ARC FLASH MANAGEMENT REVIEW

October 2017

Arc Flash – Management Review

PURPOSE:

- The issue of Arc Flash Exposure has been knocking around for the past couple of months but unsure if we all understand the issue with this item and how relative it is to our current activities.
- As a group, we were asked to review a document provided by NECA – Guide to Arc Flash Analysis and provide feedback on how relevant you believe this issue to be in our current site activities and any recommendations you could provide.
- Following is a summary of these findings.

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- **ARC FLASH:** Extremely high temperature discharge - upwards of 20,000 deg.
  - 4 times hotter than the sun surface.
- **ARC BLAST:** High Temperature sound wave
- **THREAT:** particularly HV – 480v and above
- **HOW IT HAPPENS:**

- Arc faults happen when electric current flows through air gaps between conductors. Arc flash often occur when racking in a breaking, performing switching, insulation failure, accidents caused by touching a test probe to the wrong surface
- Arc flash is caused by uncontrolled conditions of electrical current from phase to ground, phase to neutral and/or phase to phase accompanied by ionization of the surrounding air. These massive releases of energy are unpredictable and uncontrollable.
- Many arc fault events result from actually turning the power back onto devices – where a fault exists and power applied.

Arc Flash – Management Review

December, 2016

Arc Flash – Management Review

December, 2016

Arc Flash – Management Review

A Senior Project Engineer provided feed back: After reviewing the guide document and having worked on many switchboards, my feedback is listed below:

There seems to be 2 schools of thought on Arc Flash – they either go down the detection and interruption of arch flash or the PPE route where the arc flash is allowed to occur and then hopefully the correct PPE is available (and works). Personally the best solution is a mix of the two.

- It's a little late to be changing the SW specification but it might be possible to at least label the existing switchboards which are either correctly protected against high fault currents or those which the levels would require mandatory PPE.
- Sydney Water currently do not have a specification requirement regarding Arch flash detection, although the recent OMPA project at North Head does have Arch flash detection in the HV and LV boards to protect the Bus. The additional cost of fitting this was between $5K to $10K.
- From a project I was involved with at Port Kembla steel works, where a new large 415V MCC was supplied from and existing (40+ years old) distribution board, we had to "suit up" in a furnace coat, full face shield and leather gloves each time we wanted to turn off any (even the 0.37KW ones) of the isolators in the new switchboard because there were large concerns that the supply breaker was not going to quench any high fault current, which would have resulted in an arc fault event. This was annoying but so is having your face removed by an arc flash.

Arc Flash – Management Review

Continued:

- From TC's perspective, we need to check or determine the fault current rating of any switchboard and its inbuilt protective measures (circuit breakers or fault current fuses) before working on it. If the level of protection is not sufficient, then we "suit up" in the correct PPE. Some of the switchboards we are going to encounter in Sydney water's large range of sites are going to be very old and in any possible condition – so this determination is not going to be easy.
- Show everyone the nasty videos of what happens in an arc fault event and then train them in how to use the PPE. Education and training.
- Do we have many situations where we have a requirement to work "live" inside of large control switchboards?
- Many arc fault events result from actually turning the power back onto devices – where a fault exists and power is applied. Generally if the board or module doors are closed, then the arc is normally contained within the steel work (while still doing damage, but if the fault is large enough then the metal work becomes part of the explosion – not very pretty.

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- **A Senior Design Engineer : FEED BACK**

- Our boards are manufactured to Form 3B which intended to limit the probability of initiating an arc fault and restrict the propagation of that fault to other components in the board. However, correct Risk Assessments and control measure should be put in place for all work on boards which are in service.
- Testing procedures as per Standard: AS3017after installation and maintenance will identify any wiring faults. If a fault is identified you are not legally able to energise the board. All faults are required to be rectified before energisation.

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CURRENT AVAILABLE EQUIPMENT/SERVICES

There is an online course available (http://www.aveling.com.au/courses/arc-flash-awareness) at approximately $120 which covers:

- Arc flash fundamentals
- Managing arc flash risks
- Personal Protective Equipment
- Switchboard labels

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NECA WEB SITE: within the information provided was a “calculator” – with this we did a “sample”

- NECA INCIDENT CALCULATOR: NENS 09-2014 Requires that base garments be manufactured from arc rated materials should be worn where there is a possibility of exposure to incident energy of 1.2 calories/cm2 or above

Prospective Three Phase Bolted Fault Current (Irms) in amps *Insert propsective three phase symmetrical bolted fault current in this box.* Note - Arcing current is assumed to be **30%** of the bolted short-circuit fault current.	800
Fault Clearance Time (t) in seconds *Refer to upstream protection device time current-curves* Default Fault Clearance Time = 0.1 seconds	0.1
Distance (r) in metres *The distance of the individual from the arc source.* Default nominal distance = 0.45m	0.45
Calculated Incident Energy (IE) in calories/cm2 for COPPER	0.09
Calculated Incident Energy (IE) in calories/cm2 for ALUMINIUM	0.1
Minimum Arc Flash Protection value	1.3

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- **CURRENT AVAILABLE PROGRAMS/APPS**

ARC Flash Analytic (AFA) software and mobile apps have been developed based on NFPA 70E Standard for Electrical Safety in the Workplace and IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations.

