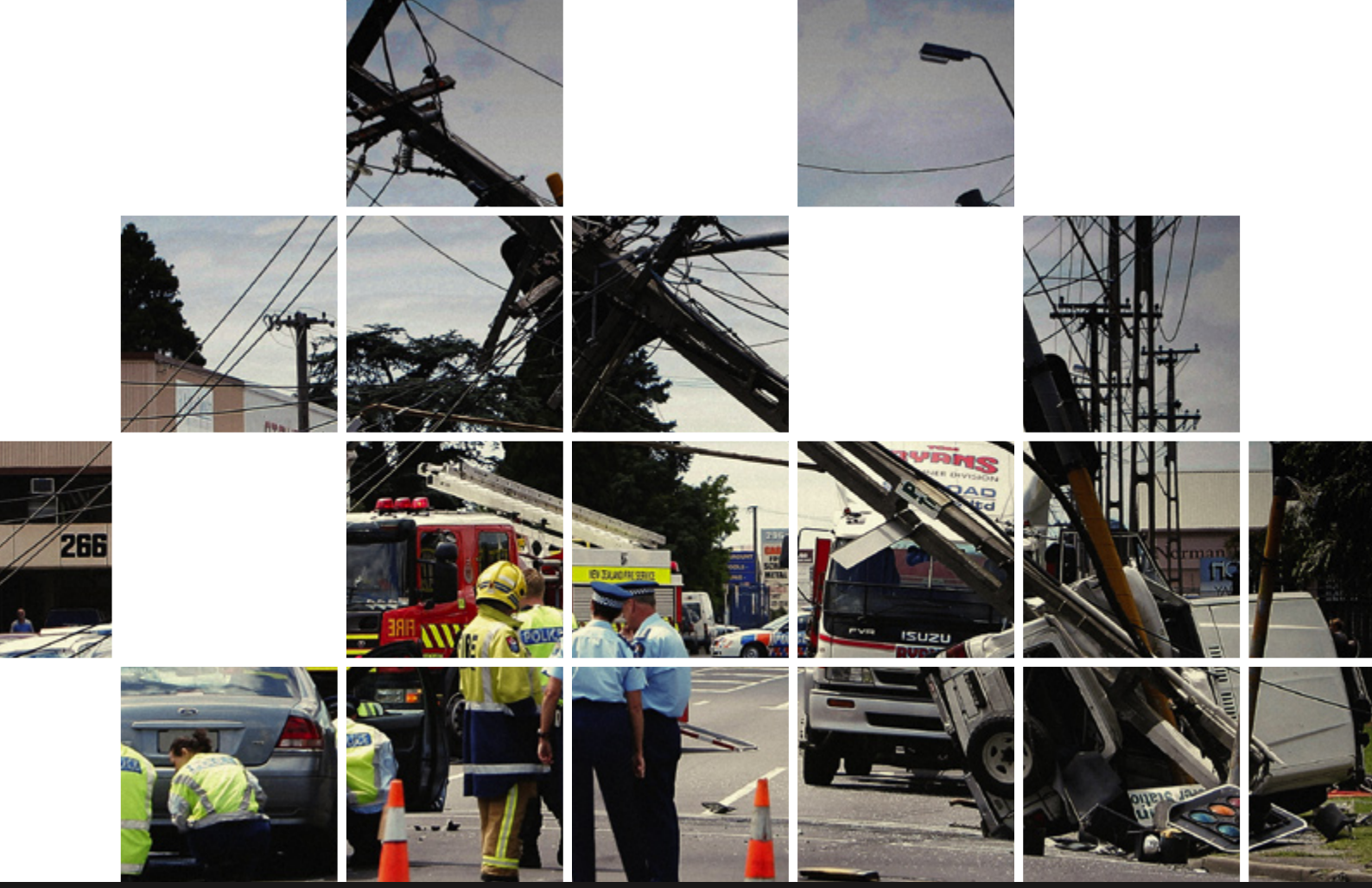


Guide to Electrical Safety for

# Emergency Services Personnel

Guidance on avoiding electrical hazards in incidents that involve any electricity network or other installations

Second Edition April 2009 Issue 1

eea Electricity Engineers' Association

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This Guide supersedes one earlier edition dated May 1988, entitled: Electrical Safety Handbook for Emergency Personnel.

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# Introduction

Emergencies can potentially involve any *electricity networks* or installations found anywhere in New Zealand. Electrical 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 intruder 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 industry;
- The fundamentals of electricity;
- Effect of electric current on the human body;
- Information about the different types of *electrical equipment*;
- Responding to incidents where there are electrical hazards, and recognising and avoiding these;
- Guidance specific to the more common incidents;
- Working with electricity transmission and distribution *electricity network companies*.

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.

# 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 avoiding electrical hazards in incidents that involve any *electricity network* or other installations. 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 towards their 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 does not override any duty to conform to any Act, Law, Code or Standard applicable in New Zealand.

Industry technology and practices, New Zealand standards, and legislative requirements may change over time. This can potentially affect the accuracy of this Guide; users should therefore exercise care in applying the guidance it provides.

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# Acknowledgements

The EEA called a work group to provide advice to assist in the development of this Guide. The group included representatives from electricity transmission (Transpower) and distribution businesses (Vector, Orion, Siemens Energy Services), the NZ Fire Service, NZ Police, and the Order of St John. The EEA would like to thank these parties for their participation.

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*.

# Contents



*continued on next page*

# 1. Terminology and definitions

**Italicised 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 operating the *electricity network*, staffed by operators.
- ***Distribution substation:*** A small substation forming part of a *distribution network* with an incoming *voltage* of 11 *kV* and outgoing *voltage* of 230/400 V (typically), often referred to as a transformer or kiosk. 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 network 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”.
- ***kV:*** Kilovolt (one thousand *volts*)
- ***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). See Table 2 for *MAD*s.
- ***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 600mm 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.
- ***Rescuer:*** The categories of *emergency service persons* that are either "*advanced electrical rescuers*" or "*basic electrical rescuers*":
  1. ***Basic Electrical Rescuer:*** an *emergency services person* trained and currently competent in understanding and keeping separation from electrical hazards to the requirements of this Guide. (See section 6.6 and Appendix D)
  2. ***Advanced electrical rescuer:*** A *basic electrical rescuer* who has received further training. An *advanced electrical rescuer* is competent in recognising and avoiding electrical hazards, and in the use of specialised electrical rescue equipment, to the requirements of this Guide. (See section 6.6 and Appendix D)
- ***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 connect or disconnect 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 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* which supplies a town, suburb or city area, typically with an incoming *voltage* of 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* 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 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 400V and 230V 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 metre boxes. Overhead service connections run direct from the street pole to the house bargeboard, and then by internal wiring cable to the meter box and switchboard.

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

A map showing the geographic coverage of New Zealand’s *electricity network companies* is available on the ENA website www.electricity.org.nz. (See Figure 1).

