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Arc flash

What you need to know to minimise risk to electrical workers

Arc flash is a potentially fatal hazard of working with electricity.

High voltage (HV), low voltage (LV), high current and complex electrical installation owners and operators should be aware of and manage their arc flash/fault hazards.

Middleton Group's engineers are experienced in all aspects of arc flash hazard management and work with clients to identify, assess and mitigate arc flash risk.

What is arc flash?

Arc flash is an unexpected, instant, violent electrical short circuit where current arcs through the air between the phase conductors, neutral and earth. In arc flash, these risks happen:

A superheated ball of energy explodes right in front of you, reaching up to 20,000 degrees Celsius, or about four times hotter than the surface of the sun.

Some of this is radiant heat, but a large proportion of the fireball is plasma, a super-heated gas caused by vaporised metals, smoke and burnt components that ignites clothing and causes external and internal burns.

This ball of fury is accompanied by a deafening boom – up to 140 decibels, or as loud as standing next to a jet engine.

The copper conductors vaporise and expand, turning into a violent shower of molten metal that can travel at more than 1100km/h.

Pressure waves knock you off your feet, with the potential to rupture your eardrums and collapse your lungs.

Arc flash incidents also damage equipment, force operations to grind to a halt, lead to fines, cause reputational damage and prompt further safety audits from regulators.

Graeme Edwards, pictured, was a unit controller at Energy Australia's Yallourn's coal-fired power plant in the Latrobe Valley for 30 years. In 2017, aged 54, he died in hospital with severe burns sustained in an arc flash and explosion that occurred while he was racking a 6.6kV circuit breaker in a high voltage switch room that was being returned to service. Energy Australia Yallourn Pty Ltd pleaded guilty to three charges of workplace safety violations following Graeme Edwards' death, and in 2023 paid fines totalling $1.5m.

Full report here.

Arc flash can maim and kill

FQM Australia Nickel Pty Ltd was fined $65,000 after an electrician was injured in an arc flash at the company's Ravensthorpe nickel mine in 2011. **Shane Russell** was working inside an electrical substation when the arc flash occurred. He suffered burns to his left hand and the left side of his face. He was hospitalised but did not suffer any permanent injuries.

An investigation by the Department of Mines, Industry Regulation and Safety found an internal report by FQM into a previous incident four months earlier had identified the danger of working on the company's motor control centre without full isolation.

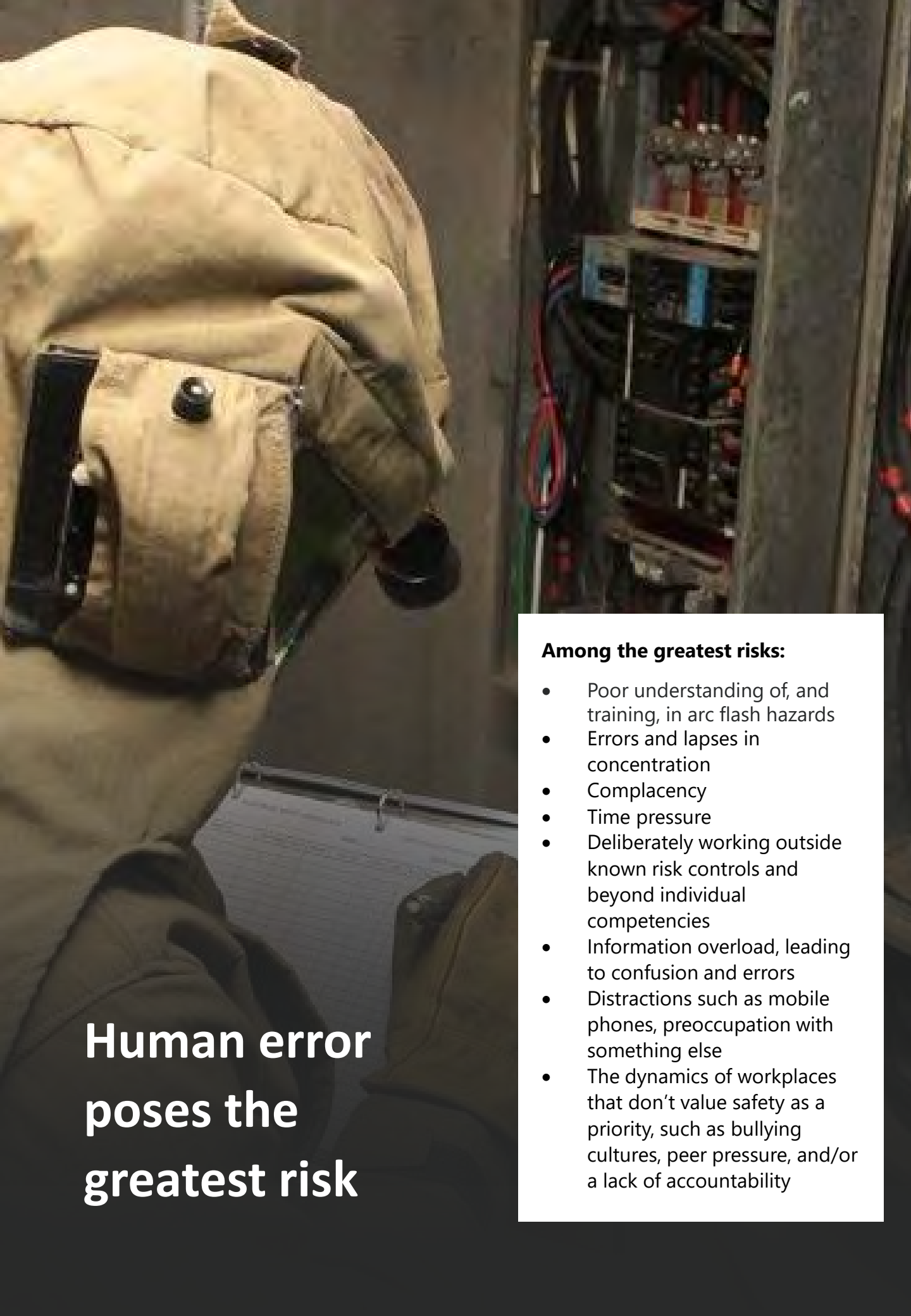
Full report here.

