ARC FLASH

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In the last several years, Arc Flash hazards and Arc Flash Safety are topics that have come much further to the forefront due to changes in various codes, including the National Electrical Code (NEC) and the publishing of “Standard for Electrical Safety in the Workplace” (NFPA 70E).

Unfortunately, while these codes and standards exist, understanding of this subject has been slow in coming, especially to smaller industries. This document is designed to be a VERY brief and VERY general overview to give the reader a basic starting place to help understand these topics, how it can affect them, and the things they are expected to do by various codes and safety organizations, including OSHA.

What is Arc Flash?

An arc flash is a voltage breakdown of the resistance of air resulting in an arc which can occur where there is sufficient voltage in an electrical system and a path to ground or lower voltage. An arc flash with 1000 amps or more can cause substantial damage, fire or injury. The massive energy released in the fault rapidly vaporizes the metal conductors involved, blasting molten metal and expanding plasma outward with extreme force. A typical arc flash incident can be inconsequential but has the potential to produce a more severe explosion. The result of the violent incident can be destruction of equipment, fire, and injury to personnel.

In addition to the explosive blast of such a fault, destruction also arises from the intense radiant heat produced by the arc. The metal plasma arc produces tremendous amounts of light energy from “far infrared to ultraviolet”. Surfaces of nearby people and objects absorb this energy and are instantly heated to vaporizing temperatures. The effects of this can be seen on adjacent walls and equipment – the surfaces are often evaporated and eroded from the radiant effects.

In general, arc flash incidents are highly improbable on systems operating at less than 208 volts phase to phase (120V to ground) when fed by less than a 125 KVA transformer (very typical of most office and home environments). 120 volts does not provide sufficient energy to cause an arc flash hazard. Most 480V electrical services have sufficient capacity to cause an arc flash hazard. Medium-voltage equipment (above 600V) is higher energy and therefore a higher potential for an arc flash hazard.

Examples of Arc Flash

It is estimated that one person dies per day from an arc flash incident. Here’s a link to a video of an actual arc flash incident caught on security camera. **Please note that the employee involved was wearing and using protective equipment.**

http://www.easypower.com/arc_flash/videos/Arc_Flash_racking_breaker.wmv

Codes and Standards

This is a brief list of codes and standards that include information on Arc Flash Hazards and Safety

- OSHA Standards 29-CFR, Part 1910. Occupational Safety and Health Standards. 1910 sub part S (electrical) Standard number 1910.333 specifically addresses Standards for Work Practices and references NFPA 70E.

- The National Fire Protection Association (NFPA) Standard 70 “The National Electrical Code” (NEC) contains requirements for warning labels.
- NFPA 70E 2000 provides guidance on implementing appropriate work practices that are required to safeguard workers from injury while working on or near exposed electrical conductors or circuit parts that could become energized.
- The Institute of Electronics and Electrical Engineers IEEE 1584 Guide to Performing Arc-Flash Hazard Calculations.

OSHA is now citing and fining employers for failure to protect employees from the dangers of arc flash. For guidelines on best practices for protecting employees, OSHA refers employers to the NFPA 70E standard, "Standard for Electrical Safety in the Workplace."

NFPA 70E instructs employers to conduct an arc flash analysis to determine the amount of thermal energy that could be generated in an arc flash incident. The information is then used to define a flash protection boundary around the potential source, and to determine the level of flame-resistant apparel and other personal protection equipment required when employees cross the boundary while they work on or near exposed live parts.

In addition, the National Electric Code® (known as NFPA 70, which is different than NFPA 70E) added a requirement in 2002 mandating that potential arc flash hazards be labeled to warn of the hazard. The requirement, covered under Article 110.16, was updated and expanded in the 2005 version of the NEC.

Reducing Hazards by Design

Obviously, one goal of any employer is to reduce the hazards to their employees. With regards to arc flash, there are three key factors that determine the intensity, and therefore the hazard, of an arc flash on personnel. These factors are: a) the quantity of fault current available in a system, b) the time until an arc flash is cleared, and c) the distance an individual is from an arc. Various design and equipment configuration choices can be made to affect these factors and in turn reduce the arc flash hazard.

Fault Current

- Fault current can be limited by using current limiting devices such as grounding resistors or fuses. If the fault current is limited to 5 amps or less, then many ground faults self-extinguish and do not propagate into phase-to-phase faults.

Arcing Time

- Arcing time can be reduced by temporarily setting upstream protective devices to lower setpoints during maintenance periods or by employing zone interlocking (ZSIP).
- Arcing time can significantly be reduced by utilizing arc flash detection equipment that will open the circuit on detection of an arc flash.
- The most efficient means to reduce arcing time is to use arc eliminator that will extinguish the arc within a few milliseconds.

Distance

- Remote operators or robots can be used to perform activities that are high risk for arc flash incidents like racking breakers on a live electrical bus. The distance from an arc flash source within which an unprotected person has a 50% chance of receiving a second degree burn is referred to as the "flash protection boundary". Those conducting flash hazard analyses must consider this boundary, and then must determine what personal protective equipment (PPE) should be worn within the flash protection boundary.

Protecting Personnel
There are many methods of protecting personnel from arc flash hazards. This can include personnel wearing arc flash PPE or modifying the design and configuration of electrical equipment. The most effective way to protect personnel who are working on exposed conductors is to de-energize circuits if this is possible.

Cost
Costs to your company can be significant, with medical treatment running into the millions of dollars. Your company may be engaged in expensive litigation with victims and their families. OSHA will level fines. And it's not just people who get hurt: equipment can be damaged, requiring repair or replacement, and possibly causing the line or even the entire plant to shut down for a period of time.

Summary
Arc Flash is a topic that is not going away. It's a subject that has received a tremendous amount of attention lately. The costs to perform the necessary arc flash hazard analysis are expensive and site specific, frequently running up to $10,000 per facility or more. Training personnel and purchasing required protective gear only increases that cost. However, OSHA has made it very clear that this is a requirement and failure to take action is severely frowned upon. If a severe arc flash incident occurs in your facility, especially if a personnel injury is involved, the preventative costs will seem minor in comparison.

The hope is that this document gives you a basic understanding of what arc flash is, some basic "what to do" concepts and how important an issue this really is.