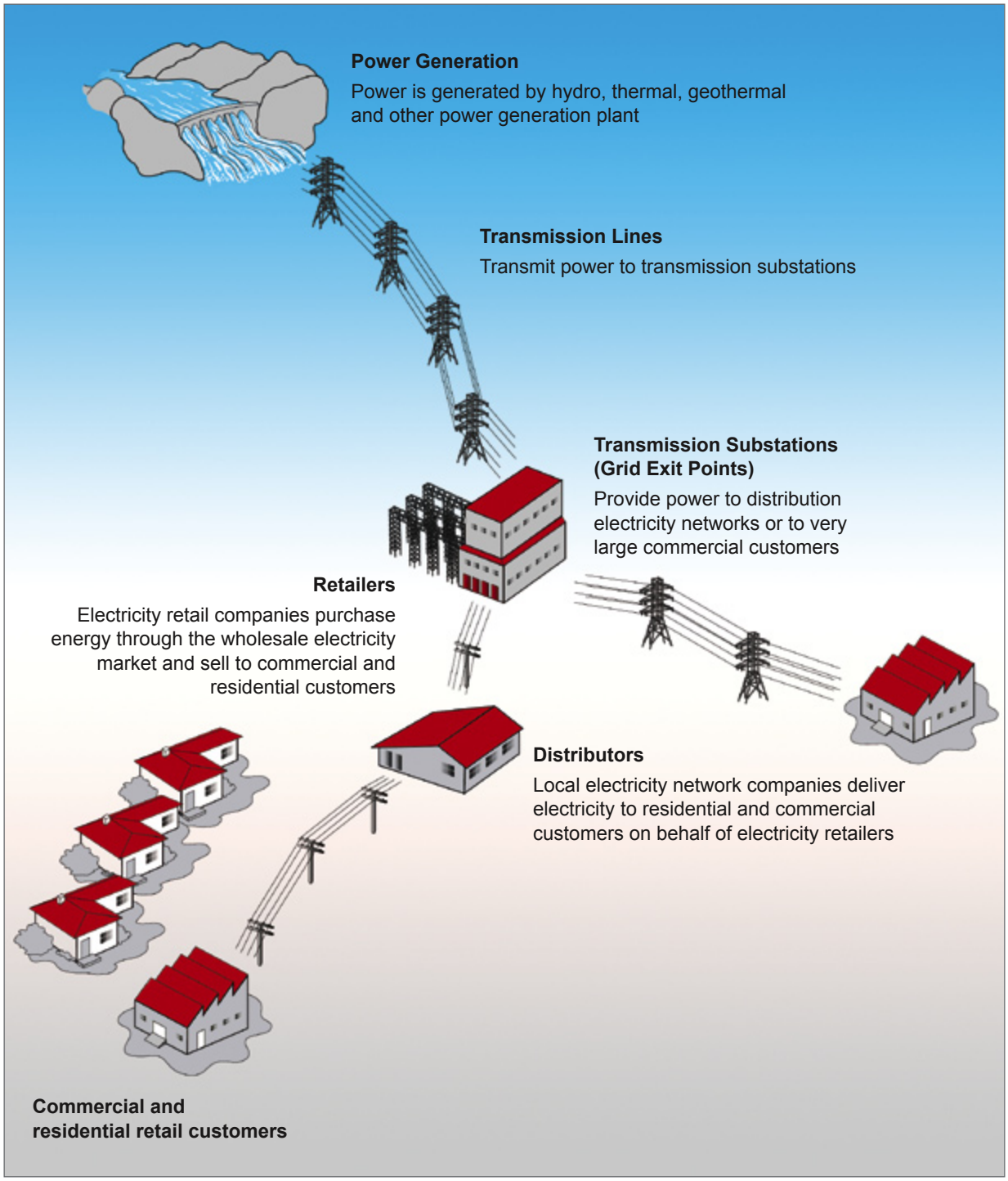


***Figure 1:*** *Electricity supply*

# 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 230V domestic electricity supply *voltage* can kill in the right circumstances, but "high *voltages*", 1000 *volts* (1*kV*) or more, are particularly dangerous. (See Figure 2).

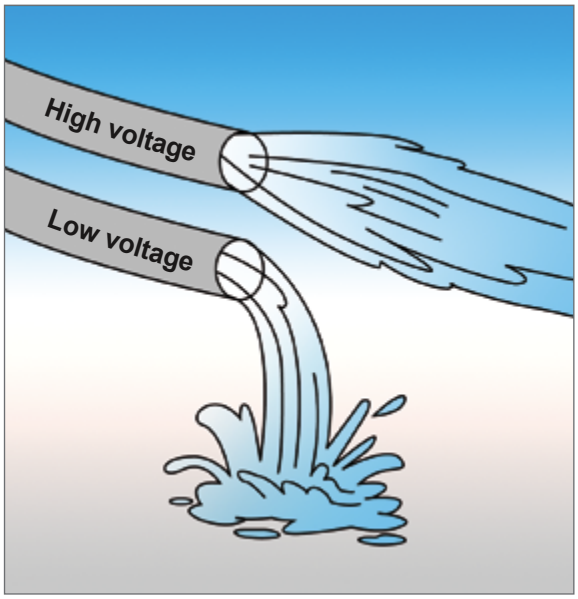


***Figure 2:*** *High and low voltages are like high and low pressure water pipes. Both high and low voltages can kill. "The higher the volts, the higher the jolts."*

## 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).

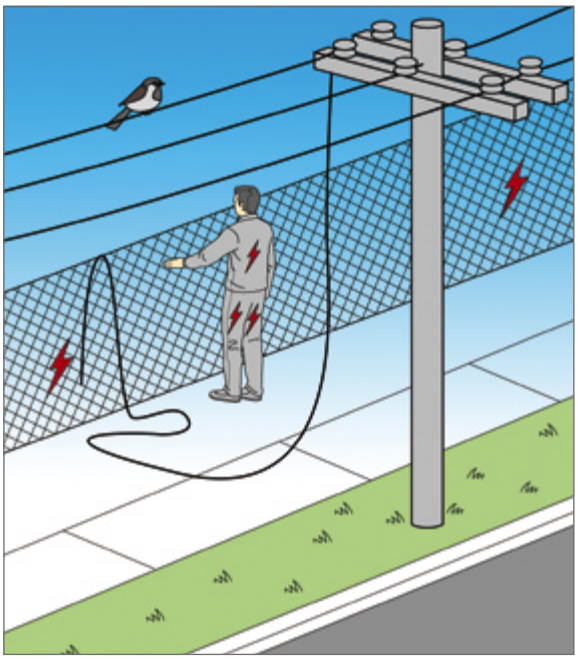

***Figure 3:*** *Electric current always looks for the easiest path to earth – make sure it is not through you!*

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 just as effectively.

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 may be electrocuted instantly.

