

## Technical solution sheet 5.1

# Working safely during solar installations – Electrical risk



### What are electrical risks?

Electrical risks are hazards to a person that can cause electric shock, electricity-related injuries, or death.

Solar panels exposed to solar radiation produce voltage at their output terminals – a person working near solar panels during daylight hours or under strong sources of artificial light is always engaging with live electrical equipment.

This is part of a series developed with Energy Safe Victoria to help Solar Homes Program installers work safely in the solar industry.

Use this sheet and others in this series to plan safe ways of working with electrical risks while installing solar systems.

#### In series 5:

- 5.1 **Working safely during solar installations – Electrical risk** (*this sheet*)
- 5.2 Electric shock and electrocution
- 5.3 Isolation of electrical equipment

See:  
[solar.vic.gov.au/safety-and-quality](https://solar.vic.gov.au/safety-and-quality)



### Planning a safe approach to managing electrical risks

Solar workers such as registered electrical contractors (REC), licensed electrical workers (LEW) and licensed electrical inspectors (LEI) have a primary duty under the Victorian *Occupational Health and Safety Act 2004* to ensure, so far as is reasonably practicable, that workers, apprentices and other persons at a workplace are not exposed to electrical risks while undertaking photovoltaic (PV) system installations, testing, commissioning, repairs or rectification work.

These duties include, but are not limited to:

- » ensuring workers are appropriately trained in working at heights, working in ceilings spaces, installing, and commissioning PV systems and Battery Energy Storage Systems (BESS)
- » making sure that only licensed electrical workers carry out electrical installation work, and that all persons conducting PV system installations are inducted into a well-developed safety management plan
- » developing and following a risk assessment process for each task, including at the start of each installation and task change
- » completing a safe work method statement (SWMS) before undertaking high-risk construction work (HRCW).

### The four-step risk management process

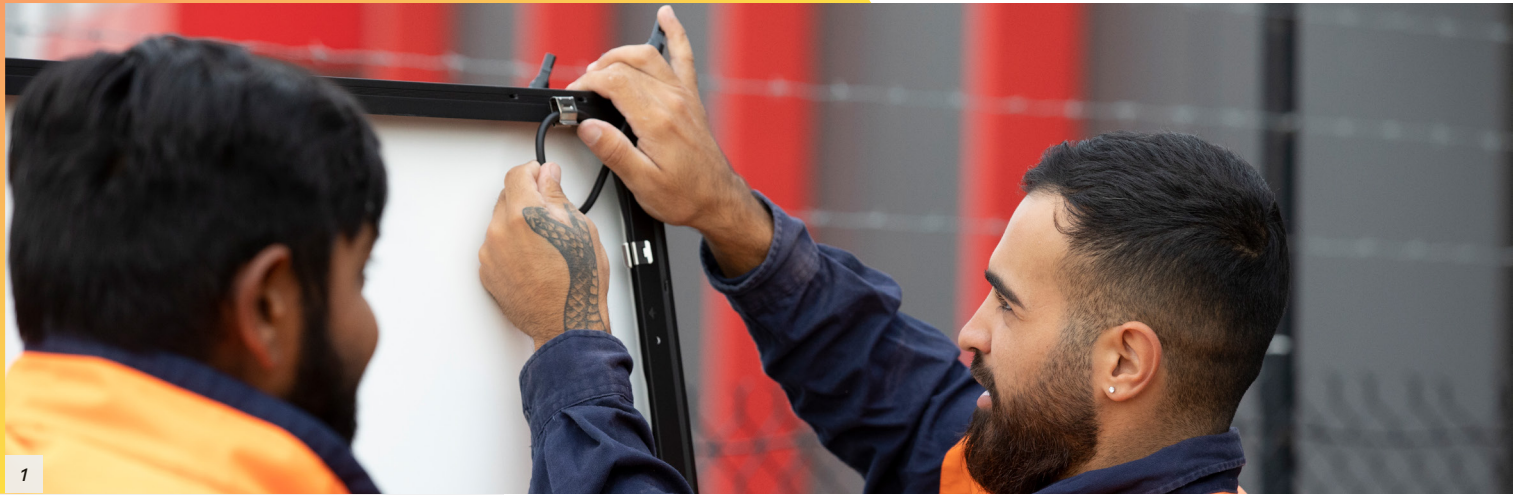
Follow this four-step risk management process to ensure hazards are identified, risks are assessed and controlled, and that employers fulfil their duty to monitor, review and revise controls when required.

Figure 1: The four-step risk management process.



Image captions:

- 1: Preparation of panel connections
- 2: Ensure correct isolation of equipment during installation activities.
- 3: Verification testing of installed system.
- 4: Ensure appropriate task-dependent Personal Protective Equipment (PPE) is available for workers.



