with a risk assessment made by a Senior Authorised Person prior to works commencing.

5. ERECTION AND USE DURING LIGHTNING STORMS

Scaffolders erecting or dismantling scaffolding and scaffold users who observe thunder storms in the distance are strongly advised to stop work immediately and get off the scaffold and go to a safe place. They should not get back on the scaffold until certain that the storm has moved away, or has abated, and there is no further risk of a strike.

6. FLOWCHART FOR EARTHING ASSESSMENT AND ARRANGEMENT PROCESS

The client/main contractor is responsible at design and pre-tender stage for assessing the requirements for earthing (in consultation with a suitably qualified electrical engineer) and for arranging earthing where required, and the following flowchart gives advice on the process.



REFERENCES

- The Health and Safety at Work etc Act 1974.
- The Management of Health and Safety at Work Regulations 1999.
- The Construction (Design and Management) Regulations 2015.
- Electricity at Work Regulations 1989.
- BS 7671:2008+A3:2015 Requirements for Electrical Installations. (18th edition due for publication July 2018)
- HSE Guidance Note GS6 (Fourth edition) <http://www.hse.gov.uk/pubns/gs6.pdf>
- BS EN 62305-2:2012 Protection against lightning. Risk Management
- BS 7430:2011+A1:2015
- <http://nationalgridces.com/latest-news/impressed-voltage-training/>

Safety Information for Scaffolders is available on www.energynetworks.org

UK Power Network Guidance, including:

- National Grid Technical Guidance Note 287 Third party guidance for working near National Grid Electricity Transmission equipment.
- “Think before you Construct Scaffolding” leaflet, available online: <https://www.ukpowernetworks.co.uk/internet/en/help-and-advice/documents/UKPN%20Scaffold%20Safety%20Leaflet>
Scaffolders Work Safe – Think Electricity: <https://www.ukpowernetworks.co.uk/internet/en/safety/>
where you can click on the link to the safety film, which takes you to YouTube video: <https://www.youtube.com/watch?v=d8uIMXSLsHk>
- UK Network Operator Advice: 0800 3163 105.

The UK electricity network is split into regions and each region has a local distribution company.

NOTE: Every effort has been made to ensure the details listed below are correct at time of writing however, these may change over time.

- **North Scotland:**
Scottish and Southern Electricity Networks
08000483516
<http://www.ssepd.co.uk/>
- **Central and Southern Scotland:**
SP Energy Networks
0330 1010300
<http://www.spenenergynetworks.co.uk/>
- **North East England & Yorkshire:**
Northern Powergrid
08000113332
- **North West England:**
Electricity North West
08001954141

- **Merseyside, Cheshire, North Wales & North Shropshire:**

SP Energy Networks

03001010300

<http://www.spenenergynetworks.co.uk/>

- **East Midlands & West Midlands:**

Western Power Distribution

08000963080

<http://www.westernpower.co.uk/>

- **South Wales & South West England:**

Western Power Distribution

08000963080

- **London, South East England & Eastern England:**

UK Power Networks

08456014516

<http://www.ukpowernetworks.co.uk/>

- **Southern England:**

Scottish & Southern Electricity Networks

08000483516

<http://www.ssepd.co.uk/>

- **Northern Ireland:**

Northern Ireland Electricity Networks

03457643643

<http://www.nie.co.uk/>

- **Republic of Ireland:**

ESB Networks

00353212382410

<http://www.esb.ie>

Whilst every effort has been made to provide reliable and accurate information, we would welcome any corrections to information provided by the Writer which may not be entirely accurate, therefore and for this reason, the NASC or indeed the Writer, cannot accept responsibility for any misinformation posted.



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