GUIDE TO ELECTRICAL NETWORK SAFETY FOR EMERGENCY SERVICES PERSONNEL

GUIDANCE ON IDENTIFYING AND CONTROLLING THE RISK OF HAZARDS IN INCIDENTS THAT INVOLVE ANY ELECTRICITY NETWORK
Guide to Electrical Network Safety for Emergency Services Personnel

Guidance on identifying and controlling the risk of hazards in incidents that involve any electricity network

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Disclaimer

This Guide is not a training manual in its own right. Neither is it a set of detailed procedures for emergency service response to incidents that involve electrical hazards. It does provide information suitable for emergency services or training providers to develop policy, detailed procedures, or training.

This Guide applies to identifying and controlling the risk of electrical and mechanical hazards in incidents that involve any electricity network. It does not address the scope of non-electrical hazards that may exist at such incidents, for example environmental or traffic hazards. Emergency services should use the information in this Guide in managing electrical hazards at incidents. This should be as part of the broader scope of their hazard management and training of emergency service personnel.

This Guide is recommended as good practice by electricity supply industry representatives, but it is not a substitute for legislative or other regulatory requirements. If there is uncertainty on what guidelines or legislative requirements should apply in any particular situation, specialist advice, including legal advice, should be sought.

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This Guide has been prepared on the basis that the user will be appropriately trained, qualified, authorised and competent.

Acknowledgements

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The Electricity Networks Association (ENA) has kindly allowed us to include a link to its website in this Guide to a map showing the geographic coverage of New Zealand’s electricity network companies.
The EEA would also like to thank the Ministry of Civil Defence and Emergency Management for the use of information and figure from the New Zealand Co-ordinated Incident Management System (CIMS) 2014 edition.
Introduction

Emergencies can potentially involve any electricity networks found anywhere in New Zealand. Electrical and mechanical hazards may arise, for example, from an overhead line that falls down in a storm or from a motor vehicle or fire incident that involves electrical equipment. Occasionally, an unauthorised person enters a substation, or climbs an electricity network pole or tower, risking serious harm or death. Or a DIY householder may need rescue from a livened metal roof. Emergency services personnel who respond to such incidents can expose themselves to the electrical hazards. This Guide helps emergency services personnel to understand and avoid these.

This Guide provides information about:

- The electricity supply industry;
- The fundamentals of electricity and electrical distribution;
- Effect of electric current through the human body;
- The different types of electrical equipment;
- Responding to incidents where there are electrical hazards, and recognising and avoiding these;
- Specific, more common incidents;
- Working with electricity generation, transmission, distribution, and contracting companies (electricity supply industry, ESI).

Reactive maintenance work and first aid response is outside the scope of this Guide.

Four key steps for emergency services (LIVE)

In preparing this Guide four key steps were identified for emergency services to follow when avoiding and controlling hazards from electrical networks. These four key steps are as follows.

1. Location of incident and assets involved

2. Identification of hazards from electricity network

3. View from at least 4 metres distance (and 8 metres for the public)

4. ESI clearance needed before approaching incident site

This Guide supports training, policy and procedures development; however, emergency service personnel may also use it in the field. The Appendices contain essential prompts such as check lists and flow diagrams suitable for field use.

The content of this report will be monitored and revised periodically. Suggestions for changes should be sent to admin@eea.co.nz or Guide to Electrical Network
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1 Terminology and definitions

Terms used in this Guide have the following definitions.

**Arc (arcing, flashover)**
Electric current jumping across an air gap, usually with a bright flash and a loud noise. A short circuit often involves arc or flashover.

**Conductor (conductive)**
Any item or substance carrying or transferring a flow of electric current. Any item or substance is conductive if it has the capacity to carry or transfer electric current.

**Control room**
Electricity network centre for controlling the electricity network, staffed by operators.

**Distribution substation**
A small substation forming part of a distribution network with an incoming voltage of 22 kV, 11 kV or 6.6 kV and outgoing voltage of 230/400 V (typically), often referred to as a transformer. These are overhead on poles, or at ground level, often at road sides.

**Electrical equipment**
Includes transformers, switchgear, streetlights, industrial and domestic wiring, appliances and electrical machines and fittings:

1. **Transmission equipment** refers to any electrical equipment in the transmission network – the National Grid.
2. **Distribution equipment** refers to any electrical equipment in a distribution network.

**Electricity network**
A generic term for electricity transmission and distribution systems, comprising the electrical equipment, overhead lines, and underground cables that make up the system:

1. **Transmission network**: refers specifically to the transmission system (National Grid), supplying electricity to large industrial users or to electricity distribution companies.
2. **Distribution network**: refers specifically to the distribution system, supplying electricity for electricity retailers to end-users such as homes and businesses.

**Electricity network company**
An enterprise owning or managing an electricity network.

For example, Transpower owns the transmission network (the National Grid), and many power companies own distribution networks.

NOTE: Different companies (including contracting companies) may manage, operate, or maintain any electricity network.
Emergency services personnel or person

Police, Ambulance or Fire Service workers who attend emergency scenes or events commonly referred to in this Guide as ‘incidents’.

Emergency services response work

Work at an accident/incident site in order for emergency services personnel to rescue victims or to minimise risk of harm to people or significant property damage due to hazards caused by the failure of, or damage to, electricity network assets or other installations.

Electricity supply industry (ESI)

Comprises electricity generation, transmission, distribution, and contracting and generation companies.

kV

Kilovolt (one thousand volts)

Incident controller

The person who coordinates and directs the response to a particular incident.

Incident control point (ICP)

A single location where an incident controller and members of their incident management team (IMT) coordinate and manage response operations at an incident level response.

Insulating, insulated, insulator

Preventing conduction of electricity, an object having the capacity to prevent conduction. An insulator prevents electrical leakage.

Live

Charged with voltage. Usually also means connected to the electricity network.

MAD

Minimum approach distance (to a live object).

National grid

The transmission network owned by Transpower.

Overhead line

Any overhead electric conductor, including any ‘transmission line’ or any ‘distribution line’, and including any overhead service connection to customer property, used for supplying of electricity:

1. Distribution line: an overhead line usually having voltage 33 kV or less and that forms part of a ‘distribution network’.

   NOTE: Some distribution networks include a small number of overhead lines at voltages 50 to 110 kV. See Table 1 ‘Voltage hazard controls’ for the hazard control particular to this voltage range: ‘do not approach’.