1

### Step 1: Identify hazards

The first step in the risk management process is to identify electrical hazards. The most common electrical hazards during the installation of PV systems are:

- » electric shock and electrocution by direct or indirect contact, tracking through or across a conductive medium such as metal guttering or roof sheeting
- » fire or explosion from arcs and sparks when high fault currents are present
- » electric shock caused by contact with overhead conductors
- » electric shock caused by step or touch potential
- » toxic fumes/gas from burning and arcing of solar cells, which contain chemicals that can be harmful if inhaled
- » electric shock, toxic fumes, explosive gases, fire risks and chemical exposure risks of Battery Energy Storage System (BESS) installations
- » energisation of wires or other electrical equipment.

### Step 2: Assess risks

Prior to commencing any installation, a risk assessment must be performed to determine the potential hazards associated with any tasks where energised systems or working at heights are factors.

As a solar worker engaged in high-risk construction work, you will need to prepare a safe work method statement (SWMS). A SWMS is a safety planning tool that identifies the hazards and risks and documents the control measures necessary to manage those risks.

The SWMS should describe to workers in clear terms how risks from the work will be effectively controlled to enable the work to be safely undertaken. Consultation with workers and sub-contractors is a vital part of the SWMS preparation process with better results being achieved through a collaborative process of risk assessment and control measure design.

See the WorkSafe website for more information on when and how to complete a SWMS for construction activities: [worksafe.vic.gov.au/resources/safe-work-method-statements-swms](https://www.worksafe.vic.gov.au/resources/safe-work-method-statements-swms)

While assessing the risks, solar workers should consider that:

- » The electrical risk associated with making incorrect connections, such as with panel-to-panel connectors, may cause serious shock resulting in death, injury, or significant property damage.
- » Even fleeting contact with electricity at 50 volts for alternating current (V a.c.) or 120 volts for direct current (V d.c.) can cause death, contact burns and damage to internal organs.
- » Working at heights and near electricity, such as on roofs or in ceiling spaces, presents major risks to workers, and electric shocks from faulty electrical equipment may lead to electricity-related injuries, such as falls from ladders, scaffolds or elevating work platforms.
- » Other symptoms related to electric shock may include muscle spasms, palpitations, nausea, vomiting, and unconsciousness.
- » Workers carrying out work on or near energised systems may not be the only ones at risk—faulty electrical equipment and poor electrical installations can lead to fires that may also cause death or injury to others



2



3



4



### Step 3: Control risks

Once the electrical risks have been identified and assessed, control measures aimed at eliminating the risk must be put in place.

If it is not reasonably practicable to eliminate a risk associated with electrical exposure, solar workers must reduce the risk by implementing the highest level of risk control, or a combination of risk controls. Use the hierarchy of control to determine the best control measures.

Never work live! Always isolate equipment and circuits before carrying out any electrical work. Solar installations contain d.c. circuits which are not provided with overload or short circuit protection and can present a higher risk of arc-over.

Always ensure at least one d.c. connector in every individual PV string remains disconnected at the PV array while d.c. isolator and inverter terminations are completed. This ensures the d.c. circuit remains 'open' and does not create a risk of shock from d.c. voltages.

Health and safety should never be compromised. See AS/NZS 3000 The Australian/New Zealand Wiring Rules and AS/NZS 4836:2011 Safe working on or near low voltage electrical installations and equipment for more information about LOTO and taking adequate precautions to eliminate risks.

Table 1 Hierarchy of control for the prevention of electrical risk.

Control level	Hazard control description	Example
1	<b>Eliminate the risk completely</b>	<ul style="list-style-type: none"> <li>» Ensure equipment is de-energised, turn off and isolate – Lock Out Tag Out (LOTO) – all electricity being supplied to the property at the main switchboard, and take steps to prevent the electricity from being turned back on while work is in progress.</li> <li>» Decommission unsafe equipment.</li> </ul>
2	<b>Change the workplace or the work</b>	<ul style="list-style-type: none"> <li>» Replace a hazardous process or equipment (e.g., use a battery-operated tool rather than a tool that is plugged into the 230V a.c. mains).</li> </ul>
3	<b>Use a work positioning system</b>	<ul style="list-style-type: none"> <li>» Use insulation and guarding where possible.</li> <li>» Protect power circuits with appropriately rated fuses or circuit breakers to prevent overloading.</li> <li>» Where portable electrical equipment can be connected, ensure circuits are protected by appropriately rated RCDs.</li> <li>» Establish exclusion zones.</li> </ul>
4	<b>Administrative management controls</b>	<ul style="list-style-type: none"> <li>» Provide information, instruction, training and supervision.</li> <li>» Obtain licences and permits as required.</li> <li>» Schedule testing, tagging and maintenance of equipment.</li> <li>» Use Danger/Out of Service tags.</li> <li>» Arrange extension leads so they will not be damaged, run across floors, sharp edges or through doorways.</li> <li>» Document and use Standard Operating Procedures (SOPs) where required.</li> <li>» Use warning signs.</li> <li>» Develop emergency plans for use in the event of an electrical incident (e.g. when conducting HRCW).</li> </ul>
5	<b>Provide personal protective equipment (PPE)</b>	<ul style="list-style-type: none"> <li>» Provide workers with appropriate safety equipment (e.g. eye protection, insulated gloves, safety footwear, suitable clothing, hard hats).</li> </ul>



