

LPA Guidelines

Safety Guidelines for the Live Entertainment and Events Industries

Electricity Hazard Guide

February 2018

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Disclaimer

In legislative terms, the requirements of the *Work Health and Safety Act 2011* (the WHS Act) and Work Health and Safety Regulations (the WHS Regulations) are mandatory. In contrast, a guide is designed to assist obligation holders to comply with the requirements of an act or regulation. The information contained in the LPA guides is not mandatory, has no legal status and may not apply in all work situations.

Obligation holders still have a duty to assess the risks in each work situation and take all reasonable steps to eliminate or minimise the risks that are specific to each work activity.

Electricity Hazard Guide

1. Overview

This guide provides information to assist in managing risks associated with **working with electricity** in live entertainment and events. Information in this guide is based on the *Work Health and Safety Act 2011* (WHS Act) and *Work Health and Safety Regulations 2011* (WHS Regulations), which are operational in all states except Victoria and WA, where adoption of the legislation is not yet enacted (as at Jan 2018).

It is recommended that this information is referenced during the planning and delivery of events to assist in identifying hazards, assessing risks and determining appropriate control measures to eliminate and or minimise these risks, so far as reasonably practicable.

This guide does not replace the need to implement risk management strategies, undertake research or seek specialist advice.

Each worker and person conducting a business or undertaking (PCBU) has a responsibility to understand their obligations under WHS legislation. Codes of practice and Australian and international standards provide approved guidance on how to meet work health and safety obligations.

An electrical hazard can cause death (electrocution), electric shock, burns, and nervous and muscular system injuries. Electrical hazards can also result in arcing, explosion and fire. Electrical hazards can lead to blackouts, creating flow-on health and safety risks to workers and patrons.

There are some additional complications because electricity cannot be seen; electric shock can be received by direct and indirect contact, by unintentionally energised (live) equipment, misuse or incorrect operation of equipment, or by not following established safe work procedures.

The risk of injury from electricity is strongly linked to where and how it is used. The risks are greater when working in outdoor or in wet environments, with portable equipment, with custom made equipment and props, or with equipment that can be damaged through high frequency use and movement.

This Electricity Safety Guide provides practical information and suggested control measures for:

- General electricity
- Electrical equipment
- Electrical leads and cables
- Licensed work
- Isolation
- Operations and maintenance
- Power supply
- Testing

For general information on duties, obligations and risk management please refer Part 1. Safety Guidelines for Live Entertainment and Events (Audience and Crowd Management Hazard Guide)

2. Key Considerations

The following questions must be considered during event design, planning and delivery. Use them to identify hazards and plan how risks will be managed.	Yes	No	Action/Comments
2.1. Design and planning			
<i>Has the scope of work (duration, equipment, scheduling, location) been clearly defined?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Have other PCBUs and workers who will be affected by this activity been identified?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Have arrangements been made to consult with and coordinate activities with other PCBUs?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Have all site/venue specific safety requirements or procedures been considered?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>If installing temporary power, has the relevant state regulator/local government organisation been contacted to check what safety certification is required?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Is electrical safety a requirement of site/venue induction?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Will the potential electrical load be within the limits and design of the power supply/circuit?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Have locations of all electrical equipment and cables been determined?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are safety procedures in place for workers working near overhead power lines?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are power supplies suitable for the location and positioned safely?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Will there be a requirement for an ongoing electrical maintenance program?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Has machinery/equipment that may expose workers to electrical risk been identified?</i>	<input type="checkbox"/>	<input type="checkbox"/>	

