

Arc flash self-audit tool

June 2022

The purpose of this self-audit tool is to assist employers and self-employed persons with identifying and controlling the hazards associated with arc flash management. This self-audit tool provides an overview for industries that may have arc flash hazards. The audit tool sets out a range of questions to assist, identify and control the hazards and risks associated with an arc flash event.

Arc flash

The Australian Energy Council states that an electrical arc fault is often referred to as an arc flash.

Arc faults arise when current flows through the air between phase conductors or between phase conductors and neutral or ground. Put simply, an arc fault could be described as an unexpected, violent, electrical short circuit in the air that produces an arc and associated by-products.

When arc faults occur, the resulting energy released may be enough to seriously burn or otherwise injure nearby persons, ignite flammable materials (including clothing), and cause significant damage to plant and equipment.

An arc flash is a serious hazard that has the potential to cause death, serious injury, damage to equipment and loss of electrical supply.

Employer duties

Under the *Occupational Health and Safety Act 2004*, employers must provide and maintain a working environment that is safe and without risk to health, so far as is reasonably practicable.

They must also provide and maintain safe systems of work for employees (and independent contractors) 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, an effective arc flash management strategy should be implemented to assist duty holders to identify and control potential arc flash hazards in the workplace, assess the risks, implement appropriate risk controls and have procedures in place to review, revise (if necessary) and maintain those controls.

The *Electricity Safety Act 1998* also sets out safety obligations for those carrying out electrical work and owners and operators of complex and high voltage electrical installations.

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Workplaces where an arc flash may occur

This self-audit tool aims to assist duty holders with assessing arc flash hazards, risks and control measures in workplaces with alternating current (AC) and/or direct current (DC). These electrical installations may include, High Voltage (HV) and Low Voltage (LV) High Current (≥ 800 amps).

Note: The examples presented here are not exhaustive. Arc flash hazards may be present in electrical installations that are not covered in these examples.

Workplaces with these types of electrical installations may include:

- power generation plants, including transmission and distribution stations and grid substations
- workplaces where electrical assets are present (eg hospitals, shopping centres and large public venues such as arts centres)
- large manufacturing plants
- traction-based public transport operators (eg train, tram networks)
- utility providers (eg electrical, gas, water management)
- large construction sites

Arc flash hazards

The likelihood of an arc flash occurring increases when a person interacts with energised electrical equipment (eg when conducting high and low voltage racking/switching). However, an arc flash event can occur without direct interaction with plant.

The risk of an arc flash may be further increased when the following occurs (note, this is not an exhaustive list):

- the purpose for which the electrical installation was designed has changed
- the installation has been altered, changed, or reconfigured
- the operating environment has changed (eg installation was originally built with no other buildings around; the area has now become populated and new buildings or structures are located in close proximity to the installation)
- the installation has deterioration, corrosion, rust, insulation breakdown, build-up of contaminants etc.

Controlling the risks

When controlling hazards and risks, duty holders should utilise the hierarchy of controls and priority must be given to the highest level of control, elimination. If it is not reasonably practicable to eliminate the risk, duty holders must reduce the risk by using the following measures in order of priority, of substitution, isolation, engineering controls or a combination of those. If the risk remains, it must be reduced further through administrative control measures (systems of work or procedures designed to reduce the risk) and may be further reduced by use of personal protective equipment (PPE).

Where a substitution, isolation or engineering control, or where any combination of these controls are used, information should be provided in the arc flash management strategy that clearly describes how the control(s) reduce the risk of an arc flash event.

Some controls may be implemented quickly and efficiently (eg installing high rupturing capacity fuses), while other controls may require greater planning and installation times (eg implementing automated operating systems).

Regularly review (and if necessary, revise) any methods implemented to control risks associated with plant or associated systems of work.

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Hierarchy of control examples

Level	Example
Elimination	Ensure arc flash hazards and risks are eliminated in the design phase of new or refurbished electrical equipment De-energise and, if necessary, discharge and electrically isolate the equipment before interacting with the electrical installation
Substitution	Implementing automated operating systems Switchboard upgrades
Isolation	Install physical separation from energised equipment or conductors
Engineering	Installing high rupturing capacity (HRC) fuses to minimise fault clearance times Installation of arc flash detection and suppression systems Adjust protection settings to reduce fault clearing time Install remote operating provisions or devices Install ultra-fast earthing devices/systems
Administrative controls	Marking out arc flash boundaries Arc flash-related labelling on switchboards and switch-room entrances Arc flash-related training
PPE	Please see ESV Arc Flash Hazard Management Guidelines for selecting PPE to be used in an environment where an electrical arc flash can occur

