

ARC FAULT INCIDENTS IN AUSTRALIA

With respect to burns from arc faults we generally get quoted United States figures by United States manufacturers of arc fault equipment. This can incorrectly result in the belief that the problem is unique to the US and mostly due to their standards and work practices. In Australia, we typically only ever hear of the extreme incidents such as the tragic Morley Galleria incident in February 2015. Many of the lesser injuries go unnoticed by all but those closest to the people involved. The following statistics are from burn data supplied by the NSW Health Agency for Clinical Innovation Statewide Burn Injury Service from June 2003 to March 2016. The data only included burn patients treated at the NSW major burns hospitals where the major contributing thermal source was electrical.

by Brett Cleaves, Engineering Safety

Of the 433 electrical burn incidents reviewed, Engineering Safety concluded that 129 of these were likely due to arcing faults from people working on or near electrical apparatus. The remainder were due to electric shock related contact burns, criminal activity such as copper theft, extra low voltage battery systems, or suicide attempts. Work included non-electrical work near electrical apparatus.

The data collected did not record the voltage level, or the part of the body that was burned, however the descriptions mainly referred to work on switchboard, meter board, fuse box and burns to hands, arms and face. The majority of the descriptions that included a voltage for Switchboard and equipment incidents listed low voltage. The lack of detail left many of the incidents open for interpretation.

STATISTICALLY SPEAKING

Statistically in NSW, the best year was 2004 with no incidents; the worst was in 2007 with 21. From 2005 to 2015 there were on average 11.6 people burned working on or near electrical apparatus each year from arc faults. The average percentage body burn for the incidents was approximately 6.4%. To put that into perspective your whole hand is approximately 2.5% of your

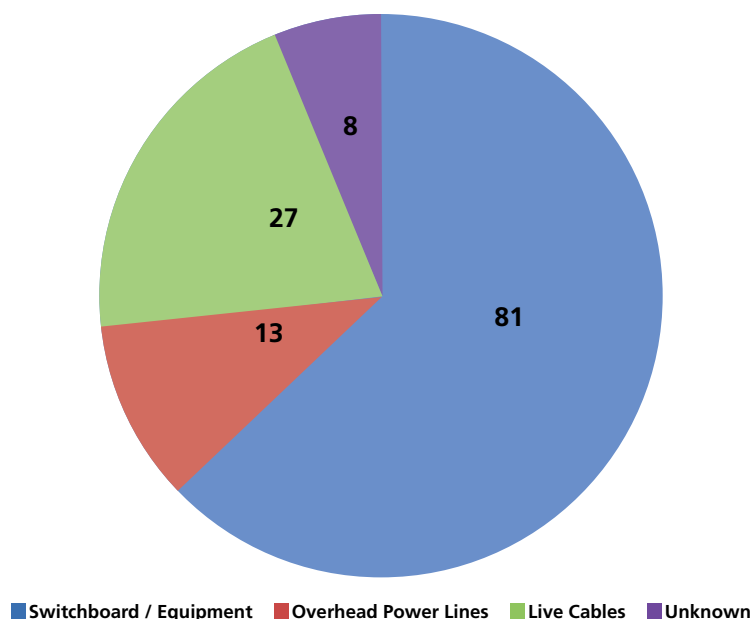
body. Only 2 of the 129 patients were female and the average patient age was 37 years. Of those injured 78 of the 129 required admission into one of the specialist burns units for treatment with the rest treated as outpatients. The following chart outlines the electrical equipment involved.

Contact with overhead power lines generally did not involve electrical workers and included the only fatality in 2006 where the patient suffered burns to 75% of their body. Burns from live cables resulted primarily from cutting, drilling or digging activities. Incidents involving work on switchboards or electrical equipment accounted for 81 of the 129 incidents.

AUSTRALIAN STATUTORY REQUIREMENTS

Under current federal work place health and safety laws businesses are required to identify and control hazards so far as is reasonably practicable as per the hierarchy of controls. State based codes of practice provide supporting detail under the act to help describe the requirements for a number of hazardous areas including electrical. The electrical codes of practice are standard across all states excluding Victoria which has similar requirements in its Electrical Safety Act and regulations. The codes of practice outline that a

Incidents and Electrical Equipment Type



ELECTRICAL SAFETY AND ARC FAULT HAZARDS

The development and implementation of arc fault safety controls in Australia is beginning to gain traction, however it is still far from being widespread. It is unfortunate that for the most part business and organisations have generally only made moves to include arc fault safety into their safety programs after they or someone close to them has experienced an arc fault incident.