## 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 cm 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.

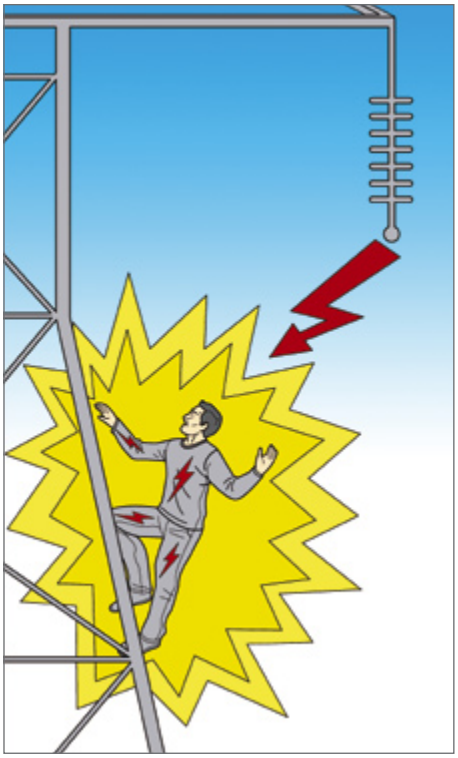

***Figure 4:*** *High voltage electric current can arc across air gaps. Keep well away.*

## 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).

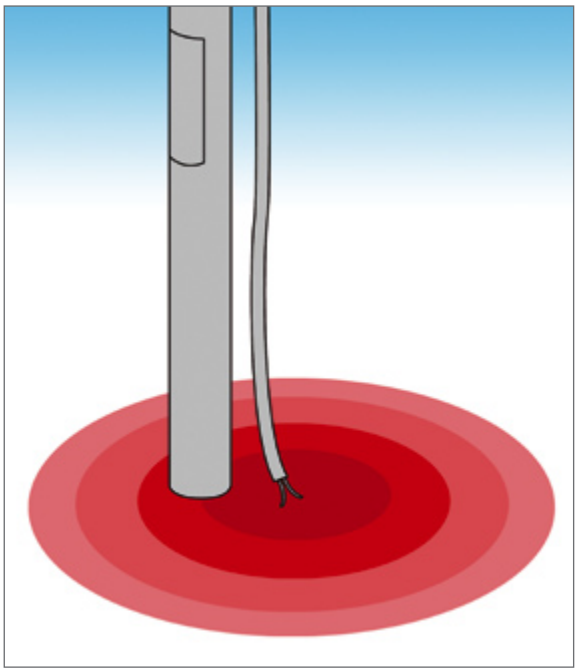

***Figure 5:*** *A broken overhead line or damaged electrical equipment can cause electric current to spread out on the ground surface, reducing as it spreads away from the point of contact.*

## 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. 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*. (See Figure 6).

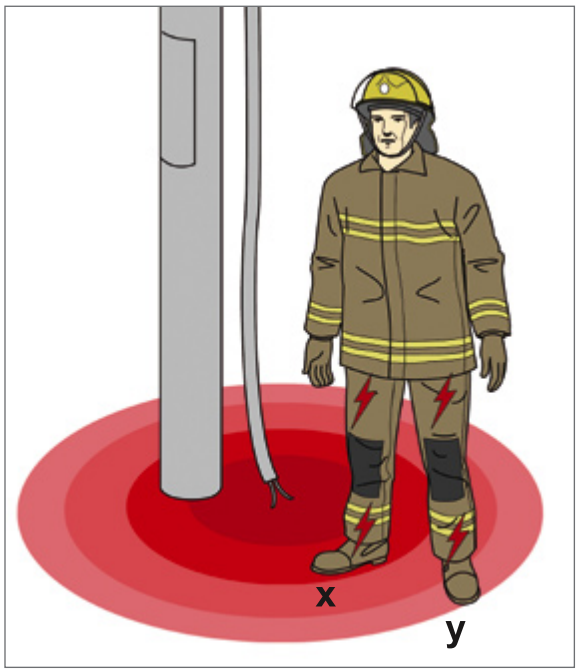


***Figure 6:*** *When electric current leaks into the ground dangerous voltages can occur on the ground surface.*

**b) *Touch voltage***

Touching something *live* by hand, with feet on the ground as above, 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 7A)