2. Transmission line: an overhead line having voltage that ranges from 50 kV and up to 400 kV AC and 350 kV DC and that forms part of the ‘transmission network’ – the national grid.

Pillar (or plinth)

A connection point between the distribution network and a customer’s underground electricity service (supply). A pillar stands about 600 mm above ground. Most commonly coloured black or green and made of composite material.
Pit
A connection point between the distribution network and a customer's underground electricity service (supply). Found underground and accessed by a small in-ground lid. Most commonly coloured green.

Reactive maintenance work
Work to repair damaged electricity supply industry assets after an incident. This is not covered in this Guide.

Short circuit
Electricity taking a short-cut, for example from an overhead line or any other electrical equipment to the ground, instead of flowing normally as intended. Sometimes the short-cut can involve a large flow of electric current that should automatically disconnect the electrical equipment, but such disconnection does not always happen even if designed to do so.

Step voltage
A voltage in the ground that can appear between two points of contact on the ground.

Switchgear
Equipment used to control (turn on and off) the flow of electricity to specific parts of any electricity network.

Touch voltage
The voltage existing between a live object and the earth experienced, for example, touching the live object by hand while the feet are on the ground.

Transmission substation
A large substation generally owned by Transpower, which may supply a large industrial customer, a region or a town.

Voltage (volt)
A measure of electrical 'pressure': measured in hundreds of volts, or at high voltage, in thousands of volts (kilovolts – kV).

Zone substation
A major distribution substation that supplies a town, suburb or city area, typically with an incoming voltage of 66 kV or 33 kV and an outgoing voltage of 11 kV.

2 The electricity industry

2.1 Generation and transmission
Power generating plants produce electricity at high voltages, typically 50 kV to 220 kV. Transmission lines carry this long-distance to transmission substations in cities or near certain large industrial plants. Transmission substations reduce the voltage to between 11 kV and 33 kV. The transmission lines and transmission substations form the transmission network known as the National Grid are owned by Transpower.
2.2 Local electricity distribution

From the transmission substations, the local electricity network company distributes electricity for the electricity retailers to commercial and residential customers. The electricity is usually first transferred by overhead lines or underground cables to zone substations.

Zone substations reduce the voltage to 22 kV or 11 kV and then distribute the electricity by other overhead lines and underground cables to distribution substations (sometimes known as transformers).

The distribution substation further reduces the voltage to 400 V and 230 V for domestic and commercial use. Distribution substations are on the ground or overhead, on a power pole for example.

The zone substations, distribution substations, connecting overhead lines on pole or other structures, and underground cables up to the customer connections, form the distribution networks. There are many distribution networks in New Zealand.

2.3 Electricity supply to residential and commercial customers

The distribution electricity network connects to customers by either an overhead line or underground cable. Customer connections are either overhead or underground ‘service lines’, ‘service mains’ or ‘service connections’. Network PITs or Pillars supply underground service connections to meter boxes. Overhead service connections run direct from the street pole to the bargeboard or another high point on the house, and then by internal wiring cable to the meter box and switchboard.

Residential customer supply is normally 230 V. Commercial customer supply voltage varies according to customer needs. Those having high voltage connection (typically up to 11kV) may have a distribution substation (transformer) on their property, typically on an external wall or basement, for example a car park.

Figure 1 represents different components of the electricity supply industry. A map showing the geographic coverage of New Zealand’s electricity supply industry is available on the ENA website www.electricity.org.nz.

Note that each connection will include a means of isolation such as a fuse by which the supply of electricity to the premises may be controlled.
3 Electricity: the fundamentals

3.1 Voltage

In its simplest form, electricity is electrical energy transferred by electrical current, as billions of electrons flowing around a circuit at the speed of light, at a voltage. Voltage is the electrical pressure or driving force behind this flow. The higher the voltage, the greater the electrical hazard.

Voltage measure is in volts (V) or thousands of volts (kV). Even a 230 V domestic electricity supply voltage can kill in certain circumstances, but 'high voltages', 1000 volts (1 kV) or more, are particularly dangerous (See Figure 2.)
3.2 Path to earth and between conductors

Electric current driven at some voltage with respect to earth has a strong tendency to leak or short circuit to ‘earth’ – the ground – by any available conductive material when circumstances allow. This is true regardless of the source, for example whether the electricity comes from a household lighting circuit, an overhead line, or lightning.

The tendency for electric current to leak to earth creates one of the major hazards for emergency services personnel working at any incident involving live electrical equipment. Any person who directly or indirectly contacts live electrical equipment or any other live conductive item and the ground at the same time may form an electrical path to ‘earth’. This could cause death or serious harm. Examples include a person standing on the ground, touching a vehicle, ladder or wire fence in contact with a downed live overhead line, or contacting a live electrical wall fitting while standing in a pool of water. (See Figure 3.)

Another major hazard exists where any person, including anything conductive that they are holding, bridges conductors that form part of any overhead line or any electrical equipment that is live, even if the person is insulated from the ground at the time. This is known as ‘phase’ to ‘phase’ contact. This contact path can cause comparatively greater electric shock effect than the path to earth for similar equipment, but both will kill.
Why is a bird sitting on a live overhead line not electrocuted? Because there is no path created to earth or to any other overhead line. However if the bird contacts more than one bare conductor at the same time it will be electrocuted instantly.

![Figure 3: Electric current always looks for the easiest path to earth – make sure it is not through you](image)

3.3 Arcing

High voltage electric current can also ‘arc’ – jump across an air gap – to create a path to earth or to any other item of electrical equipment such as an overhead line. An arc can also jump between conductors in an overhead line or between live parts of any electrical equipment. The higher the voltage the further the electric current can arc. A lightning strike is an extreme example of an arc and involves millions of volts. By contrast, an electric arc-welder works at comparatively few volts, but the heat produced by the high current is still strong enough to melt steel.

Common high voltage electrical equipment can produce arcs ranging from a few centimetres to a couple of metres or more depending on the voltage. For example, an arc can jump from a high voltage overhead line to any number of objects to try to create a path to earth, including trees, water, metal objects, a person or an object a person may be holding. (See Figure 4.)
An arc (also known in the electricity industry as a flashover) is extremely hot and can ignite flammable material nearby. Molten metal may also drip or spray into flammable material nearby such as dry grass, starting a fire.

