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Arc Flash *Fast Facts*

Definitions and Statistics

- According to the National Fire Protection Association (NFPA), Arc-flash is an electric current that passes through air when insulation or isolation between electrified conductors is no longer sufficient to withstand the applied voltage. The flash is immediate, but the result of these incidents can cause severe injury including burns. Each year more than 2,000 people are treated in burn centers with severe arc-flash injuries.

- Five (5) to ten (10) arc explosions occur in electric equipment every day in the United States, according to statistics compiled by CapSchell, Inc., a Chicago based research and consulting firm that specializes in preventing workplace injuries and deaths. This number doesn't even include cases in which the victim is sent to an ordinary hospital or clinic for medical treatment. Instead, these incidents involve injuries so severe the victims require treatment from a special burn unit. Note that these are burn injuries, not electrical shocks. It is not necessary to touch live components to sustain an arc flash injury.

- The flash protection boundary is an imaginary sphere that surrounds the potential arc point "within which a person could receive a second degree burn if an electrical arc flash were to occur," according to NFPA 70E. This standard also defines the incident energy level as "the amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event."

- A calorie is the energy required to raise one gram of water one degree Celsius at one atmosphere. Second-degree burns occur at 1.2 calories per centimeter squared per second. One calorie per centimeter squared per second can be equal to holding your finger over the tip of the flame of a cigarette lighter for one second.

- Electrical arcs produce some of the highest temperatures known to occur on earth, up to 35,000°F (19,426 °C). This is 4 times the temperature of the surface of the sun which is about 9000°F (4982°C).

Causes of arc flashes

- An arc flash may be caused by a tool, rodent or other element in a breaker or service area, that could compromise the distance between energized components. Incidents often occur when personnel fails to ensure that the equipment has been properly de-energized.

- The intense heat from arc causes a sudden expansion of air. This results in a blast with very high air pressure (lightning are natural arcs).

- When materials vaporize, they expand in volume (Copper-67,000 times, water 1670 times sq).

Dangers of arc flashes

- An arc flash can cause minor injuries, third degree burns and potential death as well as other injuries including blindness, hearing loss, nerve damage and cardiac arrest.

- Fatal burns can occur when the victim is several feet from the arc. Serious burns are common at a distance of 10 feet. Staged tests have shown temperatures greater than 437°F (225°C) on the neck and hands of a person standing close to an arc blast.

- Arcs spray droplets of molten metal at a high speed. Molten metal from an arc can be propelled for distances up to 10 feet. Blast shrapnel can penetrate the body.

- Blast pressure waves have thrown workers across rooms and knocked them off ladders. Pressure on the chest can be higher then 2000 lbs/sq. ft.

- Clothing can be ignited several feet away. Clothed areas can be burned more severely than exposed skin.

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Standards

- Four separate industry standards establish practices for the prevention of arc flash incidents in the United States:
    - OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S (Addresses standards for work practices)
    - NFPA 70-2005, National Electric Code (contains requirements for warning labels)
    - NFPA 70E-2004, Standard for Electrical Safety Requirements for Employee Workplaces (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)
    - IEEE Standard 1584-2002, Guide for Performing Arc Flash Hazard Calculations
- The NFPA 70E standard is a comprehensive standard that contains detailed information on how to protect workers from the heat of electric arc exposures. Preventative maintenance, worker training, and an effective safety program can significantly reduce arc flash exposure.

Costs

- Arc flashes can destroy equipment causing extensive downtime and requiring costly replacement and repair.
- Treatment for the injured worker can be very costly. This does not include significant litigation fees, insurance increases, fines, accident investigation, etc.

Arc Flash Safety and Prevention

- Arc flash analysis must be performed prior to allowing personnel to work on energized equipment. The analysis defines the flash protection boundary distance and the type of Personal Protection Equipment (PPE) required.
- OSHA is an enforcer of safety practices in workplaces within the United States. OSHA 1910.132 (d) and 1926.28(a) states that the employer is responsible to assess the hazards in the work place, and to select, have and use correct PPE and document the assessment. The employer is required to conduct hazard assessment in accordance with 29CFR1910.132(d)(1). Employers who conduct the hazard/risk assessment, and select and require their employees to use PPE, as stated in the NFPA 70E standard, 2004 edition, are deemed in compliance with the Hazard Assessment and Equipment Selection OSHA Standard.
- The most common and industry accepted Personal Protective Equipment is flame resistant (FR) clothing.
- Use arc resistant equipment such as the Centerline ArcShield from Rockwell Automation for a higher level of employee protection.

The arc flash information contained in this document was compiled using information from the National Fire Protection Association (NFPA), ESA's Practical Solution Guide to Arc Flash Hazard, and an article in EC&M magazine (Electrical Construction & Maintenance) Preventing Arc Flash Incidents in the Workplace, by George Gregory, 2003.

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