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Item	Topics	Questions	Example of what to look for	Implemented		Comments
				Yes	No	
1	Identify the hazard	Has an initial arc flash study or assessment been undertaken?	The arc flash study or assessment has been undertaken on locations of the electrical installation(s) where persons may be interacting with or be in the vicinity of the electrical installation.	<input type="checkbox"/>	<input type="checkbox"/>	
		Is a system of work in place to ensure the arc flash study or assessment is reviewed and, if necessary, revised when changes are made to the installation or changes are made that may affect the installation?	The arc flash study determines:	<input type="checkbox"/>	<input type="checkbox"/>	
			• incident energies at defined operating distances	<input type="checkbox"/>	<input type="checkbox"/>	
			• arc flash boundaries	<input type="checkbox"/>	<input type="checkbox"/>	
• required PPE levels	<input type="checkbox"/>	<input type="checkbox"/>				
		Is a system of work in place to ensure the arc flash study or assessment is reviewed and, if necessary, revised when changes are made to the installation or changes are made that may affect the installation?	The study assesses all scenarios in which the equipment (eg switchgear) is operated or interacted with (eg doors open, doors closed, electrical protection operates).	<input type="checkbox"/>	<input type="checkbox"/>	
			A system of work is in place to ensure the arc flash study is reviewed and, if necessary, revised.	<input type="checkbox"/>	<input type="checkbox"/>	

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2	Assess the risk	<p>Has an arc flash risk assessment been completed to understand the extent of the risk in the electrical installation(s)?</p> <p>If 'yes', is the risk assessment(s) reviewed and, if necessary, revised to reflect current or changes to the workplace conditions and systems of work?</p>	<p>The risk assessment:</p> <ul style="list-style-type: none"> identifies the hazards and likelihood of employees being exposed to an arc flash event 	<input type="checkbox"/>	<input type="checkbox"/>	
			<ul style="list-style-type: none"> identifies the type of electrical equipment used, arc rated/ designed equipment, how and where it is used, and how it is maintained 	<input type="checkbox"/>	<input type="checkbox"/>	
			<ul style="list-style-type: none"> identifies areas where employees are working near or in the vicinity of electrical equipment/installations with no direct interaction with the energised installation (for example, undertaking preventative maintenance such as thermography) 	<input type="checkbox"/>	<input type="checkbox"/>	
			<ul style="list-style-type: none"> considers automatic operating equipment including protection operation 	<input type="checkbox"/>	<input type="checkbox"/>	
			<ul style="list-style-type: none"> identifies priority areas and areas of concern 	<input type="checkbox"/>	<input type="checkbox"/>	
			<ul style="list-style-type: none"> reviews associated operating and maintenance procedures 	<input type="checkbox"/>	<input type="checkbox"/>	
			<p>Short term and long term control measures are identified and length of time to implement control(s) is considered.</p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>Considerations of prior arc flash events, if applicable, are included.</p>	<input type="checkbox"/>	<input type="checkbox"/>				
<p>The risk assessment has been undertaken in consultation with employees and health and safety representatives.</p>	<input type="checkbox"/>	<input type="checkbox"/>				

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3	Control the risk	Has the risk of an arc flash event been controlled, so far as is reasonably practicable, having regard to the hierarchy of controls?	Does the arc flash risk assessment list the controls to reduce the hazards and risk of an arc flash event?	<input type="checkbox"/>	<input type="checkbox"/>	
			The highest order of control, so far as is reasonably practicable, has been implemented.	<input type="checkbox"/>	<input type="checkbox"/>	
3.1	Elimination	Can the risk of an employee being exposed to an arc flash event be eliminated?	For example, only interacting with or being in the vicinity of electrical equipment that is de-energized.	<input type="checkbox"/>	<input type="checkbox"/>	
3.2	Substitution and/or isolation	If elimination is not reasonably practicable, are risk control measures in place that ensures employee interaction with electrical equipment is substituted and/ or employees are isolated from an arc flash event?	For example: <ul style="list-style-type: none"> • manual operating systems are substituted for automated operating systems • local operation is substituted for remote operation • employees are isolated by physical separation from energized equipment or conductors • electrical switchboards are constructed to contain and/ or vent the energy associated with the arc flash event 	<input type="checkbox"/>	<input type="checkbox"/>	
3.3	Engineering controls	Are engineering controls in place to reduce the risk associated with an arc flash event? Does the arc flash study clearly articulate how the engineering control(s) reduce the risk of an arc flash event?	For example, one or a combination of the following: <ul style="list-style-type: none"> • HRC fuse types and ratings • adjust protection settings to reduce fault clearing time • arc flash detection devices • type testing to specifications • relay fitted with arc flash reduction maintenance system • remote switching • remote racking • zone selective interlocking • ultra-fast earthing systems 	<input type="checkbox"/>	<input type="checkbox"/>	