![Figure 4: High voltage electric current can arc across air gaps – Keep well away](image)

### 3.4 Insulators and conductors

It is important to know that electric current can pass through some materials; these are conductors. However other materials hinder electric current. These are insulators, used to prevent electrical leakage.

*Examples of conductors include:*

- Metals (for example overhead lines, car bodies, fences, roofing, pipes, wires in buildings, ladders (including ladders with wire reinforcement), wire fences);
- Water;
- Wet wood (including growing trees);
- People and animals;
• Pole structures such as wood poles and concrete poles even if they appear dry, and steel pole structures;

• Soil;

• Flames, hot gases and dense smoke from fires.

A live overhead line lying on something conductive transfers its voltage to the conductor. For example, a live overhead line touching a car makes the whole car body live. A car on top of exposed wires in a broken pillar makes the whole car body live. A live overhead line contacting a phone line makes the phone line live.

Metal and wire reinforced ladders readily conduct electric current. Do not use these ladders close to live electrical equipment.

*Examples of insulators* (when clean and dry) *include*:

• Glass;

• Dry wood;

• Plastic;

• Porcelain;

• Rubber;

• Air.

Some insulating materials such as wood or rubber can become conductors when wet, contaminated or damaged.

### 3.5 Electricity on the ground

Electric current can travel through or on the surface of the ground. Current leaking into the ground surface, for example from a live overhead line on the ground or from the line contacting a tree or metal fence, will spread out from the points of ground-contact. This creates a voltage gradient on the surface.

As the electric current spreads out, there is a ‘rippling effect’ on the voltage. The ‘ripples’ created become smaller and smaller as they move away from the point of contact; that is, full voltage at the point of contact, voltage progressively reducing with increasing distance from this point. (See Figure 5.)
3.6 Step and touch voltages in the ground

The voltage in the ground creates two electrical hazards known as ‘step voltage’ and ‘touch voltage’.

a) Step voltage

If there is a voltage gradient or difference on the ground and inadequate insulation underfoot, electric current will flow through a person’s body from one foot to the other. (See Figure 6). The illustration shows one foot on the ground at a point having x volts and the other foot a step away at a point having y volts. The voltage difference (x-y volts) determines the current level through the body. This is step voltage.

b) Touch voltage

Touching something live by hand, with feet on the ground, allows electric current flow through the body to ground. An example is touching a live overhead line or other live object such as a tree or car in contact with the line. (See Figure 7.)

Vegetation such as trees can readily conduct electric current to ground level, and dangerous step and touch voltages may be present on the tree trunk and the surrounding ground.

Be aware that water and conductive objects can extend the step and touch voltage hazard area. Avoid standing in water or touching metal or conductive objects near any damaged overhead line or other electrical equipment as any of these might be live. (See Figure 8.)
Figure 6: When electric current leaks into the ground dangerous voltages can occur on the ground surface.

Figure 7: Touching anything live may make you a path to earth.
4 Electricity and the body

4.1 Effect of electric current on the body

The effect that electric current has on the body can vary depending on:

- the voltage;
- where the electric current enters and exits the body;
- the time in contact with the electricity source;
- the condition of the skin (the severity of an electric shock can be greater if the skin is moist since the electric current is greater).

A person contacting anything live may be thrown clear, or may become 'locked on' when their muscles tighten from the current flow through the body.

4.2 Electrical injuries

Contact with a live conductor may cause serious external and internal burns, serious internal organ damage and heart fibrillation. Also a person close to a large electrical arc may suffer serious burns from the heat and ultraviolet rays. Ultraviolet rays may also cause flash burns to the eyes in the same way as an electric welder.

Any person receiving an electric shock that causes any external burns, any incapacity or any other symptoms, such as those above, must have urgent medical attention.
4.3 Responding to victims of electric shock

First check to ensure your own personal safety before aiding any victim. Assess and manage the electrical hazards as outlined in sections 6 to 8 of this Guide.

A victim may have external burns, their heart may begin to fibrillate, they may become unconscious, or a combination of these. Contact the relevant emergency service for assistance. First aid response information is beyond the scope of this Guide.

5 Recognising parts of electrical networks

It is important to accurately describe to the control room the parts of any electrical network involved in an incident. The following outlines key recognition features. Photographs are at Appendix A.

5.1 Overhead lines

5.1.1 Transmission lines (national grid)

- Usually found on private property, have Transpower signs, including voltage information, on the supporting poles and steel towers;
- Poles made of wood, concrete, or tubular steel section; usually distinguishable by their large size, having a height range typically 15 – 50 m;
- Towers usually spread well apart, with conductor spans often greater than 250 m, the conductors held by large insulators usually 1 m or longer.

5.1.2 Distribution lines

- Usually found along roadsides or on private property;
- Poles typically timber, concrete; or steel rails usually about 10 m high;
- Often feature several crossarm layers of overhead lines; small insulators (<300 mm long) usually pointing upwards;
- May also carry telecommunications lines;
- Some poles also support pole-mounted electrical equipment, such as a distribution substation (transformer) or switchgear.

5.2 Underground cables

Underground cables are common with these features:

- Vary in size from 5 mm to over 100 mm in diameter;
- Most commonly carry voltage ranging from 240/400 V to 11 kV, and sometimes up to 66 kV;
• Cables usually laid 600 mm to 1500 mm deep. Changes to ground cover can alter the depth;
• Cable risers are often visible above ground entry or exit points, fixed to wood or concrete poles, or fixed to walls near electrical panels.

5.3 Ground-mounted distribution equipment

Ground-mounted distribution equipment is usually found on roadsides or on private property and includes:
• Distribution substations, commonly referred to as transformers, which increase or decrease voltage;
• Switchgear, used to control the flow of electricity to any part of a distribution network;
• Pillars, which are connection points between the distribution network and a customer’s underground electricity service.

5.4 Substations

The transmission network includes transmission substations. Distribution networks include many zone substations and many distribution substations.

5.4.1 Transmission substations (generally owned by Transpower)
• In large enclosed outdoor yards;
• Distinguishable by Transpower signage on the security enclosures or buildings;
• Full security fencing and locked gates form the enclosures;
• The electrical equipment is usually large, mounted on concrete pads, and connected by overhead lines and cylindrical or bar conductors;
• Often include one or more buildings, the larger substations including spaces for indoor switchgear, maintenance workshops and control rooms.