Why arc flash happens

Arc flash hazards exist wherever HV (>1000 V) or LV (≤1000) switching and racking occurs. The only way to eliminate workers' exposure to arc flash hazards is by working on equipment that is de-energized, isolated and verified. However, in some situations, this may not be possible.

Arc flash hazards may also be caused by other factors, such as:

- Tools unintentionally coming into contact with live parts
- Equipment failure due to poor installation, maintenance or improper design
- Loose contacts
- Worn or damaged insulation
- Dust and condensation on the insulating materials – this can provide a path for the electrical current and can lead to flashovers that create an arc discharge
- Incorrect installation and non-compliant equipment
- Incorrect work procedures and personal protective equipment (PPE)



Human error poses the greatest risk

Among the greatest risks:

- Poor understanding of, and training, in arc flash hazards
- Errors and lapses in concentration
- Complacency
- Time pressure
- Deliberately working outside known risk controls and beyond individual competencies
- Information overload, leading to confusion and errors
- Distractions such as mobile phones, preoccupation with something else
- The dynamics of workplaces that don't value safety as a priority, such as bullying cultures, peer pressure, and/or a lack of accountability

Our service to you

At Middleton Group, one of our core values is safety and wellbeing. We commit to not only keeping our staff safe, but ensure that we help clients improve safety on their own sites.

We work closely with site personnel to understand their everyday operations. Our assessments identify arc flash hazards, determine the likelihood of an arc flash, and calculate the thermal energy personnel may be exposed to in the event of an arcing fault, depending on how far they are from the seat of an incident.

We carry out assessments to industry-leading standards: IEEE 1584-2018 Guide for Performing Arc-Flash Hazard Calculations, and NFPA 70E Electrical Safety in the Workplace.

Compliance with arc-fault protection requirements of AS/NZS 3000:2018 (LV installations) and AS 2067:2016 (HV installations) is also verified.

We simulate at least two short-circuit fault levels, a minimum and maximum of the specified electrical system. Risk-mitigation techniques can then be deployed to either eliminate or reduce arc flash risk to an acceptable level.

Typical mitigation measures include optimising protection settings, reviewing and updating current safety practices and prescribing the minimum grade of personal protective equipment that workers should wear depending on the environment. Equipment upgrade recommendations are also provided if necessary.

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We come to your worksite to discuss assessment results with staff, the implications and the safety procedures required.

Contact one of the team listed above.

Case study: Cathedral Rocks Wind Farm

Cathedral Rocks Wind Farm, pictured, is 30km southwest of Port Lincoln in South Australia. The wind farm consists of 32 wind turbines and generates 64 MW of total power. Owner ACCIONA Energía asked Middleton Group to carry out arc flash assessment as per IEEE standards for the wind farm's electrical assets, which ranged from main AC switchboards to DC battery systems.

Our engineers gathered all the data for relevant electrical assets, using SKM PowerTools software to model various operating conditions in order to predict various arc flash faults, determine the arc-flash boundary (the distance at which a person without personal protective equipment may get a second-degree burn if an arc flash occurs) and the incident energy (the measurement of energy, typically measured in calories per square centimetre, as it strikes a surface, theoretically a worker standing at the switchboard with the panel doors open).

The assessment helped identify safety hazards for HV and LV switchboards during arc flash faults and suggested appropriate actions to improve plant safety, including amending protection settings, identifying which switchboards needed to be completely de-energised for work to be safely carried out, specifying what personal protection equipment needed to be worn around each switchboard and outlining what arc flash safety labelling was needed to raise staff awareness of risks.

What our clients say about us

"Amajith and the wider arc flash team have been great to work with. Ama and the team have been very patient with us as we found our feet to get the arc flash strategy off the ground. He has always gone above and beyond to make sure everything is on track and clear to the stakeholders on the actual assessments. Well done on having such a top team member!"
Confidential client, Melbourne

"Middleton Group provided a very comprehensive report, and we very much appreciate their efforts and professionalism. It is a genuine pleasure to work with a company that understand the importance of customer relations."
Paul Gardner, General Manager, Pacific Energy

Further reading

Electrical Arc Flash Hazard Management Guideline, Australian Energy Council: A thorough explanation of what arc flash is, how to approach risk reduction and recommended practices for Australia.

Arc Flash Self Audit Tool, WorkSafe Victoria: This check sheet helps in identifying and controlling the hazards associated with arc flash management.

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