# Arc Flash Mitigation – Distance is Safety

Finley Ledbetter – Group CBS Inc.
Scott Peterson – CBS Nuclear Services Inc.

**Abstract – Over the last few years many companies have been working to comply with the *NFPA 70E Standard for Electrical Safety in the Workplace* by conducting arc flash studies, training employees, and providing them with arc flash PPE. With the recent implementation of the practices found in the 70E standard into CSA Z462 in Canada and the NESC for utilities it has become clear that arc flash protection is here to stay. This paper will focus on how to mitigate the arc flash hazards to safer levels when working on metal clad switchgear by increasing the working distance from the prospective arc to the worker by implementing new technologies. Practical solutions for three recent arc flash incidents will be discussed. Finally we will review the pitfalls of conventional protection methods to conclude that distance is the only foolproof method of arc flash protection.**

## I. Introduction

The preferred method for electrical work is to de-energize the equipment you will be working on, however, in order to do this the equipment must be switched off, and this action is considered an "arc flash hazard". The 2009 NFPA 70E defines an "arc flash hazard" as a dangerous condition associated with the possible release of energy caused by an electric arc, and refers to the tasks in table 130.7 (C)(9)as examples. If procedures require the operation of switchgear while energized, these techniques and safety tools will limit exposure to arc flash and other dangers.

## II. Protection From Electric Arcs

The most common method used to protect personnel from arc flash hazards is to determine the hazard level by either using the tables found in the applicable standard or conducting an arc flash hazard analysis. That data is then used to determine the level of PPE required to protect the worker from second degree burns; there are several potential pitfalls from relying on this method alone:

1. The data used from the study needs to be accurate and conditions may change after the analysis is complete.
2. The arc flash levels may be above the limitations of PPE.
3. The analysis assumes that the upstream protective device will operate in a specific time period; failure of the over current protective device (OCPD) to function as assumed invalidates the entire hazard analysis.

## III. Mitigation Methods

There are two basic concepts for arc flash mitigation:

1. Reduce the total amp-cycles of the arcing fault. ($I^2t$)
2. Increase the distance from the arc to the worker.

Limiting fault current seems to be a simple solution, however reducing the fault current may increase the clearing time of the OCPD which may *increase* the hazard. Reducing the clearing time of the OCPD can be a viable solution for certain applications but can be difficult (and expensive) for other applications. Reducing clearing times also relies on the OCPD operating as assumed in the analysis. While the best method for protecting workers is to not work on energized equipment, increasing worker distance is the most reliable method when working de-energized is not feasible.

## IV. Case Study #1

On Jan 5, 1993 at Gulf States Electric Utilities in Beaumont, TX company and contract electricians

forced a 5 kV Federal Pacific circuit breaker from the cell after it became lodged in the structure; the resulting arc flash killed two employees and severely burned three others. All of the technicians that were killed and badly burned were wearing arc flash PPE. The arc flash was un-survivable with any known PPE. Increasing the working distance through the use of remote racking and switching devices could have saved these people from injury.

## V. Case Study #2

On March 4, 2009, at the Jubail Project in Riyadh, Saudi Arabia, three workers were removing a 480-Volt, molded-case circuit breaker from the bucket of an energized Motor Control Center (MCC) when an electrical arc flash occurred, severely injuring them. All three sustained first- and second-degree burns and were hospitalized following the accident. The system should have been de-energized to perform this task; if de-energizing was not “feasible” the bucket could have been extracted remotely.

## VI. Case Study #3

On May 23, 2009 a power plant in the Midwest experienced a severe arc flash incident. The incident occurred while racking in a closed Siemens 15 kV GMI breaker with a faulty interlock. When the (closed) breaker contacted the bus, a large arc flash occurred. The breaker was being racked in remotely (wireless), the operators were in another room and there were NO injuries of any kind. Plant personnel that were present are convinced that lives were saved that day.

## VII. Conclusion

On average there are about 2,000 arc flash victims sent to burn centers every year. The goal of the NFPA 70E, CSA Z462, OSHA, and the NESC is to reduce these injuries by protecting workers from electrical arc hazards in the workplace. While there are many different methods that can be used to accomplish this, increasing working distance is the best, safest, and in many cases, the most cost effective mitigation method available.