***Figure 7:*** *Touching anything live may make you a path to earth.*

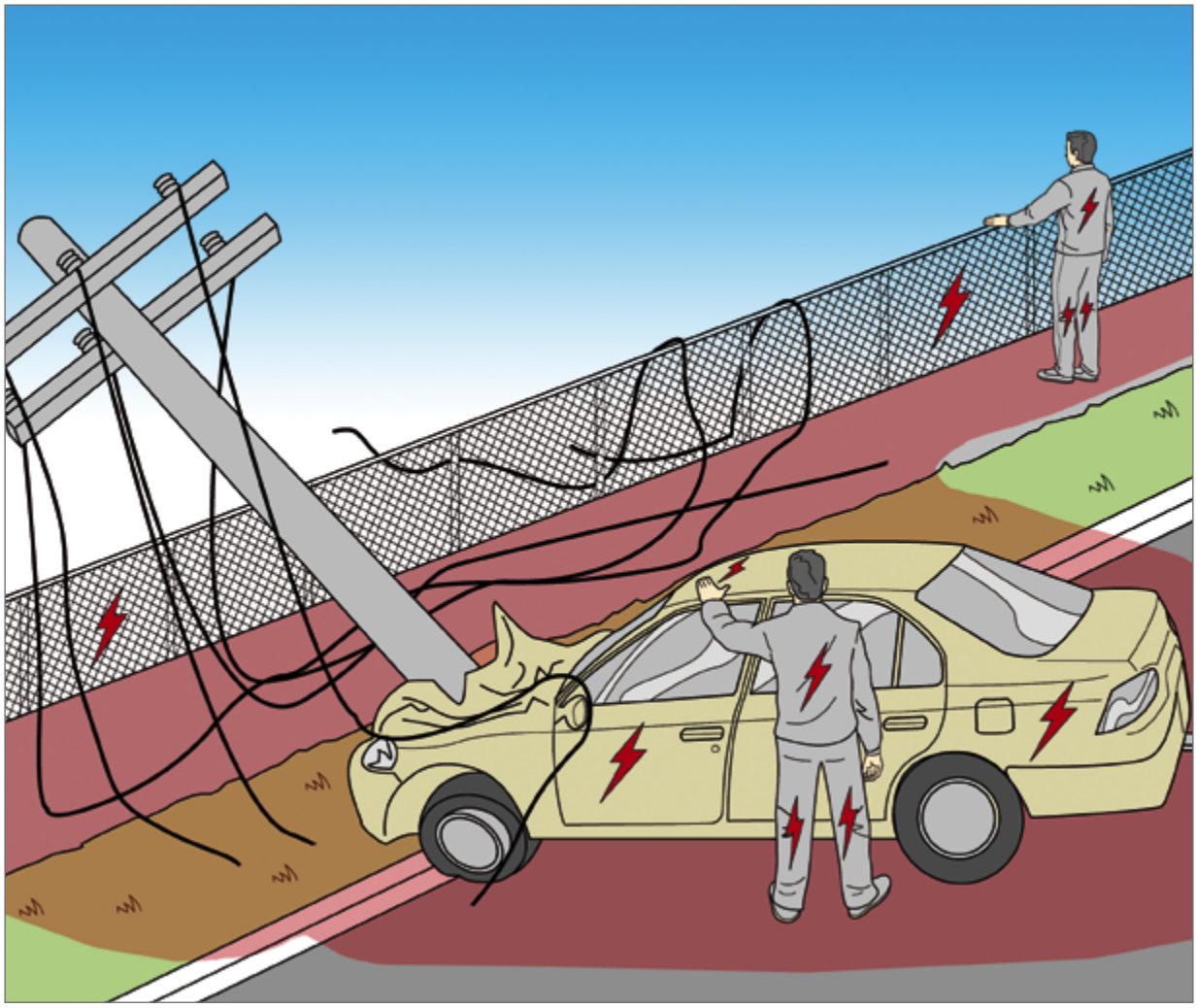

***Figure 7A:*** *Live overhead lines touching and livening other objects increase the step and touch voltage area.*

# 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 must have urgent medical attention.

## 4.3 Responding to victims of electric shock

First check to ensure personal safety before aiding any victim. Assess and manage the electrical hazards as outlined in section 7 of this Guide.

A victim may have external burns, their heart may begin to fibrillate, they may become unconscious, or a combination of these. First aid response information is beyond the scope of this particular Guide; however, it is readily available from other sources.

# 5. Recognising parts of electrical networks

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

## 5.1 Overhead lines

**a) 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 the large size, having a height range typically 15-50m;
- Towers usually spread well apart, with *conductor* spans often greater than 250m, the *conductors* held by large *insulators* usually 1m or longer.

**b) Distribution lines:**

- Usually found along road sides or on private property;
- Poles typically timber or concrete; usually about 10m 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. Key recognition features:

- Vary in size from the thickness of a finger to over 100mm in diameter;
- Most commonly carry *voltage* ranging from 240/400V to 11*kV*, and sometimes up to 33*kV;*
- Cables usually laid 600mm to 1200mm 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 or kiosks, which increase or decrease *voltage*;
- *Switchgear*, used to connect and disconnect any parts of a *distribution network*;
- *Pillars* or *plinths*, which are connection points between the *distribution network* and a customer's underground electricity service.

## 5.4 Substations

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

**a) *Transmission substations* (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*.

**b) *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.

**c) Distribution substations:**

- Common, found everywhere, typically at or near city, suburb or industrial area road sides, as well as in country locations;
- Most commonly ground-mounted ("kiosks") or pole-mounted;
- Kiosks often painted green to blend with the background;
- Can also be within buildings.

Substations involve significant electrical hazards. *Emergency services personnel* should never try to enter any substation unless the *electricity network company* allows this, or their representative is on site.

# 6. Managing electrical hazards

On arrival at an incident it is important to recognise any electrical hazards. *Emergency services personnel* including anything they may be holding (for example ladders or any hand held equipment) or anything they 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* or electric current 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 accurately describing it to the *electricity network control room* helps the *emergency services personnel* on-site and the *electricity network company* 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 network* 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*.

## 6.1 What part of an electricity network is it?

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

## 6.2 Who owns or controls it?

A primary step is identify correctly the *electricity network 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. Signage will include the line or substation name and pole or tower number. (See sign example at Appendix A).
- *Distribution network zone substations* are often clearly signed with the *electricity network 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 Appendix A).

*Note: Multiple companies may own, manage, or operate any item of electrical equipment. For instance, the electricity network representative who arrives on-site may be an employee of a contractor to the electricity network company.*

## 6.3 What voltage is the equipment?

Signs on *transmission network* poles and towers show the *transmission line voltages*. (See example 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 network company* 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**

| Voltage | Location/use | Hazard control |
|---|---|---|
| 230V/400V | Domestic, commercial, building wiring | Disconnect by switching or unplugging where possible |
| 230V/400V<br>11,000V (11 *kV*)<br>22,000V (22 *kV*)<br>33,000V (33 *kV*) | *Distribution equipment* and *distribution lines*: mainly found near roads, in towns and rural areas. (But see the note) | Special tooling and techniques required |
| 50,000V (50 *kV*)<br>220,000V (220 *kV*)<br>350,000V (350 *kV*) | *Transmission network* including *transmission lines* (Transpower's *National Grid*): mainly found on private property | Do not approach |

*Note: 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".*

## 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 network company* or their representative formally confirms that they can be treated as being free from electrical hazards.** The *electricity network company* representative will usually have to test the equipment to confirm this.

### a) Fallen Overhead Lines

When any *overhead line* falls and contacts the ground, the supply of electricity may automatically disconnect, or the fallen lines may remain *live*. In particular, any fallen *overhead line* will not automatically disconnect 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 disconnected 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 reconnect 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.

**b) 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*.

**c) 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 *emergency 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 network company*. See section 8.9.

Any property fire that involves *live electrical equipment* in or near the property creates similar hazards for fire fighters.

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 Training, equipment and minimum approach distances

**a) Training and equipment**

Special training, and sometimes use of special equipment, is necessary for those emergency service personnel who carry out emergency and rescue tasks close to *live electrical equipment*. Emergency services organisations are responsible for ensuring that these people, called "*rescuers*" in this Guide, are competent and suitably equipped for the tasks, and that they apply suitable procedures.

Three levels of competence are applicable in this Guide:

Level 1: Public and *emergency services personnel* who have no specialised training or skills in electrical hazard recognition and avoidance. An 8m *MAD* safety perimeter applies for these people.

Level 2: *Basic Electrical Rescuers*, being *emergency services persons* who are competent in recognising and avoiding electrical hazards. *Basic electrical rescuers* may work near *live electrical equipment*, applying the correct *MAD* for level 2 training in Table 2. Training is according to Appendix D for Level 2.

Level 3: *Advanced Electrical Rescuers*, being former *basic electrical rescuers* who have added competencies in electrical hazard recognition and control for rescue, including competence in the care and use of specified electrical tooling and safety equipment used in rescues. *Advanced electrical rescuers* may work near *live electrical equipment*, applying the correct *MADs* for level 3 training in Table 2. Training is according to Appendix D for Level 3.

**b) Minimum approach distances**

Table 2 (over page) specifies minimum approach distances (*MADs*) according to levels of competence.