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3.4	Administrative controls	If a risk remains after implementing substitution, isolation and engineering controls, what administrative controls are in place to further reduce the risks?	Systems of work to reduce the risk, for example: <ul style="list-style-type: none"> ensure all electrical equipment has been installed and maintained in accordance with manufactures specifications and relevant standards there are no missing nuts or bolts in the electrical equipment all the doors close all equipment is tested and functioning as designed reduce available fault current, for example by switching to take a transformer out of service or splitting the bus (instead of both transformers feeding the fault only one will reducing the kA s available) 	<input type="checkbox"/>	<input type="checkbox"/>	
			Preventative maintenance has been performed to reduce the risk, including for example: <ul style="list-style-type: none"> partial discharge thermography via thermography windows condition monitoring 	<input type="checkbox"/>	<input type="checkbox"/>	
			Arc flash labelling is installed that indicates the: <ul style="list-style-type: none"> incident energies arc flash boundaries and required categories of PPE 	<input type="checkbox"/>	<input type="checkbox"/>	
			Arc flash boundaries are clearly marked.	<input type="checkbox"/>	<input type="checkbox"/>	
			Employees have been given information, training, instruction or supervision in relation to arc flash hazards and utilised control measures.	<input type="checkbox"/>	<input type="checkbox"/>	

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3.4	Administrative controls (continued)		Work procedures or instructions are reviewed and/or modified, if necessary, to identify high risk activities, such as, the locking of bus shutters and validate controls to lower risk.	<input type="checkbox"/>	<input type="checkbox"/>	
			Access to areas where an arc flash event can occur have been restricted to trained and authorised personnel only.	<input type="checkbox"/>	<input type="checkbox"/>	
			An engineering change management system is in place which considers the risks associated with arc flash posed by upgrades or alterations to the electrical installation.	<input type="checkbox"/>	<input type="checkbox"/>	
			A defect management system is in place.	<input type="checkbox"/>	<input type="checkbox"/>	
			A permit to work system in place.	<input type="checkbox"/>	<input type="checkbox"/>	
			A lock-out tag-out system is in place.	<input type="checkbox"/>	<input type="checkbox"/>	
3.5	Personal protective equipment (PPE)	If a risk remains after implementing substitution, isolation, engineering controls and administrative controls, is the appropriately rated and maintained PPE available for employees who require it?	All electrical installations have been assessed and the PPE required for undertaking works on electrical installations has been identified.	<input type="checkbox"/>	<input type="checkbox"/>	
			A procedure is provided detailing the: <ul style="list-style-type: none"> arc flash rating of the PPE to be used type of PPE to be worn how to fit, use and maintain the PPE when the PPE is required 	<input type="checkbox"/>	<input type="checkbox"/>	
			All PPE is adequately arc flash rated.	<input type="checkbox"/>	<input type="checkbox"/>	
			PPE should include ultra-violet eye protection and silicon ear plugs.	<input type="checkbox"/>	<input type="checkbox"/>	

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3.5	Personal protective equipment (PPE) <i>(continued)</i>		PPE is stored, maintained and laundered in accordance with manufacturer's instructions.	<input type="checkbox"/>	<input type="checkbox"/>	
			PPE is stored outside the arc flash boundaries.	<input type="checkbox"/>	<input type="checkbox"/>	
			Employees have been trained and provided with information and instruction in the use, fit, testing and storage of PPE.	<input type="checkbox"/>	<input type="checkbox"/>	
			PPE is not the only control relied upon, and is used in combination with higher order controls.	<input type="checkbox"/>	<input type="checkbox"/>	
4	Reactive	In the event of an arc flash, are systems in place to respond appropriately?	There is an emergency response plan in place which includes responding to an arc flash event.	<input type="checkbox"/>	<input type="checkbox"/>	
			Employees are trained to respond to an arc flash event and an emergency drill(s) has been conducted to test efficiency and effectiveness of the plan.	<input type="checkbox"/>	<input type="checkbox"/>	
			Switch-rooms are free of equipment, clean, have clear exits, emergency lighting and exit signage in place.	<input type="checkbox"/>	<input type="checkbox"/>	
			Support is available for employees following an event eg an employee assistance program.	<input type="checkbox"/>	<input type="checkbox"/>	

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				Yes	No	
5	Consultation	Has consultation occurred with employees (and independent contractors) and their representatives regarding matters including identifying or assessing hazards or risks, and making decisions about the control measures implemented by the arc flash management strategy?	Employees (and independent contractors) who are, or are likely to be, affected.	<input type="checkbox"/>	<input type="checkbox"/>	
			Health and safety representatives where employees are represented by an HSR.	<input type="checkbox"/>	<input type="checkbox"/>	
			Arc flash subject matter experts.	<input type="checkbox"/>	<input type="checkbox"/>	

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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 03 9203 9700 or visit esv.vic.gov.au.

WorkSafe

Occupational Health and Safety Act 2004

Occupational Health and Safety Regulations 2017

Plant, Compliance Code

Consultation: A guide for Victorian workplaces

Energy Safe Victoria

Electricity Safety Act 1998

Electricity Safety (General) Regulations 2019

Arc Flash Hazard Guideline

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

Australian Energy Council

Electrical Arc Flash Hazard Management Guideline
energycouncil.com.au

Australian standards

AS/NZS 3000 Wiring Rules

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

Other

IEEE 1584-2018: Guide for Performing Arc-Flash Hazard Calculations

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

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

For DC calculations refer to AS/NZS 5139 or NFPA 70E

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