

Arc flash hazard management

Focus group: owners and operators of High Voltage, Complex and Low Voltage installations with a rated current of 800Amps or greater (High Current)

Guideline

Who we are

Energy Safe Victoria (ESV) is the independent technical and safety regulator responsible for gas, electricity and pipeline safety in Victoria. Part of our role is to ensure all electrical work is conducted safely and to enforce Victoria's electrical safety legislation.

WorkSafe Victoria is the state's occupational health and safety regulator. Our role is to prevent workplace injuries, illness and fatalities, and to enforce Victoria's occupational health and safety legislation.

Introduction

High Voltage (HV), Low Voltage (LV) High Current and Complex electrical installation owners and operators need to take particular account of and manage their arc flash/fault hazards. This does not preclude owners and operators of other installations from the need to manage these risks.

Recent incidents in the electrical industry have given ESV and WorkSafe cause for concern. This guideline has been developed to provide owners and operators of HV, LV High Current and Complex electrical installations with information about the factors that need to be considered and the overall need to understand and manage arc flash hazards.

An arc flash is a serious hazard that has the potential to cause death, serious injury, damage to equipment and loss of electrical supply. An arc flash could be considered as an unexpected and violent, electrical short circuit in the air that produces an arc and associated explosions of gases and molten metal.

Arc flash incidents occur when low impedance electrical connections are inadvertently made across phases, phase to neutral or from phase to earth. These connections can occur by accidental contact across terminals from tools or equipment, a breakdown in insulation or from a build-up of contaminants such as carbon or dust. Most arc flash incidents occur when high risk activities, such as operating or racking of circuit breakers are being carried out, however arc flash incidents can occur at any time.

It is commonly assumed that substantial arc flash incidents only occur in HV situations, however, it is important to understand that these incidents can and do occur in LV installations due to high fault currents.

Owners and operators of electrical installations that are HV, LV High Current and Complex in nature should be managing their arc flash hazards.



Owners, operators and employers responsibilities

Owners, operators and employers must provide and maintain a working environment for their employees that is safe and free of risks to health so far as is reasonably practicable.

Regulations 501 and 502 of the Electricity Safety (General) Regulations 2019 outline the duties of owners and operators of HV and Complex installations. These regulations include, but are not limited to, the following requirements:

Owners and operators must ensure that:

- the electrical installation is safe and maintained and operated safely
- any person operating the HV or Complex electrical installation has a standard of qualifications, proficiency and experience that enables that person to safely perform their function
- any person operating or maintaining the HV or Complex electrical installation has written operating and maintenance procedures that describe the methods of operation, maintenance, earthing, isolation, energisation and de-energisation of the complex electrical installation
- any person operating or maintaining any part of the HV or Complex electrical installation is trained, authorised and instructed to perform the work on the complex electrical installation in accordance with the owner or operator's operating and maintenance procedures
- any person working on or near the installation complies with the provisions of the Blue Book.

This does not diminish or underestimate the need to manage potential arc flash hazards for other installation types.

Under the *Occupational Health and Safety Act 2004*, employers must provide and maintain a working environment that is safe and free of risks to health, so far as is reasonably practicable.

They must also provide and maintain safe systems of work for employees involved in the provision, use, inspection and maintenance of electrical equipment, including all electrical installations, under the employer's management and control.

To meet their obligations and provide a safe system of work, employers should identify potential arc flash hazards in the workplace, assess the risks, implement appropriate risk controls and have procedures in place to review and maintain those controls.

Incident energy

The amount of energy that a person is potentially exposed to during an arc flash is termed incident energy and the industry accepted standard for its measurement is generally stated as calories/cm². The arc energy is the energy in the arc and the incident energy is the energy that reaches an individual or surface at a distance from the arc source during an arc fault. The duration of an arc fault may be short. It is primarily determined by the time it takes for circuit protection to operate.

Incident energy and personal injury is increased by any or the combination of any of the following factors:

- higher fault currents
- longer protection clearing times
- shorter distances from the arc fault.

ESV and WorkSafe's expectations

Identify the hazard

Hazards may come from the type of electrical equipment used, how and where it is used, and how it is maintained. Generally an arc flash hazard is present wherever HV or LV High Current switching occurs.

Assess the risk of arc flash – refer to IEEE 1584 or similar standards

1. Carry out an Arc Flash/fault study or assessment.

If you do not have the competencies available, engage a third party that does have the competency and experience in this type of work. An accurate arc flash study will quantify the risk and give information regarding the consequence if exposure occurs.

2. Determine the likelihood of personnel being exposed to an arc flash event.

The risk assessment process should include areas where employees are working near (in close proximity or with high frequency) high-energy switch rooms/gear. Higher risk tasks include live work, live switching/racking, fault finding, and installing isolation/earths. Consideration must be given even if there is no direct interaction with energised boards (i.e. employees in the vicinity) and when automatic operation of the inherent protection activates.