To put it into perspective, engineering tools to assist with the development of controls have been available since 2002, the local wiring rules included changes to help protect people and equipment in Australia in 2007. In that year, I also first presented work on the BlueScope Steel arc fault analysis results and controls. Aside from the great work by Ausgrid, the NENSO9 committee and a number of revisions of overseas standards the resistance to act on or recognise the risk locally has continued. Many companies seem to be waiting for the next revision of standards in the hope that they will better describe the process needed to control the risks. It is unfortunate, as the incident statistics in the pie chart show that people continue to be burned interacting with low and high voltage apparatus. It is also important to note that legislation is already in place requiring risk assessment and control of all electrical hazards including arc faults. The next wave of standards have been under development for years and may take many more years to be released and ratified for Australia.

person conducting a business has the primary duty under the act to ensure that workers and other persons are not exposed to electrical risks arising from the business.

The codes of practice list the following as electrical:

- Electric shock causing injury or death.
- Arcing, explosion or fire causing burns.
- Electric shock from 'step and touch' potentials.
- Toxic gases causing injury or death from arcing or burning electrical equipment.
- Fire resulting from an electrical fault.

The codes of practice include guidance on the process for identifying and controlling electrical risk in the workplace and are available for free download from your relevant safety regulator such as Workcover NSW.

WORKING LIVE

There is no doubt that working on or near live electrical equipment increases the likelihood for an electrical incident. Live electrical work is generally prohibited unless one or more of the exceptions under work place health and safety regulations apply. Testing and fault finding is electrical work, and most standards and codes provided exceptions to allow testing and fault finding on live equipment.

Working de-energised requires three general stages, creating a safe working situation, performing the work and restoration. The first and last stages are generally considered operational work. Likewise, for testing and fault finding, the tasks required for isolation, earthing, and isolation verification as well as the reverse all have associated arc fault hazards that need to be assessed and controlled as does the important step of test before you touch (TBYT).