They are easy to use and comprehensive instruments for calculating arc incident energy and arc flash boundary, for determining limited, restricted, prohibited approach boundaries and hazard levels required by NEC / CEC and OSHA when work is to be performed on or near the energized equipment.

Also, the AFA V5.0 software for Windows operated PCs allows one to calculate initial pressure generated by arc blast and arc flash explosive equivalent- at a cost of approximately $US 320.

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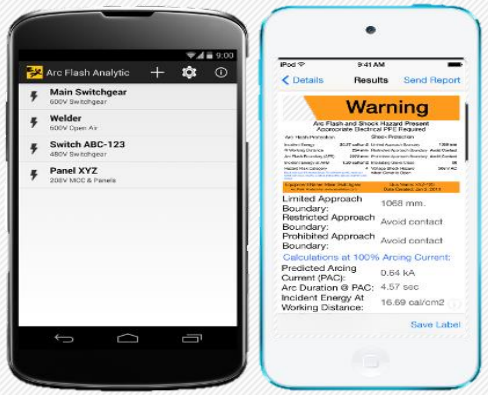
- **CURRENT AVAILABLE EQUIPMENT/SERVICES**
- AFA mobile can be downloaded, installed and used for free. The free AFA mobile version is limited to 208V systems only but fully capable otherwise. There's an optional in-app 'Pro Upgrade' purchase available for approximately $US 200.00. The upgrade will unlock system voltage box for the voltages in the 208 to 46000V range.



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- **PPE REQUIREMENTS;**

The table below is based on table 9.1 from AS/NZS 4836:2011 and shows the new Arc Flash requirements for PPE in clear, easy to understand format. *NB: This table applies when working on, or near live-parts, as is discussed in the scope of the standard.* Products to suit all of the below requirements are readily available from reputable safety companies.

Personal Protective Equipment (PPE)	Requirements to AS/NZS 4836:2011	Clarification
Eye protection	No metal, complying with AS/NZS1337 and selected in accordance with AS/NZS 1336.	Heat resistant, no metal
Face Shield	Certified to 10cam/cm^2	Tested to 10cal
Arc Flash suit and hood	Certified to 40cam/cm^2	Tested to 40cal
Insulating gloves	AS2225 or Equivalent, rated to appropriate voltage, air tested before use.	IEC, ASTM and EN gloves acceptable
Flame-resistant (FR) gloves	Gloves made from leather or other non-melting heat-resistance material	Complying with AS/NZS2161.4
Protective Clothing	Flame-resistant, full body clothing with no metal.	Cotton not suitable. Must be FR rated and tested fabric.

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- **PPE AVAILABLE:**
- According to the NECA Label for a board – the minimum would be fabric that has a Arc Flash rating of 5.6cal/cm2 rating.
- Clothing is categorised : PPE1 (HRC1) is the minimum requirement. Preferable only ½ button and placketted front (concealing the buttons)
- However this clothing is vast in costing:
- The Bisley Wear – this fabric is made with the retardant in the weave.
- At a cost of approximately $150 per shirt
- Trousers are approximately $160 each

Arc Flash – Management Review

- The alternatives are where the cotton fabrics are “dipped” in retardant – however are only guaranteed for 50 washes
- Shirt cost approximately $120
- Trousers approximately $60
- Alternative –PPE 4: is the “suit up” on requirement:
- Approximately $1200

Bare in mind that underwear
Is also required to be cotton.

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- **Timeframe & recommendations:** LETS DISCUSS IT NOW!
- Lets keep in mind that NECA are stating between 4 and 9 lost their lives and 200 presenting in emergency rooms with electricity related injuries over a 6 year period.
- How big is the budget vs exposure vs risk.

- **Immediate Recommendation:**
- Ongoing Risk Assessments
- Download the free mobile app and trial to see how it goes – Supervisors/Engineers/PM's

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- How much is the budget Vs. the exposure

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- Following testing procedures accurately as per AS3017
- The tests detailed in this Standard are as follows:

(a) Earthing system continuity and resistance;

(b) Insulation resistance;

(c) Polarity;

(d) Correct circuit connections;

(e) Phase sequence;

(f) Fault-loop impedance;

(g) Verification of operation of residual current devices;

(h) Earth electrode resistance;

(i) Touch voltage; and

(j) Continuity and resistance of the incoming neutral.

The Standard illustrates testing procedures for an electrical installation connected to an MEN system of earthing. The equipment and methods:

(k) Are not exclusive and other equipment and methods may be used;

(l) May be applied to types of low voltage installations other than MEN; and

(m) May be applied to work affecting only part of an installation, e.g. alterations, additions or repairs