The following questions must be considered during event design, planning and delivery. Use them to identify hazards and plan how risks will be managed.	Yes	No	Action/Comments
2.2 Event Delivery			
<i>Have the people working with electricity been given information, instruction and training?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are residual current devices (RCDs) labelled and tested?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are plugs, sockets in good condition?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Have power boards or piggy-back plugs been used in preference to double adaptors?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are cords of suitable length for their intended use?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are switchboards labelled correctly and protected from damage?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>A check has been conducted to ensure that no aerial cables are fixed or attached to scaffolding?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Has all electrical equipment and cables been inspected, tested and tagged in accordance with AS/NZ 3760?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are extension cables protected from water, and from being damaged or cut?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are electrical installations suitably protected from damage that would increase the risk of electrical shock or fire?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Do extension cables have either moulded or transparent type plugs/sockets attached?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Are light fittings suitable for the location and protected from breakage?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Is all portable electrical equipment protected by RCDs?</i>	<input type="checkbox"/>	<input type="checkbox"/>	
<i>Has a check been conducted to ensure that extension cables and connections DO NOT prevent access to emergency response equipment?</i>	<input type="checkbox"/>	<input type="checkbox"/>	

3. General Guide – Electricity

3.1 Responsibilities

The Work Health and Safety Regulations impose specific requirements on PCBUs concerning electrical work, including to:

- Manage any electrical risks
- Ensure workers receive adequate training so as to work safely with electrical equipment
- Inspect, test and tag electrical equipment at the workplace
- Disconnect and replace or remove unsafe electrical equipment
- Use and test appropriate residual current devices
- Follow conditions for work carried out on energised electrical equipment and cables

Duty holders may also have additional responsibilities under state electrical safety regulations.

3.2 Training and competence

Different licensing and competency requirements apply across Australian states and territories. Responsible persons should check with their state electricity regulator to clarify what type of licence is required. Broadly, the following requirements apply for each task/activity:

- **Inspect, test and tag electrical equipment and cables** Inspection and testing of electrical equipment must be carried out by a competent person – someone who has acquired the knowledge and skills to carry out the task through either training, a qualification or experience. The unit of competency '*UEENEEP026A Conduct in-service safety testing of electrical cord connected equipment and cord assemblies*' is the minimum benchmark for persons conducting or supervising this type of work.
- **Electrical cable plug and socket repair** Electrical plugs and sockets may be replaced by a non-electrically licensed person provided the person has been trained, assessed and found to be competent to fit plugs and sockets according to the manufacturer's instructions. The unit of competency '*UEENEEP024A Attach cords and plugs to electrical equipment for connection to a single phase 230 Volt supply*' is the minimum recommended benchmark for persons conducting or supervising this type of work.
- **Electrical equipment repair and maintenance** The repair and maintenance of electrical equipment must be carried out by a competent person – someone who has acquired the knowledge and skills to carry out the task through either training, a qualification or experience. The Restricted Electrical Worker's Licence (Class C) allows a person to disconnect and reconnect low voltage (under 1000v AC / 1500v DC) electrical equipment or components for the purpose of repair, replacement or maintenance.
- **Work on energised electrical equipment and cables** This is an extremely high risk activity and is restricted to a Licensed Electrician, Registered Electrical Contractor, or Qualified Electronic Technician. This activity must be thoroughly risk assessed with a range of controls introduced. Further to this, a 'rescue from live electrical apparatus' plan must be in place prior to commencement of work.

3.3 Consultation, co-operation and co-ordination

The WHS Act makes consultation with workers a legal requirement. Consultation, cooperation and coordination between PCBUs is a requirement where they share a duty for the safety of a worker or for work to be done.

All PCBUs have a duty to consult, co-operate and co-ordinate with all other PCBUs and workers involved in the activity. They should use the information in this guide to consult with workers including event staff to determine the electrical hazards and risks associated with an event and how to best eliminate or minimise these risks using the hierarchy of controls.

Consultation should start as early as possible, before decisions are made, and continue through the duration of the event.

Consider the other parties who will need to be involved in the consultation process in the planning stages of the event and determine what information needs to be shared and discussed.

During an event, PCBUs are required to consult, co-operate and co-ordinate with other PCBUs such as the venue or site management, unions, production companies, designers, event organisers or promoters, catering providers, security, subject matter experts (e.g. registered electricians or safety officers), local authorities or governments, rigging companies, performers, suppliers of plant or equipment.

If employees are represented by health and safety representatives, the consultation must involve those representatives.