5.4.2 Zone substations
• Found outdoors, on industrial sites, or in high-rise commercial areas and sometimes found within a building to blend into the environment;
• Some outdoor zone substations look like transmission substations but are smaller.

5.4.3 Distribution transformers
• Common, found everywhere, typically at or near city, suburb or industrial area roadsides, as well as in country locations;
• Most commonly ground-mounted or pole-mounted;
• Transformers often painted green to blend with the background;
Substations involve significant electrical hazards. Emergency services personnel should never try to enter any substation unless a representative of the network company is present and available to supervise any movements by the personnel.

6 Managing electrical hazards

On arrival at an incident it is important to identify any electrical hazards. Emergency services personnel including anything you may be holding (for example, ladders or any hand-held equipment) or anything you may use (for example, pressurised water or other extinguishment) must keep a safe distance away from any part of any electricity network involved, including anything in contact, until they understand the hazards. Voltage from any source can seriously harm or kill.

Understanding the part of the electricity network involved, what the voltage is, whether it is live or might be live, is critical to assessing electrical hazards and deciding how to avoid these. Recognising the part and describing it to the electricity network control room helps the emergency services personnel on-site and the electricity supply industry representative(s) to carry out proper hazard control.

Any particular part of the electricity network involved with an incident can be treated as being free of electrical hazards only when the authorised electricity supply industry representative has formally advised that it is safe to do so. Otherwise, treat the part as being live.

In general, incidents involving electricity networks more commonly involve roadside distribution lines or ground-mounted distribution equipment.

Emergency services personnel should also be aware that there could be additional electrical hazards present such as customer-owned generation, including solar photovoltaic, wind power, micro-hydro, and diesel generators; and also that power lines can be overhead or underground.

See Appendix B for an electrical hazards checklist to help you address key aspects of an incident with a potential electrical hazard.

6.1 What part of an electricity network is it?

Section 5 and Appendix A aid in identifying parts of the electricity network.

6.2 Who owns or controls it?

A primary step is to identify the electricity supply industry company that owns or controls the particular electricity network involved in the incident:
• Transmission network poles, towers and substations are clearly identifiable as belonging to Transpower. Signs will include the line or substation name and pole or tower number. (See sign example at Figure A.2 of Appendix A.)

• Distribution network zone substations are often clearly signed with the electricity supply industry company name and, usually, a contact number.

• Signage is unlikely on distribution electrical equipment, such as pillars, and distribution substations (transformers), although some equipment has an identification number. Some poles are numbered. (See example at Figure A.2 of Appendix A.)

NOTES:
1. Multiple companies may own, manage, or operate any item of electrical equipment. For instance, the electricity supply industry representative who arrives on-site may be an employee of a contractor to the electricity supply industry company.
2. Information on which electricity supply industry or company owns a particular asset, may be available through the Fire or Police Communications Centres.
3. For information on how to communicate with the appropriate electricity supply industry organisation see 8.1.

6.3 What voltage is the equipment?

Signs on transmission network poles and towers show the transmission line voltages. (See example at Figure A.4 of Appendix A.)

Distribution equipment signage does not usually show the specific voltage, but may show ‘high’ or ‘low’ voltage. The electricity network control room might be able to advise the specific voltages involved on receiving a description from the incident site. But confirmation of this may depend on an electricity supply industry representative arriving on-site.

Table 1 shows the hazard controls likely to suit the voltages once confirmed. Regardless of the hazard controls applied, remember that contact with any live electrical equipment at any voltage can seriously harm or kill.
Table 1: Voltage hazard controls

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Location/use</th>
<th>Hazard control</th>
</tr>
</thead>
<tbody>
<tr>
<td>230V/400 V</td>
<td>Domestic, commercial, building wiring and customer-owned generation</td>
<td>Disconnect by switching or unplugging where possible</td>
</tr>
<tr>
<td>230V/400 V</td>
<td>Distribution equipment and distribution lines: mainly found near roads, in towns and rural areas and some larger customer-owned generation (But see note)</td>
<td>Special tooling and techniques required</td>
</tr>
<tr>
<td>11,000 V (11 kV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22,000 (22 kV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33,000 (33 kV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50,000 (50 kV) and above</td>
<td>Transmission network including transmission lines (Transpower’s National Grid): mainly found on private property</td>
<td>Do not approach</td>
</tr>
</tbody>
</table>

NOTES:
1. Some distribution networks include instances of overhead lines and electrical equipment at transmission-level voltages 50 to 110 kV; hazard controls for these particular items are as for transmission networks and transmission lines – 'do not approach'.
2. Be aware that voltages from customer owned generation (e.g. photovoltaic cells) vary.

6.4 Is the equipment live?

It is impossible to determine whether any electrical equipment or overhead line is live merely by its appearance. Treat all of these as being live until the electricity supply industry representative formally confirms that they can be treated as being free from electrical hazards. The electricity supply industry representative will usually have to test the equipment to confirm this.

6.4.1 Fallen overhead lines

When any overhead line falls and contacts the ground, the supply of electricity may automatically be switched off, or the fallen lines may remain live. In particular, any fallen overhead line will not automatically have its supply of electricity removed but will remain live where:

- It is still clear of the ground; or where
- It is lying on something that is a poor conductor. This could include, for example, dry concrete or tarmac, ice or snow, dry soil, dead tree, car with rubber tyres.

An overhead line that has had its supply of electricity removed can also reliven without any warning. This can happen when switchgear automatically recloses. Or a control room operator who is not aware of any incident may operate switches to restore the electricity supply.

It is important to remember that electricity often supplies electrical equipment or overhead lines from more than one direction, for example livening both ends of a broken overhead line.

A live fallen overhead line may not necessarily show any sign that it is still live, but sometimes there might be signs such as:
• Sparking or glowing;
• Crackling or buzzing;
• Heat or melting;
• Smoke or steam.

Also, any electrical equipment or any overhead line may still be live if lights or other electrical items nearby are still working.

### 6.4.2 Ground-mounted distribution equipment

Vehicles may crash into roadside distribution equipment such as plinths, pillars and transformers, exposing live parts. This may liven the vehicle, and the live contact may not be obvious where the vehicle is on top of the roadside equipment. Also, moving the vehicle while it is in contact with such equipment may cause it to become livened, if not already so. Treat all vehicles in contact with such electrical equipment as being live.