All *emergency services personnel* other than *basic electrical rescuers* or *advanced electrical rescuers* must conform to the 8 metre *MAD* from any *electrical equipment*. After *voltage* is confirmed, basic and *advanced electrical rescuers* may apply the *MAD* for their competence level, for rescue or other emergency response purposes. Any emergency service persons may approach closer than their *MAD* only when the *electricity network company* has formally confirmed that the *electrical equipment* is safe to approach.

- Always treat every item of *electrical equipment* and any *overhead line* as *live* until the *electricity network company* 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.

| TABLE 2: RECOMMENDED MINIMUM APPROACH DISTANCES (MAD) | | | | |
|---|---|---|---|---|
| **Persons** | **Training** | **Equipment/ Voltage status** | **Voltage** | **MAD** |
| Public, and *emergency services personnel* who are not *basic electrical rescuers* or *advanced electrical rescuers* | Level 1<br><br>No electrical hazard training. Not competent to the requirements of this Guide | Any equipment type & *voltage*, not yet confirmed as free from electrical hazards | All *voltages* | 8.0 metres |
| *Basic electrical rescuers* | Level 2<br><br>Basic Electrical Rescuer competence in electrical hazard recognition and avoidance specified in Appendix D | Equipment type known but *voltage* not yet confirmed | Distribution | 3.0 m |
| | | | Transmission | 4.0 m |
| | | Once the *voltage* is confirmed | Up to 11 *kV* | 1.0 m |
| | | | 22/33 *kV* | 1.5 m |
| | | | 50/66 *kV* | 2.0 m |
| | | | 110 *kV* | 3.0 m |
| | | | 220/350 *kV* | 4.0 m |
| *Advanced electrical rescuers* | Level 3<br><br>Advanced Electrical Rescuer competence in high *voltage* hazard management and specialist tool use specified in Appendix D | Equipment type known but *voltage* not yet confirmed | Distribution | 2.0 m |
| | | | Transmission | 4.0 m |
| | | Once the *voltage* is confirmed | 11/33 *kV* | Contact using specialist tools and equipment |
| | | | 50/66 *kV* and above | *MAD* as for *basic electrical rescuers* above. See note to Table 2 |

*Note 1: Transmission equipment voltages involve the greatest electrical hazard and need specialised training and tooling. Since this is impracticable for advanced electrical rescuers, and since incidents involving transmission electrical equipment are rare, emergency services personnel must call Transpower for specialised help at such incidents.*

*Note 2: Some distribution networks include a small amount of electrical equipment and a small number of overhead lines at voltages 50 to 110 kV. Conditions parallel to Note 1 apply. Contact the electricity network control room for specialised help.*

# 7. Responding where electrical hazards are present

## 7.1 Communicating with the electricity network company

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 contact the electricity network *control room* as soon as possible 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. This may include any isolating and disconnecting of *live* equipment where approved by the electricity network *control room*.

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.

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

## 7.2 Arriving on-site.

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

- Level 1 *emergency services personnel* and everyone not directly involved keep well clear - at least 8m (see *MAD's* section 6.6 and Figure 8);
- Carry out a preliminary site hazard assessment (see section 7.3 below);
- Report to the electricity network *control room* as soon as possible;
- Ask for on-site help. Follow the *control room* instructions. They will send a representative to the site.

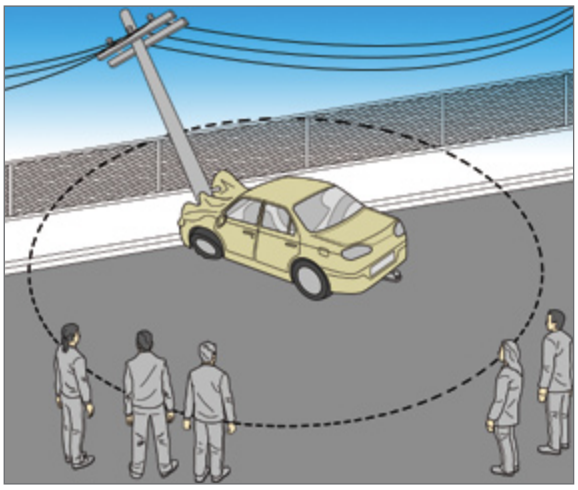

***Figure 8:*** *Keep the public at least 8m from any fallen overhead lines.*

## 7.3 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 9).

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);

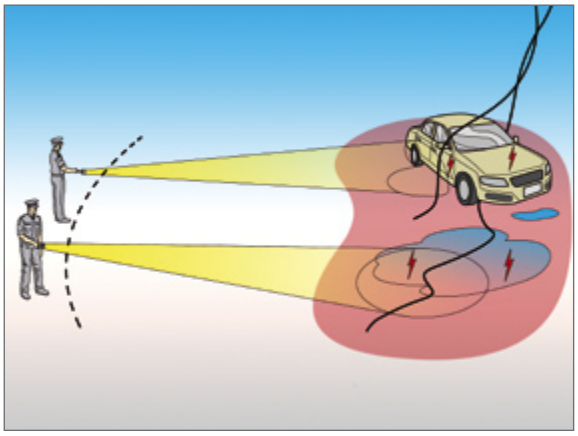

***Figure 9:*** *Visually assess for electrical hazards before approaching.*

- Immediately advise the electricity network *control room*, providing as much information as possible.

[Requests for any *electricity network company* to disconnect 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. Disconnecting electricity supply in any parts of such networks potentially affects large numbers of people and may put the safety of some at risk.]

## 7.4 Approach distances

**Treat all *electrical equipment* and all *overhead lines* as *live* until the *electricity network company* confirms they are free from electrical hazards.**

Where they are not yet confirmed free from electrical hazards, *basic electrical rescuers* and advanced electrical workers can work to the correct Table 2 *MADs* (see section 6.6) after correctly identifying the *electrical equipment* and/or *overhead lines* and having confirmed its *voltage*.

## 7.5 Urgent rescue

Occasionally, urgent response to electrical hazards may be vital to rescue in life threatening incidents, for example persons in a smouldering vehicle covered by *live overhead lines*. Only *advanced electrical rescuers* may carry out such urgent response, provided that:

a) They operate within their employer's guidelines and procedures for such urgencies;

b) They have assessed the hazards and they know the type and *voltage* of the *electrical equipment* or *overhead line*;

c) They clearly understand the electrical hazards and they have and use suitable equipment to carry out the response (up to 33 *kV* only – no such response is permissible above this *voltage*);

d) They maintain the correct *MAD* and follow the other requirements in this Guide for (Level 3) *advanced electrical rescuers*;

e) They withdraw as soon as the urgent rescue is complete, pending confirmation that the *electrical equipment* or *overhead lines* are free of electrical hazards before carrying out any further procedures.

# 8. Guidance for common incidents

In general, the guidelines in section 7 apply at all incidents involving *electrical equipment* and *overhead lines*; however, further specific guidelines in this section 8 cover the more common incidents.