Areas to address during consultation may include induction, schedules, floor plans, set elements, lighting and sound designs, site specific requirements, risk assessments, SWMS, hazards and control measures, legislative requirements, licences, plant movement, traffic management, exclusion zones, key contacts, emergency procedures, permits to work etc.

Opportunities for consultation include at toolbox talks, event briefings, site inspections, and stakeholder meetings, post event reviews, working groups or forums.

3.4 Design and planning

In the early stages of design and planning for an event, the following criteria should be addressed when planning to work with electricity:

- Consultation with relevant PCBUs and workers
- Consultation with all departments that will require electrical power
- Development of risk assessments and SWMS including controls agreed to during consultation
- Selection of the plant and equipment required to complete the task
- Agreed scheduling and allocation of resources to minimise impact on others
- Access to site and delivery logistics
- Maintenance programs
- IP rating requirements for outdoor electrical equipment and cable
- Location and accessibility of power supplies/source(s)
- Maximum capacities of power supplies/source(s)
- Circuit and phase load calculations

- Rating of cables and connectors for maximum load requirements
- Licensing requirements to connect and disconnect temporary mains supply
- Type and capacity of mobile generators
- Type and capacity of uninterruptable power supplies
- Cable routes/runs and management strategies
- Emergency procedures for rescue from energised electrical apparatus

3.5 Event delivery

In the delivery stages of an event (bump-in, rehearsal, show, bump-out) the following criteria should be addressed when undertaking work with electricity:

- Consultation with relevant PCBUs and workers
- Site-specific inductions
- Equipment inspections and/or maintenance
- Work permits or engineering certificate requirements
- Implementation and monitoring of controls identified in risk assessments or SWMS
- Enforcing compliance to legislative requirements
- Reviewing, consultation and adjusting control measures as required on site
- Incident reporting and management
- Communication procedures
- Sign-off and handover procedures

3.6 Review

After an event, the following criteria should be reviewed in consultation with relevant parties:

- Incident reports and outcomes including near-misses.
- Effectiveness of the control measures
- Scheduling
- Areas for improvement
- Incidents of non-compliance
- Any new hazards or risks identified

3.7 Documentation and records

The following documents and records should be created, maintained and kept on site when working with electricity during an event:

- Risk assessments and SWMS
- Training records, certificates of competency and licences
- Induction records
- Toolbox talk topics and attendance
- Evidence of consultation
- Incident reports, including near-misses
- Maintenance records
- Engineering certification, work permits and sign-off records
- Power calculations and circuit loadings

Any of the above documents could be requested to be sighted by other PCBUs for verification or clarification and should be available at all times. Some WHS documents and records need to be retained for a specific period of time – see relevant WHS legislation for details.

3.8 Reporting

Electrical incidents require notification to the state/territory electrical regulator and safety regulator. Organisations and specific events will have differing reporting channels, which must be made clear to all workers, contractors and PCBUs ahead of time. Workers must report ALL electrical shocks or accidents to their employer, involving the relevant Health and Safety Representative, where they exist.

3.8.1 Reporting to the state/territory safety regulator

All electrical shock injuries are notifiable to the state and territory safety regulator, except those resulting from extra low voltage (<50v AC, <120v DC). Near misses are also reportable – that is where such injury could have occurred had a person been present. The regulator should be notified immediately.

In such circumstances the worksite must not be disturbed.

In the event of a person being killed this must be reported immediately by telephone. The PCBU must ensure that the worksite (area) is not disturbed.

Serious risks to public safety must be reported.

3.8.2 Reporting to the electrical supplier/regulator

In Tasmania, New South Wales, Queensland, only electrical accidents and events requiring medical attention require notification to the electrical supplier. In all other jurisdictions, all electrical incidents or events must be reported to the network supplier (energy company) and/or electricity regulator. Always confirm with the state and territory safety regulator who else needs to be notified after making the first contact following an incident.

An event that causes significant damage to property must also be reported, as this would be classified as a 'near miss' or a 'dangerous incident'.