### 6.4.3 Transmission or zone substations

Parts or all of any transmission or distribution substation equipment are likely to remain live after any incident such as vehicle crash into the equipment. Also, electricity may supply the equipment from many directions. It is impossible to assess by mere observation whether the equipment or any part of it is still live, and therefore it must be treated as live. Any audible hum signals that it definitely is still live.

### 6.5 Fire

Fire near electrical equipment presents many hazards. For example, fire can create dense smoke and hot gas, both of which can conduct electric current. This increases the likelihood of electric arc from overhead lines to ground, creating significant hazard to any services personnel trying to put out the fire. Dense smoke can also obscure the presence of the live electrical equipment.

Water conducts electric current well, and hoses trained on a fire can create a direct or indirect conductive pathway from the electrical equipment. Electric current may also arc to ground by the water and hose.

Also, the likelihood of electric arcing is much higher around transmission lines 110 kV or higher.

Trees can also conduct electric current. They can cause electric arc or vegetation fire if they contact live overhead lines or electric equipment.

Substation fire is particularly dangerous; a pre-agreed fire plan should be developed with the electricity supply industry company. See 9.9.

Any property fire that involves live electrical equipment in or near the property creates similar hazards for firefighters.
These hazards emphasise the importance of keeping fire extinguishment such as water from any fire hose or any other conductive extinguishment agent a safe distance from any fire, until confirmed that the property or equipment involved is free from electrical hazards.

6.6 Minimum approach distances

All emergency services personnel must conform to the 4 metre MAD from any electrical equipment. Any emergency service persons may approach closer than the MAD only when the electricity supply industry representative has formally confirmed that the electrical equipment is safe to approach. If other risks exist, in addition to electrical risks (such as an explosion risk), the incident controller may consider imposing a larger minimum approach distance at the scene of the incident.

- Always treat every item of electrical equipment and any overhead line as live until the electricity supply industry representative confirms that it is free from electrical hazards.
- Always apply the MAD to any conductive item (for example, any vehicle) in contact with electrical equipment not confirmed as being free from electrical hazards.

7 Managing mechanical hazards

On arrival at an incident involving an electricity supply industry asset, it is important to identify any potential mechanical hazards in addition to electrical hazards (outlined in section 6).

Hazards that may be present include:

- Electricity poles (or other equipment) that have been compromised due to impact by a vehicle (see Figure 9); or
- Cable failure under tension (see Figure 10).
- Pole-mounted equipment that may fall (transformer, switchgear or hardware).
Figure 9: Electricity pole compromised by an incident

Figure 10: Cable failure under tension
8 Responding where electrical hazards are present

8.1 Communicating with the electricity supply industry

It is very important that electricity supply industry organisations and emergency services have in place pre-agreed communication plans to ensure that when an incident occurs that actions taken to rescue injured persons can be done in an efficient and co-ordinated manner where all parties understand each other’s responsibilities (see Appendix C).

All electricity network companies have control rooms with good communications. The control room operators run their electricity networks and are in charge of all switching. They are the contact point for network company support in any incident involving the electricity network.

Emergency services should follow their pre-agreed communication plan on becoming aware of any incident involving the network. Prompt advice may significantly lessen the time between the incident and arrival on-site of competent network company electrical staff. Once on-site they can help control the electrical hazards.

Various factors can influence the time it takes for an electricity supply industry representative to reach the scene of an incident. Factors include whether the incident has occurred in a rural or urban area (traffic can increase the time to respond and ability to locate the incident in a rural area can increase response time). If multiple incidents have occurred at the same time (e.g. during a storm event) this can increase the time to respond.

A key factor in arriving to the site quickly is ensuring accurate information on the location and details of an incident. The following information will help:

1. Information that enables the ESI to precisely identify the scene:
   - Location (street address or rapid number or GPS location/co-ordinates or closest intersections)
   - Asset number of power pole or nearby asset number (or ID)
   - Landmarks.

2. Type of asset (as per Appendix A).

3. Nature of the failure (e.g. broken pole; wires down; car versus pole etc).


The electricity supply industry representative who arrives on-site to make it safe from electrical hazards in order for the emergency services personnel to undertake rescue must follow a strict set of steps. This is called the hierarchy of control. The steps involve the following:

1. Eliminating the risk.

2. Minimising the risk (for example by isolating).
The electricity supply industry representative who attends the incident contacts the incident controller as they arrive on-site and would keep the incident controller well informed about what steps were being taken to make the site safe for emergency personnel to enter.

Direct phone numbers to electricity network control rooms are unlisted. This prevents call swamping during emergencies. Unless directed otherwise, emergency services and electricity network control rooms must follow communications protocols based on pre-agreed communication plans (suggested content of pre-agreed communication plans is included in Appendix C).

Emergency services should ensure that their communications and protocols are current and functioning according to the agreed plan.

### 8.2 Arriving on-site

On arrival at an incident involving electrical equipment, emergency services personnel should follow the steps below:

- Establish a cordon around the incident, where appropriate.
- Everyone not directly involved with the rescue should keep well clear – at least 8 m (see Figure 11);
- Carry out a preliminary site hazard assessment (see 8.3);
- Follow the pre-agreed communication plan with the electricity supply industry organisation and identify the location of the incident (see 8.1);
- Ask for on-site help. Follow the instructions received from the electricity supply industry organisation. They will send a representative to the site.
- Once on-site the electricity supply industry representative will identify the incident controller and will make themselves known to the incident controller. The electricity supply industry representative will provide regular updates to the incident controller in situations where emergency services response work is underway, to set clear expectations on how long it will take and when extra equipment is required to make the site safe.
- Electricity supply industry representatives are bound by Safety Manual – Electricity Industry (SM-EI) rules. If the electricity supply industry representative is requested to undertake a task by the incident controller they will state whether it is possible or not and if not, why not.
8.3 The site hazard assessment

Be cautious. Approaching the incident too closely before understanding the hazards may expose personnel or others to serious electrical hazards. (See Figure 12.)

Conduct the first hazard assessment from at least 8 m away, where possible, to:

- Find out whether there is any contact with or damage to parts of the electricity network in the immediate area;
- Identify the parts of the network involved (see section 6 and Appendix A), whether electrical equipment or overhead lines, transmission or distribution, and gather key information;
  NOTE: This includes, for example: region, district, street name, equipment description, distinguishing features and any identification or tag number (if labelled), any other information about the incident or status of the equipment.
- Immediately advise the electricity network control room, providing as much information as possible.