### Step 4: Review and revise controls

An employer has a duty to review and, if necessary, revise control measures:

- » when proposing alterations to any plant or system of work that is likely to result in an electrical risk
- » after a notifiable incident has occurred
- » if a new hazard or risk is identified
- » if the control measures are deemed to be inadequate
- » if consultation with workers indicates the necessity for a review
- » at the request of a Health and Safety Representative

Review and revision are a vital step in ensuring control measures are adequate and being properly applied. Your review activities must also include testing of electrical equipment such as portable socket-outlet assemblies (PSOA) and power tools to identify obvious wear and damage, checks to ensure administrative risk controls are being properly applied by employees, and continued consultation with employees to ensure new risks are identified and controlled.

Solar workers should keep records of electrical safety maintenance programs, including any testing and tagging of equipment. These records should remain available for review, inspection and investigation purposes.

For more information on industry requirements for testing RCDs and electric appliances used on construction sites, see Electrical installations at construction sites: Industry standard: [worksafe.vic.gov.au/resources/electrical-installations-construction-sites-industry-standard](https://www.worksafe.vic.gov.au/resources/electrical-installations-construction-sites-industry-standard)

**Note:** Always carry out the mandatory verification testing of the electrical installation in accordance with AS/NZS 3000 Section 8 and test and commission in accordance with AS/NZS 5033:2021 *Installation and safety requirements for photovoltaic (PV) arrays* and AS/NZS 4777.1:2016 *Grid connection of energy systems via inverters installation requirements*, as documented in the Clean Energy Council commissioning checklist.

## Important resources

See the Energy Safe Victoria website for legislation and regulations: [esv.vic.gov.au/about-esv/energy\\_regulatory\\_framework/legislation-and-regulations](https://esv.vic.gov.au/about-esv/energy_regulatory_framework/legislation-and-regulations) including:

- » *Electricity Safety Act 1998*
- » Electricity Safety (General) Regulations 2019.

See also:

- » *Occupational Health and Safety Act 2004*: [legislation.vic.gov.au/in-force/acts/occupational-health-and-safety-act-2004](https://legislation.vic.gov.au/in-force/acts/occupational-health-and-safety-act-2004)
- » Occupational Health and Safety Regulations 2017 (OHS Regulations): [legislation.vic.gov.au/in-force/statutory-rules/occupational-health-and-safety-regulations-2017](https://legislation.vic.gov.au/in-force/statutory-rules/occupational-health-and-safety-regulations-2017)

Standards:

- » AS/NZS 3000:2018 *The Australian/New Zealand Wiring Rules*.
- » AS/NZS 3760:2022 *In-service safety inspection and testing of electrical equipment and RCD's*.
- » AS/NZS 3017:2022 *Electrical installations – Verification by inspection and testing*.
- » AS 4509.1:2009 *Stand-alone power systems Safety and installation*.
- » AS/NZS 5033:2021 *Installation and safety requirements for photovoltaic (PV) arrays*.
- » AS/NZS 5139:2019 *Electrical installations – Safety of battery systems for use with power conversion equipment*.
- » AS/NZS 4777.1:2016 *Grid connection of energy systems via inverters installation requirements*.
- » AS/NZS 4836:2011 *Safe working on or near low-voltage electrical installations and equipment*.

## More information

Call Energy Safe Victoria on 03 9203 9700 (option 2) or 1800 800 158 or email [info@energysafe.vic.gov.au](mailto:info@energysafe.vic.gov.au) [energysafe.vic.gov.au](https://energysafe.vic.gov.au)

Call WorkSafe on 1800 136 089 or email [info@worksafe.vic.gov.au](mailto:info@worksafe.vic.gov.au) [worksafe.vic.gov.au](https://worksafe.vic.gov.au)

Call TechSafe Australia on 03 8558 0100 or email [techsafe@techsafe.com.au](mailto:techsafe@techsafe.com.au) [techsafe.com.au](https://techsafe.com.au)

For more information about Solar Victoria's commitment to safety and quality, including training and workforce development, see: [solar.vic.gov.au/industry](https://solar.vic.gov.au/industry)

## Community languages



To speak with us in your language, please call the free National Translating and Interpreting Service on 131 450.

## Accessibility

If you would like to receive this publication in an alternative format, please contact Solar Victoria at [comms@team.solar.vic.gov.au](mailto:comms@team.solar.vic.gov.au)

This document is also available online at [solar.vic.gov.au](https://solar.vic.gov.au)

© The State of Victoria Department of Energy, Environment and Climate Action 2024.

### Disclaimer

This publication may be of assistance to you but the State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.