## 8.1 Victim at house building or factory involving *live* overhead lines or electrical equipment

**a) *Voltages* not more than 230/400V**

For typical house or building where *voltages* are no more than 230/400V:

- First remove the electrical hazard; switch off the electricity supply by either disconnecting it at a wall socket or at the building main switchboard;
- If the electricity supply cannot be switched off, *rescuers* may drag the victim away from the electricity source by grasping their dry clothing, or kick/shove them away using footwear having *insulating* properties. Or pull the victim away using a dry *non-conductive* object, such as a wooden or plastic handled broom. Ensure any clothing item used has no *conductive* part such as a metal zip.

**b) Business or commercial property having higher *voltage* electricity supply**

Businesses or commercial property having an electricity supply of 11 *kV* or possibly 33 *kV*, and high *voltage electrical equipment* (cables, transformers or large switchboards) involve significantly greater hazard level:

- Take extreme caution;
- Apply the correct *MAD* as outlined in section 6.6;
- Only contact the victim or items involved in the electrical incident after electricity supply disconnection and confirmation it is free from electrical or other hazards.

## 8.2 Overhead line brought down by storm or fallen tree

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

## 8.3 Vehicle into pole – overhead line down but not on vehicle

*Rescuers* may safely approach the vehicle to assist provided it is well clear of any *overhead lines* or *conductive* items, at least a distance equivalent to the *MAD* for *basic electrical rescuers* (see section 6.6 Table 2). If the vehicle is closer than this distance to the *overhead lines* or to any surrounding *conductive* items, *rescuers* must maintain the correct (Table 2) *MAD* 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 doing 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.

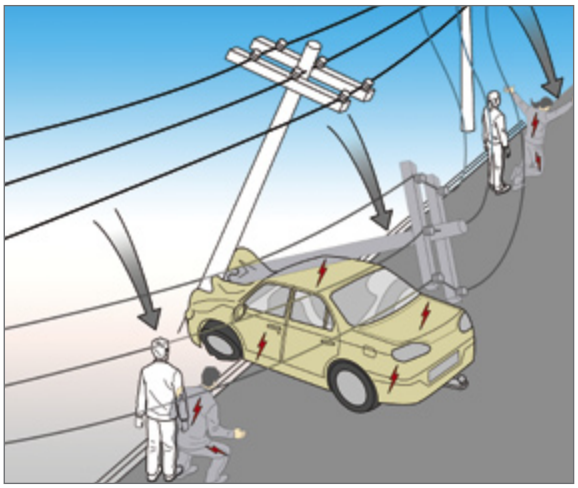

***Figure 10:*** *Following a crash, overhead lines can break and drape on the ground or on objects nearby. Overhead lines may also pull tight with risk of breaking without warning.*

## 8.4 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 *overhead line*, electric cable running up a pole, or ground mounted *electrical equipment*. The vehicle body may be *live*, and vehicles in contact pose significant step and touch hazards. Keep the correct *MAD* (section 6.6) and an equivalent distance from the vehicle and any *conductive* items, such as adjoining wire fence or water pool.

Figure 10 illustrates other hazards such as pole or conductor collapse.

Check whether the vehicle is on top of or against any ground mounted *electrical equipment* since this may also liven the vehicle. (See Figures 11 and 12).

Rubber tyres might 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*. Stay well clear; the moving vehicle may release lines 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 an instant path to earth for the electric current.

Other life-threatening risks such as fire might force an emergency evacuation 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), dry timber pallets, layers of plastic sheeting or other *insulating* materials. The occupants should exit the vehicle by jumping on to the *insulated* platform so there is no possibility of simultaneous contact with the vehicle and the ground. (See Figure 13).

*Note 1: Consider such emergency evacuations as emergency rescues and do these according to section 7.6.*

*Note 2: Improvised insulated platforms have unknown electrical insulating qualities, 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 network company representative to arrive on-site to disconnect the electricity supply.*

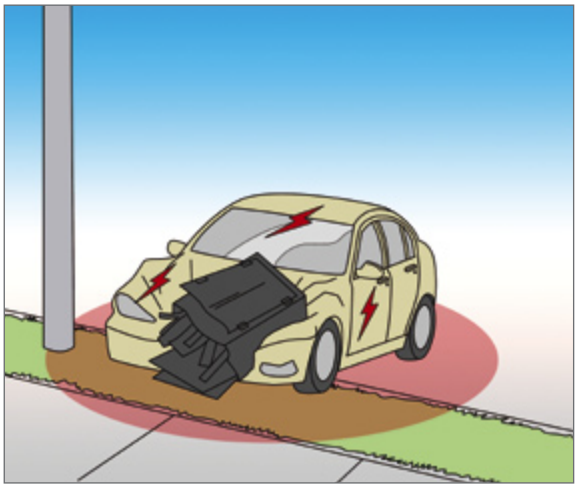

***Figure 11:*** *The whole vehicle can be live if it crushes a pillar: do not touch.*

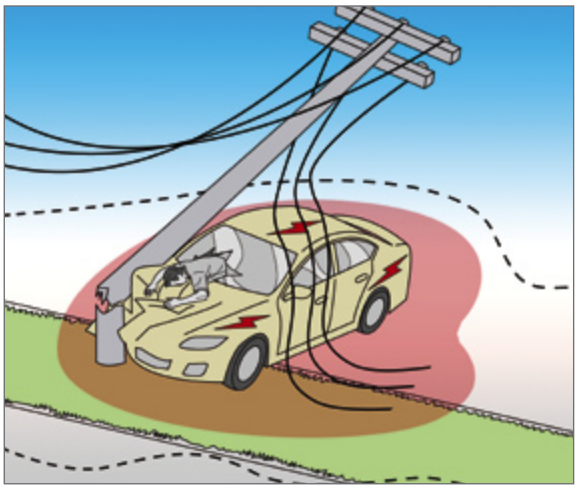

***Figure 12:*** *A vehicle in contact with lines or equipment may be live. Keep the correct distance away (see Table 2).*

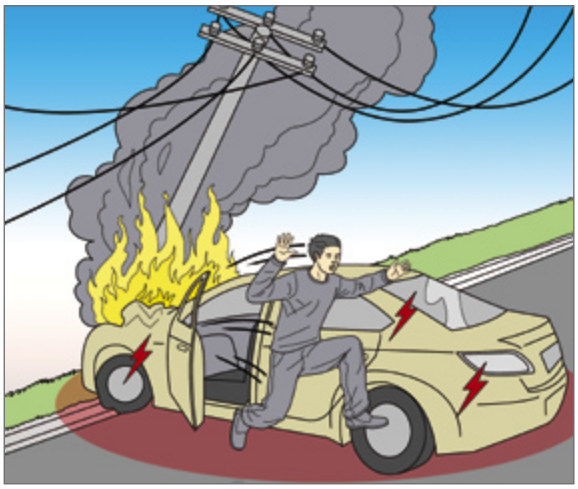

***Figure 13:*** *A driver or passenger exiting the vehicle must jump well clear.*

## 8.5 Machinery contacting overhead lines or underground cables

Transporting high loads such as buildings, cranes and raised tip truck trays occasionally contact *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 Figure 14).