3.8.3 Multiple PCBU reporting

At a site where multiple PCBUs are operating, each PCBU must ensure that a 'notifiable incident' is reported. PCBUs should clarify who is responsible for reporting. This may be the event manager, site safety officer, or persons undertaking such duties, or the employer.

4. Suggested Control Measures

4.1 General electricity

Almost every event will require electrical power of some form or another. It is important that electricity is carefully risk managed at all times due to the serious consequences that may result.

4.2 Electrical equipment

All equipment must be well maintained and must not be used if it appears faulty.

Workers must be trained in conducting routine inspection and must clearly understand how to report worn, faulty or damaged equipment.

Unsafe equipment must be disconnected or isolated.

'Out of service' ('lockout') tagging procedures must to be understood. 'Return to service' procedures should be understood and include testing of equipment prior to use.

All equipment and cables must be inspected, tested and tagged in accordance with AS/NZ 3760. Testing frequency must be determined with respect to WHS regulations, state regulations and taking into account conditions of use. Appropriate records must be maintained.

4.2.1 Lighting Fixtures and Dimmers

Lighting equipment likely to reach high temperature must be suitably guarded with a clearance maintained from flexible cords to prevent overheating and melting.

To avoid overloading and a consequent fire hazard, maximum loads of lighting dimmers must not be exceeded.

Lighting designers or persons designing a temporary lighting system require knowledge and understanding for the capacity of the available power supply. In designing a system and the layout of equipment, the capacity of cabling should also be considered. Dimmer and phase loading plus size of lighting equipment should be carefully planned with a load diagram for the system.

4.2.2 Portable equipment

Portable electrical tools/appliances must be protected by RCDs, or when incompatible (e.g. dry ice machines) protection must be provided by current protection on the distribution board.

4.3 Leads and cables

During the planning stage, decisions will need to be made as to which type of cable management system is to be used. For example a cable tray may be more appropriate than the use of centenary wire to travel the cable overhead.

The use of socket adaptor plugs (piggy backs) must be carefully managed and only used in the way they are designed.

Cable routes need to be carefully planned pre-event. Cable management may be required for protection against sharp edges and heavy loads. Any protection should be conspicuously marked to avoid trip hazards.

Cable connections and joins need to be secured and protected, especially in outdoor environments exposed to weather. It may be necessary to fit appropriate weatherproofing and elevate the cable connection to prevent exposure to moisture/water.

Cables should be selected to minimise excess length. Any excess length on power cables should be coiled in a 'figure 8' pattern so as to dissipate any heat build-up and help reduce induction.

When managing excess power cable on a truss or bar the cable should be run-out along the structure and double-backed on, so as to dissipate any heat build-up and help reduce induction, rather than coiled or wrapped around the structure.

Once the installation of cables is complete, it is best practice to do a walk-through of the work site to see if any heavy duty rubber mats or extra signage are required to avoid trips.

All leads and cables must:

- Be tested and tagged in accordance with AS/NZ 3760
- Be of industrial quality
- Be protected from weather
- Be secured and clearly identified
- Be protected from sharp edges and heavy loads, including during transport
- Have ends covered with plastic protective covers
- Have any excess coiled in a 'figure 8' configuration
- Be stored so they will not be damaged
- Not be frayed or have wiring exposed
- Not be twisted, crushed or kinked
- Not create a tripping hazard
- Not be in contact with cranes or overhead mobile plant and equipment

Be off the ground, or if not possible, protected from damage, weather and tripping with suitable cable covers

4.4 Licensed work

Work that is undertaken on an electrical installation or equipment (except extra low voltage – <50 v AC or 120 v DC) must only be undertaken by competent and licensed or registered electricians.

Before working on any electrical equipment it must be isolated, tagged and checked. For work on energised electrical equipment – the safe work procedure 'TEST FOR 'DEAD' BEFORE YOU TOUCH' must be applied at all times. WHS Regulation 161 requires that all electrical work on energised electrical equipment is carried out in accordance with a safe work method statement (SWMS).