Requests for any electricity supply industry company to switch off any electricity supply are weighed against potential adverse effects on customers and the public. This is because electricity networks are critical to supporting essential community services such as water, sewerage, hospitals, street lighting, traffic lights and telecommunications. Removing electricity supply from any parts of such networks potentially affects large numbers of people and may put the safety of some at risk.
8.4 Approach distances

Treat all electrical equipment and all overhead lines as live until the electricity supply industry representative confirms they are free from electrical hazards.

Where the equipment or lines are not yet confirmed free from electrical hazards, emergency services personnel must maintain the MAD of 4 m.

8.5 Managing an incident site

The incident controller manages the incident site and the electricity supply industry representative will identify themselves to the incident controller and keep them updated on their actions to make the site safe from electrical hazards. The incident controller is located within the cordon. Figure 13 illustrates this cordon and the control of movements of persons at the scene of an incident.

Electricity supply industry representatives and emergency services personnel can face pressure from the public to take shortcuts in making sites safe where persons have been injured. This pressure should be managed by the incident controller.
9 Guidance for common incidents

In general, the guidelines in section 8 apply at all incidents involving electrical equipment and overhead lines; however, further specific guidelines in this section cover the more common incidents. A brief response procedure is given in Appendix D and Appendix E sets out core knowledge components for emergency services personnel dealing with electrical hazards.

9.1 Victim at house building or factory involving live overhead lines or electrical equipment

Where a person has come into contact with live overhead lines or electrical equipment at a residential property (for example, with the service line to the house) or factory take the following steps

- Exercise extreme caution;
- Apply the MAD;
• Only contact the victim or items involved in the electrical incident after the electricity supply industry representative has confirmed the site is safe from electrical or other hazards.

For typical houses and buildings where voltages are no more than 230/400 V – on carrying out a dynamic risk assessment, if there is an immediate life risk, isolate the electrical hazard by switching off the electrical supply at the switchboard. If this is not achievable treat all wires as live until the electricity supply industry representative has confirmed the site is safe from electrical hazards. The electricity supply industry representative should attend in all cases. Be aware that turning off the main switch will NOT isolate a service line.

NOTE: For victims within a house or factory follow specific procedures provided by relevant emergency service.

9.2 Overhead line brought down by storm or fallen tree

Keep all members of the public at least 8 m from any fallen overhead line (and anything in contact with the line) and advise the electricity network control room immediately.

9.3 Vehicle into pole – overhead line down but not on vehicle

Emergency services personnel must maintain the MAD of 4 m from the overhead lines, and the vehicle and any conductive items such as water pools.

• If the driver is conscious and the vehicle is driveable, tell the driver to remain in the vehicle and carefully drive to a safe distance from all the electrical hazards before exiting the vehicle;

or

• If the vehicle cannot move for any reason, leave the driver in the vehicle and obtain confirmation that the overhead line is free from electrical hazards before undertaking the rescue. Live overhead lines and conductive items in the area not confirmed free from electrical hazards involve high step voltage risks.

These incidents involve no direct or obvious contact between the vehicle and overhead line. But check to ensure that no other hidden electrical contact exists, such as crushed electric cables on poles, or crushed pillars or plinths under the vehicle. If live, these involve high step and touch voltage risks at the site.

9.4 Vehicle into and contacting pole, overhead line or other electrical equipment

Do not touch or indirectly contact any vehicle that is in contact with any ground-mounted electrical equipment (see Figure 14), overhead line (see Figure 15), or electric cable running up a pole. The vehicle body may be live, and vehicles in contact pose significant step and touch hazards. Keep the MAD of 4 m and an
equivalent distance from the vehicle and any conductive items, such as adjoining wire fence or water pool.

Figures 16 and 17 illustrate other hazards such as pole or conductor collapse.

Figure 14: The whole vehicle can be live if it crushes a pillar – do not touch

Figure 15: A vehicle in contact with lines or equipment may be live – keep at least 4 m away
Figure 16: Following a crash, overhead lines can break and drape on the ground or on objects nearby. Overhead lines may also pull tight with the possibility of breaking without warning. Check whether the vehicle is on top of or against any ground-mounted electrical equipment since this may also liven the vehicle. (See Figure 18.)

Figure 17: Pole collapse on vehicle

Figure 18: Vehicle on ground-mounted electrical equipment

Rubber tyres may insulate the vehicle from the ground but tyres can ignite and burn. This increases risk of electric current travelling through the ground surface in the immediate area.

If the driver is conscious and the vehicle is in working condition, tell the driver to drive well clear of the overhead line, pole or electrical equipment. Ensure all persons stay well clear; the moving vehicle may release lines and cause them to spring up unexpectedly.

Contact the electricity network control room for help.
Vehicle occupants will be safer if they stay in the vehicle; to leave the vehicle while it is live or potentially live is dangerous at any voltage. Any person doing so may create a path to earth for the electric current.

Other life-threatening risks such as fire might force an emergency evacuation (self-rescue) from the vehicle even if it is live or potentially live. Evacuation can be on to an insulated platform. Improvised platforms may, for example, be a layer of several rubber car mats, layers of dry clothing (beware of metal attachments such as zips and buttons), dry timber pallets, layers of plastic sheeting or other insulating materials. The occupants should exit the vehicle by jumping onto the insulated platform so there is no possibility of simultaneous contact with the vehicle and the ground. (See Figure 19.)

If self-rescue is to be attempted then the following information should be conveyed to the person attempting the self-rescue. Do not try this procedure for voltages over 33 kV; this is too dangerous.

1. If there is no imminent danger to the person attempting self-rescue they should be strongly warned that they are safer staying where they are and that the emergency services are preparing to come and get them shortly.

2. If they try to move then they are in danger of electrocution or being badly burnt.

3. If self-rescue is to be attempted then the occupant needs to position themselves so they can ensure they are steady and can jump as far as possible from the car landing upright with two feet together on the ground (see Figure 19.)

NOTE: Improvised insulated platforms have unknown electrical insulating properties, especially in wet conditions. Use these only in extreme emergencies where occupants face imminent life-threatening danger from other hazards. Otherwise, wait for an electricity supply industry representative to arrive on-site to make the site safe from electrical hazards.

Figure 19: A driver or passenger exiting the vehicle must jump well clear
9.5 Machinery contacting overhead lines or underground cables

Transporting high loads such as buildings, cranes and raised tip truck trays occasionally come into contact with overhead lines. Diggers and thrusting machines can also contact overhead lines or, digging down, contact underground cables. When this happens, the vehicle or machinery can become live. (See Figures 20 and 21.)