- 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 correct *MAD* (see section 6.6).
- If the operator or driver is in the cab tell them to remain there until an *electricity network company* representative arrives on-site and disconnects the electricity supply.

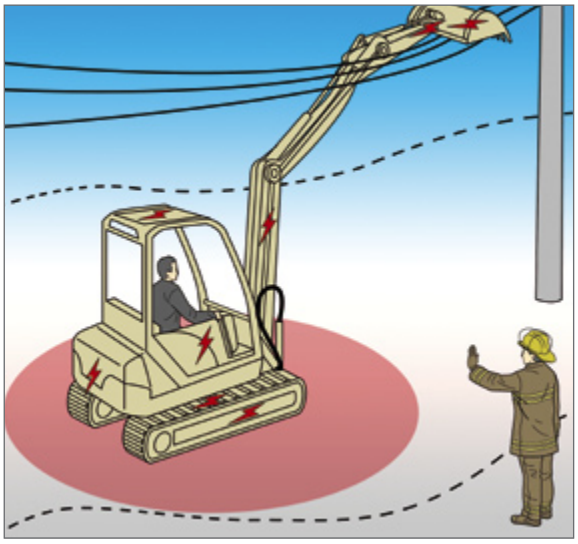

***Figure 14:*** *Where possible, the driver and any passengers should stay in the vehicle until after electricity supply disconnection.*

The first choice should always be to disconnect the electricity supply to the site 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 section 8.4.

## 8.6 Person on overhead line pole or tower.

*Emergency services personnel* should not attempt immediate rescue of any person injured and on a pole or tower, even if the *overhead line* (or lines) are taken out of service by the *electricity network company*. Electrical hazards continue from other *live* circuits on the same structure, and there are also significant fall hazards. Only trained *electricity network company* lines staff may *conduct* such rescues, including with the use of any bucket truck or cherry picker equipment.

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 network company* personnel to arrive and complete the rescue.

## 8.7 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 for people aloft are usually significantly higher than at ground level; substations include many uninsulated high *voltage conductors*.

People not trained to be in substations 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 network company* 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 electricity network *control room* and seek expert help on site as soon as possible. Once on site, the *electricity network company* 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.

## 8.8 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 section 6.5 and Figure 15). Wherever practicable, ask the *electricity network company* for a representative to disconnect the electricity supply to the incident site before fighting the fire.

When fighting a fire close to a *live overhead line*, take particular caution 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*.

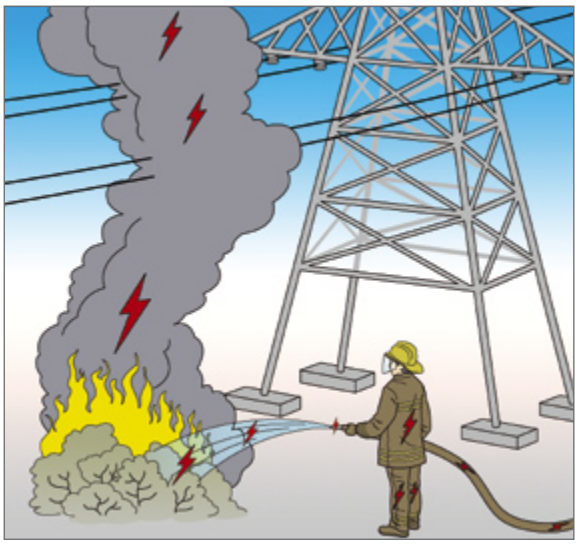

***Figure 15:*** *Electric current can arc through smoke and flames, as well as travel through water jets.*

Be aware that:

- *Overhead lines* may break and fall to the ground because of the heat from a fire;
- Timber poles, cross-arms 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;
- Ensure that any *emergency services personnel* and members of the public stay well clear of any potential fall or splatter zone.

## 8.9 Fire in a substation

All substation fires are especially dangerous, and it is necessary to develop a fire control plan with the *electricity network 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 section 8.8.

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

- 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*.

## 8.10 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 disconnected by an electrically competent person and confirmed free from electrical hazards.**

## 8.11 Other incidents

Section 8 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 network company* for advice and help before acting in any rescue or fire response that involves *electrical equipment*, or *overhead lines*.

# Appendix A: Identification of electricity distribution equipment

This Appendix illustrates examples of *overhead lines* and *electrical equipment*. These help emergency staff to identify *electricity network* items to support their communications with *electricity network companies*, particularly their *control rooms*.

**Photo 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; 11*kV* on the top crossarm and 400V on the bottom crossarm. Structures often carry telecommunications including bundled fibre optic communications lines underneath the *overhead lines*.

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**Photo 2:** Many *electricity network* poles carry some form of identification number. From this the *electricity network company* can usually tell the pole location.

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**Photo 3:** Transpower 220 *kV transmission lines*.


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

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**Photo 5:** Transpower *transmission substations* are typically large and found near major cities. Transpower substations have signs at the entry with the station name.

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**Photo 6:** Examples of outdoor *zone substations*.

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**Photo 7:** Examples of enclosed *zone substations*.

**Photo 8:** Example of pole mounted *distribution substation* (transformer).

**Photo 9:** Examples of ground mounted *distribution substation* (transformer) often housed in purpose designed kiosks.


**Photo 10:** Examples of connection points, often referred to as '*pillars*' or '*plinths*', between the *distribution network* and the customer's underground electricity service (supply).


**Photo 11:** Examples of switchgear, used to connect or disconnect specific areas of the *distribution network*.

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**Photo 12:** An example of a high *voltage* underground electric cable.

# 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 network company* name, line name, pole number, equipment ID number.
3. Advise the *electricity network company control room*:
   - Describe the damaged *overhead line* or *electrical equipment*, complete with any identifying information;
   - Ask for electricity network expert help.
4. Identify everything that might be *live*, such as car bodies, metal fences, metal roofing, pools of water, 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 network company* to arrive and make the *overhead line* or *electrical equipment* safe, before any rescue.
7. For '*rescuers*' only (see section 6.6 "Training and equipment"), where closer approach is absolutely necessary, once *electrical equipment* or *overhead lines* positively identified and *voltage* confirmed: conform to *MADs* summarised below. (See detailed *MADs* in Table 2 Section 6.6).