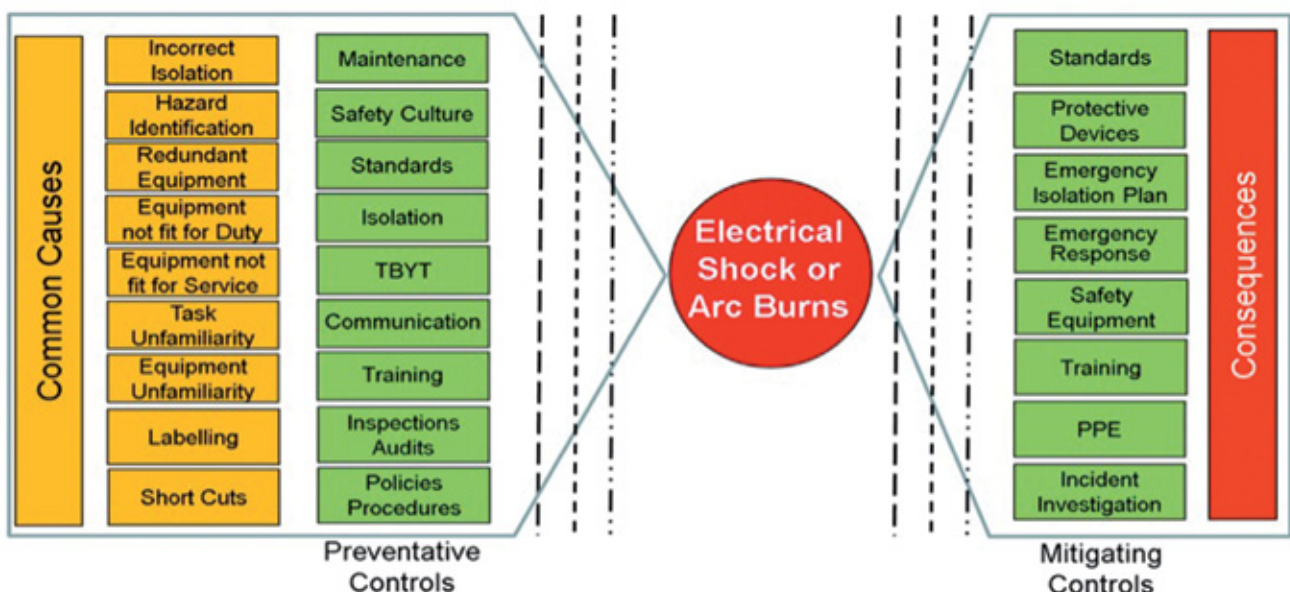
CONTROLLING ARC FAULT HAZARDS

Like any hazardous work, electrical safety requires skilled workers to understand and constantly apply multiple standards and regulations. For a business conducting electrical work to operate safely you need a system that supports the works from the key risk of electric shock and arc faults. The bow tie diagram below illustrates the various elements of an electrical safety system.

In the diagram, the controls in green are required to eliminate or reduce the likelihood or severity of an electrical incident. The yellow elements depict the common causes of electrical incidents. Failings in any of the controls will increase the likelihood of an incident.

As per the hierarchy of controls, elimination is the best option with arc fault hazards. If you sufficiently isolate the sources of supply, you eliminate the hazard. Again, it is important to remember that the process to establish and verify the required isolations exposes you to Arc Fault Hazards.

Electrical Safety System



Work involving tasks such as those listed below should only be performed under full (remote end) isolation:

- The removal of busbar covers
- Any work on the incoming side busbar system or anything directly connected to it
- The removal or insertion of bolts or screws that enter blind holes in back plates, equipment mounting plates, etc.
- All drilling except on an open door where both sides can be seen
- Metal work modifications where both sides of the panel cannot be seen
- Pulling-in and termination of cables in compartments with exposed conductors or terminals
- Disconnecting and re-terminating of cables in compartments with exposed conductors or terminals
- Blowing out or vacuuming any of this equipment
- Any activity (except operating work) on any isolating device where the incoming side is still live
- Working on top of or above switchgear

Consideration should also be given to operating tasks, such as racking of breakers and the provision of low fault level testing points for isolation verification.

The potential energy as seen by a worker in an arc fault is a function of the arc current, arc duration and distance from the arc. Arc currents in low voltage installations are typically 50% or less than the available bolted fault current. By modelling your system, changes can often be made to circuit breaker trip settings that can dramatically reduce the duration of arcing faults.

Personal Protective Equipment (PPE)


PPE is the least preferred method of hazard control. Despite all the other controls, testing and fault finding, isolation verification and especially test before you touch place workers in close proximity to electrical apparatus that is live or not verified as de-energised. The end result is that while incident energies can be reduced, the need for arc rated PPE

cannot be eliminated.

When exposed to even low level arcing faults cotton PPE can ignite increasing the severity and coverage of the burns to the worker. Knowing this, NSW Sydney metropolitan electrical utility Ausgrid completed extensive arc fault testing at its Lane Cove test facility and the results and recommendations were included in the 2014 revision of the Australian Energy Networks Association NENS 09 National Guideline for the Selection, Use and Maintenance of Personal Protective Equipment for Electrical Arc Hazards. NENS 09 recommends a minimum arc rating of 4cal/cm² be adopted for all work on or near electrical apparatus.

For factory, building and plant owners the best and most complete results for understanding and controlling arc fault hazards are via a detailed arc fault hazard assessment.

For contractors however, it is not practicable to complete a detailed assessment and calculations for each of your client sites. In this case, NENS 09 PPE recommendations combined with voltage rated gloves with leather outers and an arc rated face shield with chin return will protect you from large percentage body burns over a range of operating and testing scenarios until a safe work situation can be established and verified.

It is the belief of the author, that had the 129 arc fault burn sufferers over the last 12 years and many of the workers with contact burns from electric shocks adopted basic level PPE as a last line of defence, then the majority of the incidents and harm could have been avoided. 

ABOUT THE AUTHOR

Brett Cleaves is the founding director of Engineering Safety and has over 20 years engineering experience in heavy industry and electrical utilities including 9 years in Arc Flash hazard analysis and controls.

For contact information refer to www.engineeringsafety.com.au