- Always check whether the vehicle or machinery is or may still be in contact with the overhead line or underground cable. If so, the vehicle or machinery is live or potentially live.
- Apply the MAD of 4 m.
- If the operator or driver is in the cab tell them to remain there until an electricity supply industry representative arrives on-site and disconnects the electricity supply.

The first choice should always be to make the site safe from electrical hazards for safe access to the vehicle or machinery. For other life-threatening emergencies or risks such as fire, an emergency rescue may be necessary. If so, do this according to the guidance in 9.4.

Figure 20: Where possible, the driver and any passengers should stay in the vehicle until the site is safe from electrical hazards
9.6 Person on overhead line pole or tower

Emergency services personnel should not attempt immediate rescue of any person injured on a pole or tower, even if the overhead line (or lines) are taken out of service by the electrical supply industry company. Electrical hazards continue from other live circuits on the same structure, and there are also significant fall hazards. Wait for an ESI representative to arrive.

Tell any uninjured person who is on a pole or tower to remain where they are and to keep still with arms close into their body. Wait for electricity supply industry representatives to arrive and make safe for rescue, in order for emergency services to undertake rescue.

9.7 Person in substation

All substations are hazardous environments. They allow movement only for competent electrical or specially trained people. Movement in substations, whether at ground level or aloft, cannot necessarily allow safe distances from live electrical equipment, especially when people carry conductive objects. Risks of harm for people aloft are usually significantly higher than at ground level; substations include many uninsulated high voltage conductors.
People not trained to be in substation cannot tell the dangerous parts of these by looking. High voltages can be present in substation enclosures and there are often multiple supply connections into these sites, any or all of which could be live.

Security fencing surrounds outdoor substations, but determined intruders occasionally climb or cut their way into such enclosures, and all equipment within is potentially dangerous.

Emergency services personnel must not enter a substation or substation enclosure unless they have consent from, and are directly supervised by, an electricity supply industry representative.

Most substations do not have permanent staff. A few larger ones have maintenance staff or an operator on-site. Emergency services priority should be to advise the electrical supply industry control room and seek expert help on-site as soon as possible. Once on-site, the electricity supply industry representative arranges any electrical equipment disconnection for rescue. Meantime, tell intruders or others within any substation or enclosure that they are at extreme risk and to follow your instructions. Tell them to remain still and to lessen bodily movement until help arrives.

### 9.8 Fire under or near an overhead line

Hoses trained on fire, including on hot gasses or dense smoke, near any overhead line can create a conductive path for electric current to earth. (See 6.5 and Figure 22). Wherever practicable, ask the electricity supply industry representative to make the site safe from electrical hazards before fighting the fire.

When fighting a fire close to a live overhead line, take particular care to:

- Stand well back from the overhead line so the water jet-reach is as long as possible;
- Keep water jets away from direct contact with the overhead line;
- Ensure that any emergency services personnel and members of the public stay well clear of any potential fall or splatter zone;

Be aware that:

- Overhead lines may break and fall to the ground because of the heat from a fire;
- Timber poles, crossarms and any pole-mounted equipment may fall;
- Pole-mounted equipment can shatter or rupture, expelling debris, including large quantities of oil that may catch on fire;
- Smoke can increase the risk of arcing.
Requests for any electricity supply industry company to switch off any electricity supply are weighed against potential adverse effects on customers and the public. This is because electricity networks are critical to supporting essential community services such as water, sewerage, hospitals, street lighting, traffic lights and telecommunications. Removing electricity supply from any parts of such networks potentially affects large numbers of people and may put the safety of some at risk.

![Electric current can arc through smoke and flames, as well as travel through water jets](image)

**Figure 22**: Electric current can arc through smoke and flames, as well as travel through water jets

### 9.9 Fire in a substation

All substation fires are especially dangerous, and it is necessary to develop a fire control plan with the electricity supply industry company, as the basis for any substation access or fire response.

Substation fires often result from electrical equipment failure, involving internal arcing, explosion and fire. Items of electrical equipment filled with oil sometimes fuel intense fire and thick conductive smoke. Also, the equipment may have exploded or be on fire, but may remain live. Other substation equipment nearby is also likely to be live.

Besides the electrical hazards from contact with live equipment, fire hose use involves hazards similar to those outlined in 9.8.

*Other, by no means exclusive, hazards in substation fire include:*

- Damaged equipment near to a burning section exploding without warning, expelling burning oil, toxic gas, broken porcelain and other debris;
• Large volumes of burning oil expelled;
• Dense smoke may trigger arcing;
• Some substations contain cylinders of compressed gas, which could explode;
• Water and debris in a flooded enclosure significantly increasing the extent and severity of an electrically dangerous area.

Fires in enclosed (indoor) substations present particular hazards:
• Electrical equipment in a confined enclosed area, and potential ventilation or extraction failure from power disruption;
• Trapped dense smoke, increasing arcing risk, and asphyxiation risk to trapped people;
• Extreme heat, thick smoke, explosion risk and electrical dangers create an especially hazardous environment for trapped people and their rescuers.

9.10 Floods

Any water close to live electrical equipment can make normally safe areas dangerous. Water conducts electric current and increases the risk of arcing.

During floods, parts of buildings and large tracts of land may be covered in water, affecting electrical equipment located underground and at or near ground level. Such equipment may include pillars, transformers and substations. Do not approach or touch electrical equipment in floodwater; immersed equipment can have dangerous voltages. Also, electricity network towers and poles could become unstable and may cause overhead lines to sag or fall.

Boat use in flood conditions can involve navigation much closer to overhead lines than normal. Cross under overhead lines only where there is plenty of clearance between the highest point of the boat and the lines. Acceptable clearance depends on the overhead line voltage: if unknown, cross under at a point of maximum available clearance.

Bodily contact with any live wall or overhead fittings (e.g. broken light bulb or light fitting) within a flooded building is a lethal combination. Such contact even while only partly immersed effectively earths the body, involving potentially lethal currents to earth. Never touch any electrical equipment or fitting in a flooded building until it has been made safe from electrical hazards and clearance given by the electricity supply industry representative.

9.11 Storms

Storm events often result in multiple incidents that present electrical and mechanical hazards from the electricity network that can cause dangers to the public. In these situations there is often a need for emergency services to
prioritise their response to incidents, which may cause delays in fault teams reaching the scene of incidents.