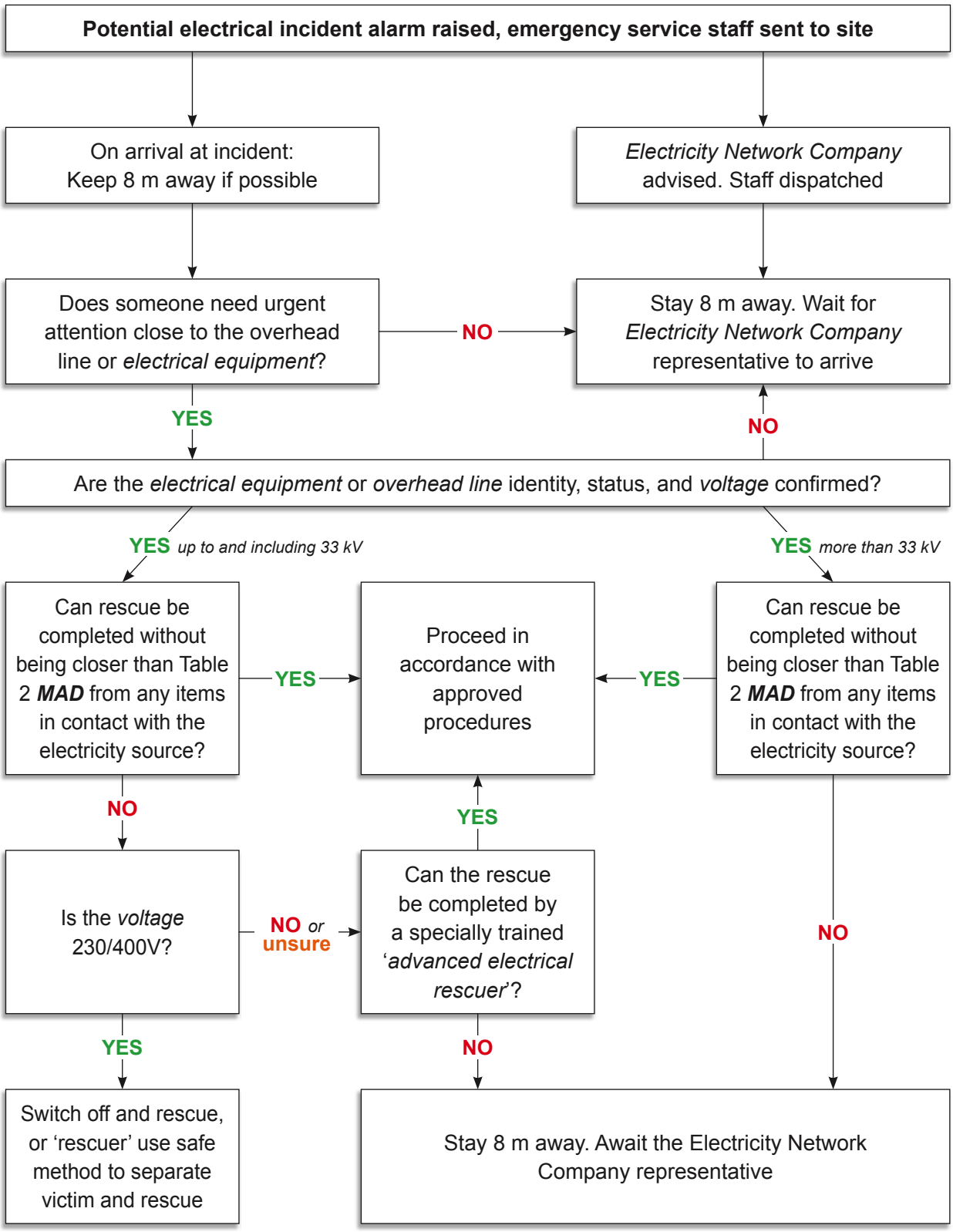
| **Voltage** | 230V/400V | Up to 11 *kV* | 22/33 *kV* | 50/66 *kV* | 110 *kV* | 220/350 *kV* |
|---|---|---|---|---|---|---|
| **MAD** | See note | 1.0 m | 1.5 m | 2.0 m | 3.0 m | 4.0 m |

   *Note. Where victim contacting no more than 230V/400V: Switch off electricity first; if impracticable to switch off, 'rescuers' only may use safe method (see section 8.1 (a)) to separate victim from electrical contact.*
8. Only '*advanced electrical rescuer/s*' can do 'urgent rescue' (see section 7.5) or other Level 3 rescue techniques (see Table 2), using suitable equipment and procedures. All other '*rescuers*' must not work nearer than the Level 2 *MAD* or try to rescue anyone in contact with anything *live* above 400V. You could be killed, or seriously burned.
9. 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 network company* to make the area safe.
10. 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*.

11. 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.
12. Electricity network substations are dangerous. Follow the pre-agreed fire control plan and only enter with help from an *electricity network company* representative.
13. Never aim fire hoses directly at *live electrical equipment* or *overhead lines*, especially bare lines. Water jets are *conductive*.
14. Fire, smoke and gasses may cause *arcing* to the ground so keep well clear.

# Appendix C:
# Brief response diagram

This diagram is a prompt only. Integrate the Guide contents into detailed procedures.



# Appendix D: Training and equipment criteria for electrical rescue

Section 6.6 outlines training responsibilities, defines the three competence levels applicable in this Guide, and specifies the minimum approach distances applicable for each. This Appendix specifies minimum training criteria for level 2 competence (*basic electrical rescuers*) and level 3 competence (*advanced electrical rescuers*).

**Level 2: Basic Electrical Rescuer Training**

*Basic Electrical Rescuers* eligible for certification to level 2 must have completed a training course and must be able to:

a) Demonstrate a clear understanding of the contents of this Guide;
b) Identify the common types of *electrical equipment*;
c) Establish the *voltage* level of *overhead lines* and *electrical equipment*;
d) Correctly apply appropriate Minimum Approach Distances (*MADs*).

**Level 3: Advanced Electrical Rescuer Training**

*Advanced Electrical Rescuers* eligible for certification to level 3 must have first been trained and certificated to Level 2, and have completed a training course in electrical hazard identification and control at distribution *voltages* up to 11*kV* or 33 *kV*.

They must be able to demonstrate:

1) An understanding of
   a) Types of *overhead lines* and *electrical equipment*;
   b) *Voltage* levels;
   c) Step and touch hazards;
   d) Line protection and reclose hazards;
   e) Electricity industry structure;
   f) *Control room* functions and protocols;
   g) What is meant by the terms: "*live*", "de-energised", "disconnected", "isolated" "tested", and "earthed".

2) The ability to safely use relevant *insulated* tools and safety equipment including
   a) Types of electrical safety equipment and tools;
   b) How they should be used, including practical demonstration of safe use;
   c) Appropriate equipment maintenance criteria, including testing.

The employing emergency services organisation is responsible for ensuring that:

a) The training is completed satisfactorily by suitably qualified trainers (*electricity network companies* may be able to suggest suitable trainers);
b) *Emergency services personnel* of all levels undertake periodic refresher training with a maximum interval of 2 years;
c) The skills learned are applied correctly at all times;
d) All equipment is correctly used, maintained, and tested as required.

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