Guidance is available in the Australian Energy Council document *Electrical Arc Flash Hazard Management Guideline*, and International Standard IEEE 1584-2018: *Guide for Performing Arc-Flash Hazard Calculations*.

Treat the risk – utilise the hierarchy of controls

Eliminate the exposure of personnel to arc flash hazards by only interacting with de-energised and isolated equipment.

Substitute manual operating systems for automated operating systems.

Isolate personnel from the hazard by installing physical separation from energised equipment or conductors. Switchboards can be constructed to contain the energy associated with an arc event.

Engineering controls

- Limit incident energy with reduced fault current and/or reduced fault clearance times by adjusting breaker protection settings.
- System modifications:
 - Arc Flash detection and suppression systems
 - remote controls and switching
 - remote racking in /racking out devices
 - upgrade switchboard form type
 - upgrade/modify boards to allow for racking with the door closed
 - fixed circuit breakers over rackable breakers for new installation/upgrades
 - insulated bus bars
 - installation design considerations for isolation and maintenance tasks
 - replacement of fuses which provide faster clearance times.

Administrative controls

- Label all switch rooms, plant and relevant locations to identify incident energy levels and the appropriate actions/precautions that need to be taken
- Demarcation of arc boundaries
- Make arc flash registers and diagrams available for employees and contractors
- Establish effective policy and procedure that reduces exposure, including training and inductions

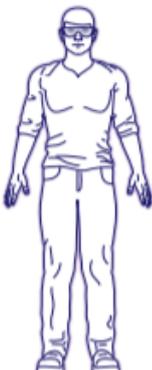
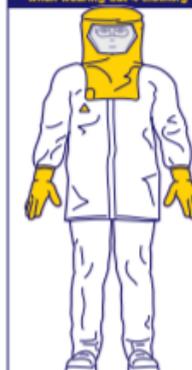
- Implement of an incident energy and PPE category system as detailed in IEEE 1584 and ENA NENS 09 – 2014 or equivalent published standards.

Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) is the least effective control and should not be relied upon unless combined with other controls. WorkSafe legislation requires employers to adopt higher order controls and only select PPE when the risk of injury has been reduced, so far as is reasonably practicable. PPE may then be used to treat the residual risk. This is because PPE does not prevent injury but may reduce severity.

To select the appropriate PPE for an electrical arc hazard environment, the following steps need to be undertaken.

1. Understand the hazard.
2. Identify assets or asset groups with arc flash/fault hazard potential.
3. Quantify the hazard – calculate the incident energy in each relevant location.
4. Assess the risk – using your organisation risk management framework.
5. Reduce the risk, so far as is reasonably practicable, using the hierarchy of controls.
6. Select the appropriate PPE if a residual risk of injury is present i.e. incident energy of greater than 1.2 calories/cm² remains.

0 cal/cm ²	4 cal/cm ²	8 cal/cm ²	25 cal/cm ²	40 cal/cm ²
PPE CATEGORY 0	PPE CATEGORY 1	PPE CATEGORY 2	PPE CATEGORY 3	PPE CATEGORY 4
				
				HAZARD - Be aware of heat stress when wearing Cat 4 clothing

The figure above is an example of a PPE and category system, provided courtesy of the Australian Energy Council.

UNDERSTAND THE RISKS
COMMUNICATE AND EDUCATE

Further information

For more information regarding Arc Flash Hazard Management, contact the WorkSafe Victoria Advisory Service on 1800 136 089 or visit worksafe.vic.gov.au

For information on electricity safety legislation, contact Energy Safe Victoria on 093 9203 9700 or visit esv.vic.gov.au

Australian Publications

AEC Electrical Arc Flash Hazard Management Guideline March 2019

ENA NENS 09 - National guide to the selection, use and maintenance of PPE for electrical arc hazards

International Publications

IEEE 1584-2018 Guide to performing Arc Flash Hazard Calculations

NFPA 70E- Standard for Electrical Safety in the Workplace 2018

References

Victorian Occupational Health and Safety Act 2004

Electricity Safety Act 1998

Occupational Health and Safety Regulations 2017

Electricity Safety (Installation) Regulations 2009

Electricity Safety (General) Regulations 2019

AS/NZS 3000 Wiring Rules

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

Code of practice on electrical safety for work on or near high voltage electrical apparatus (the Blue Book)

NEC Electrical Arc Flash Hazard Management Guideline March 2019

ENA NENS 09 - National guide to the selection, use and maintenance of PPE for electrical arc hazards

IEEE 1584-2018 Guide to performing Arc Flash Hazard Calculations

NFPA 70E - Standard for Electrical Safety in the Workplace 2018

Document information

For information regarding this document please contact:

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