ESI representatives will respond as quickly as possible to events as prioritised by their organisation. The basic principles for responding to an incident remain unchanged for storm events and MADs should be followed until electricity supply industry representatives have made the incident scene safe.

9.12 Other incidents

Section 9 does not address other less common incidents. Emergency service responses to such incidents should always conform to the recommended practices in this Guide. This includes contacting the electricity supply industry company for advice and help before acting in any rescue or fire response that involves electrical equipment, or overhead lines.

9.13 Additional considerations

Other electrical and mechanical hazards exist that are outside the responsibility of the electricity supply industry; however emergency services personnel should be aware of these hazards:

- Electricity can be generated on-site at domestic and commercial/industrial sites. Examples are photovoltaic generation, fuel cells and so on;
- Electric vehicles;
- Trucks contacting overhead conductors can cause tyres and bearings on vehicles to be compromised.
Appendix A Identification of electricity supply industry equipment

This Appendix illustrates examples of overhead lines and electrical equipment. These help emergency services personnel to identify electricity network items to support their communications with electricity supply industry representatives, particularly their control rooms.

Figure A.1: Examples of distribution lines with various layers. These examples include: 33 kV on the top crossarm, 11 kV on centre crossarm and 400V on bottom crossarm (left side); 11 kV on the top crossarm and 400 V on the bottom crossarm (right side). Structures often carry telecommunications including bundled fibre optic communications lines underneath the overhead lines.

Figure A.2: Many electricity network poles carry some form of identification number. The electricity supply industry company can usually tell the pole location from this.
Figure A.3: Transpower 220 kV transmission lines

Figure A.4: Transpower transmission line signs provide identification information, for example the line name (Oteranga Bay – Haywards A), tower number (1452), and voltage (500,000V)

Figure A.5: Transpower transmission substations are typically large and found near major cities. Transpower substations have signs at the entry with the station name
Figure A.6: Examples of outdoor zone substations

Figure A.7: Examples of enclosed building substations
Figure A.8: Example of pole-mounted distribution substation (transformer)

Figure A.9: Examples of ground-mounted distribution substation (transformer)
Figure A.10: Examples of connection points, often referred to as ‘pillars’ or ‘plinths’, between the distribution network and the customer’s underground electricity supply

Figure A.11: Examples of switchgear, used to control the flow of electricity to specific areas of the distribution network
Figure A.12: An example of a high voltage underground electric cables
Appendix B Electrical hazards – key points checklist

1. Voltage and electric current are dangerous: Treat every overhead line and item of electrical equipment as live until it is confirmed as safe. DO NOT TOUCH.

2. Search for identification on the pole, tower or electrical equipment, such as the electricity supply industry company name, line name, pole number, equipment ID number.

3. Advise the electricity supply industry company control room:
   – Describe the damaged overhead line or electrical equipment, complete with any identifying information;
   – Ask for electricity supply industry expert help.

4. Identify everything that might be live, such as car bodies, metal fences, metal roofing, pools of water, and trees with overhead lines touching them.

5. Keep the public and anyone not directly involved in a rescue at least 8 m from any live or potentially live items.

6. Wait for the electricity supply industry representative to arrive and make the overhead line or electrical equipment safe, before any rescue.

7. For emergency services personnel conform to the MAD of 4 m.

8. If a vehicle or machine is contacting a live overhead line or electrical equipment, tell the occupants to stay in the vehicle and wait for the electricity supply industry company to make the area safe and give clearance that the scene has been made safe from electrical hazards.

9. For voltages 33 kV or less: if the occupants have to exit because of other dangers, they must jump clear, or exit onto an insulating platform such as timber pallets, rubber mats, multiple layers of plastic sheeting, dry clothing. Do not try this procedure for voltages over 33 kV; this is too dangerous. Respect the MAD. Do not imperil yourself by trying direct rescue action for occupants in a vehicle or machine that is live or that may be live.

10. Keep the number of people and the time spent close to the hazard area to an absolute minimum. Withdraw to 8 m as soon as practicable.

11. Electricity network substations are dangerous. Follow the pre-agreed fire control plan and only enter with help from an electricity supply industry representative.

12. Never aim fire hoses directly at live electrical equipment or overhead lines, especially bare lines. Water jets are conductive.

13. Fire, smoke and gasses may cause arcing to the ground so keep well clear.
Appendix C Pre-agreed communication plans

Pre-agreed communication plans between the electricity supply industry organisations and emergency services help all parties understand each other’s responsibilities in responding to incidents. Such a communication plan would include the following information:

1. Unlisted direct numbers to both the electricity supply industry call centre and the emergency services.
2. Provision of incident location, its nature, asset identification information.
3. Identification of responsible persons including incident coordinators.
4. Provision of information detailing the status of response (i.e. estimated time of arrival of fault persons).
5. Provision of information on the status of work to make safe the incident site.
Appendix D Brief response procedure

Potential electrical incident alarm raised, emergency services personnel sent to site.

On arrival at incident, keep 8 m away to conduct hazard assessment.

Does someone need urgent attention close to the overhead line or electrical equipment?

Yes

Can rescue be completed without being closer than 4 m from any items in contact with the electricity source?

Yes

Proceed in accordance with approved procedures.

No

Stay 4 m away (keep public 8 m away). Wait for Electricity supply industry representative to arrive.

Electricity supply industry company advised. Staff dispatched.

Stay 4 m away. Wait for electricity supply industry representative to arrive.
Appendix E Basic knowledge for emergency services personnel on incidents involving electrical hazards

It is expected that emergency services personnel have a basic understanding of the steps they should take when an electrical network hazard has been identified. Personnel must be able to:

1. Identify every potential electrical and mechanical hazards at the scene of an incident involving an electrical network.

2. Apply the Minimum Approach Distances (MADs).

3. Identify the asset number on a piece of electrical equipment in order to determine location.

4. Understand that the electricity supply industry representative that responds to an incident must follow the industry’s safety requirements in making the site safe to effect rescue and that they will keep the incident controller informed of their progress during an incident.

5. Have the principles-based checklist ‘LIVE’ committed to memory.
   (i) Location of incident and assets involved
   (ii) Identification of hazards from electricity network
   (iii) View from at least 4 metres distance (and 8 metres for the public)
   (iv) ESI clearance needed before approaching incident site