4.5 Isolation

Exposed wiring or any electrical item in need of repair or maintenance or should be isolated from its power source. For example, when replacing a globe in a lighting fixture, it must be unplugged locally from its power source. This also applies to distribution boards. Circuit breakers may need to be tagged out to protect personnel working downstream.

4.6 Operations and maintenance

All workers must be aware of their responsibilities with regard to electrical safety, through induction, ongoing training and appropriate supervision. Manufacturer's instructions must be followed. Instructions and operating manuals should be available and accessible to workers using equipment.

All outlets must be considered live/energised unless proved dead (de-energised).

Conducting materials such as earth, concrete, wet/damp timber, flames, all metal objects such as rulers, tapes, rings and belts and including yourself must, as far as possible, be removed from contact with any electrical work.

Double adaptors or rewireable three-pin piggy-back plugs must not be used.

The use of moulded or clear, riveted (not user accessible) piggyback plugs is acceptable only when wired by competent, appropriately trained, authorised personnel.

Ladders intended for electrical use must be used. In practice only ladders made from non-conductive materials such as fibreglass should be used for work around live electrical equipment.

4.7 Power supply

Ensure all power distribution systems are energised in steps, starting at the main power supply and flowing down stream through each distribution point until the last device is reached.

Ensure all power distribution systems are de-energised in steps, starting at the last device, back through each distribution point and ending at the main power supply.

Prior to energising or de-energising a distribution system, ensure all co-workers are informed that the distribution system is 'alive' or 'isolated'.

Check supply boards annually. Thermal imaging while under load is a good way to assure the board is safe.

Ensure all contractors and staff are aware of and adhere to power load allowances.

At outdoor events, mains power must be Earth protected and all power supplies be fitted with RCDs including the electrical grid, portable distribution boards, electrical panels etc. Production electrical distribution devices (tie-ins or tails) must only be installed, removed or handled while the mains/generator power is isolated. Ensure that the electrical grid is effectively isolated from mains or generators while any electrical equipment is installed or removed. Danger tagging and physical isolation of mains/generators outlets and mains controls must occur while works along the power grid are being undertaken.

All switchboards must be of robust weatherproof construction and have a locking device, protective doors that will not damage flexible extension cords, securely fixed to a structure and be locked after work each day/shift. All temporary switchboards must additionally have an isolating switch.

All power lock mains and power distribution systems used for temporary power must be installed off the ground, out of water and protected from the elements.

State regulators and some local government organisations require safety certification for temporary power installation. Checks are required during planning to assure which specific licences may be required to perform certain tasks or installations.

A secure (fenced) location should be provided for portable generators, including the fuel source. Work procedures must ensure inhalation of fumes and fuel spillage hazards are managed. A silencer may be required to manage noise. Whenever power lock cables are installed it is best practice to install the earth first. When disconnecting, the earth should always be left in until all the other colours have been disconnected.

The WHS Regulations have additional specific requirements for regular testing of electrical equipment used in a 'hostile operating environment' (outdoor, exposure to moisture, heat, vibration).

5. Legislation, Standards and Guidance

Safe Work Australia (2012) *Managing Electrical Risks in the Workplace Code of Practice 2012* Safe Work Australia *Fact Sheet: Electrical Risks at the Workplace*

Workcover NSW Low Voltage Electrical Work Code of Practice Worksafe Victoria – *Electrical installation on construction sites*

5.1 Australian and New Zealand Standards

AS/NZS 2978 *Insulating mats for electrical purposes.*

AS/NZS 3000 *Electrical installation (Australian/NZ Wiring Rules)*

AS/NZS 3100 *Approval and test specification – General requirements for electrical equipment*

AS/NZS 3017 *Electrical installations – Verification guidelines*

AS/NZS 3190 *Approval and Test Specification – Residual Current Devices*

AS/NZS 3760 *In service safety inspection and service of electrical equipment*

AS/NZS 3820 *Essential safety requirements for low voltage equipment*

AS/NZS 4836 *Safe working on or near low-voltage electrical installations and equipment*