

ARC FLASH SAFETY GUIDELINES

OVERVIEW

Arc flash hazards have existed since electricity came into use, but increased studies have begun to identify the causes, effects, and methods by which workers can protect themselves.

Each day approximately seven workers are killed and/or injured in electrical arc flash incidents. Approximately 30% of electrical injuries are caused by unsafe equipment and unsafe conditions. The remaining 70% are caused by unsafe acts

SCOPE

These Arc Flash Safety Guidelines apply to any facility where there is a transmitter, an operations center supplying power to mechanical equipment, or even an office where there is an electrical panel box that is accessed or can be accessed by our employees or contractor employees in a “live” state (in other words, energized).

Working on a “live” circuit can cause not only an electrical shock risk, but a unique situation called an electric arc flash.

An arc flash is basically a short circuit through the air, causing a sudden release of large amounts of heat and light energy at the point of the fault. This energy explodes outward from the equipment being serviced, creating pressure waves that can damage a person’s hearing; a high-intensity flash that can damage eyesight; and heat that can cause severe burns and inhalation injuries from expanding hot metal. The pressure waves are also powerful enough to send loose materials, such as damaged pieces of the electrical equipment, tools, and other objects flying through the air. Flammable materials that are nearby may also be ignited, resulting in secondary fires that can destroy an entire facility.

REQUIREMENTS

Because of the inherent dangers associated with electrical work, the Occupational Safety and Health Administration (OSHA) has enacted several standards dealing generally with electrical safety. These standards include:

- 29 CFR 1910.132(d)(1): Requires that employers perform a hazard assessment to determine the necessary personal protective equipment (PPE).
- 29 CFR 1910.269(l)(6)(iii): Requires employers to ensure each employee who is exposed to the hazards of flames or electric arcs does not wear clothing that could increase the extent of injury when exposed to such a hazard.
- 29 CFR 1910.335(a)(1)(i): Requires employees working in areas where there are potential electrical hazards to use electrical personal protective equipment appropriate for the specific parts of the body for the work being performed.
- 29 CFR 1910.335(a)(1)(iv): Requires employees to wear non-conductive head protection whenever exposed to electric shock or burns due to contact with exposed energized parts.
- 29 CFR 1910.335(a)(1)(v): Requires employees to wear personal protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from an electrical explosion.
- 29 CFR 1910.335(a)(2): Requires employees to use insulated tools or handling equipment when working near exposed energized conductors or circuit parts.
- 29 CFR 1926.28(a): Employer shall require employees to wear appropriate personal protective equipment.

In addition to these OSHA standards, the National Fire Protection Association (NFPA) has developed a standard addressing safe electrical work practices which recently was updated to address *specifically* the hazards associated with arc flash.

The standard on safe electrical work practices, known as NFPA 70E, consists of safety-related installation requirements, work practices, maintenance requirements, and requirements for special equipment. These safety practices can help to minimize the risk of burns, blindness, electrocution, electric shock, and other associated injuries to employees. While NFPA 70E is published as a voluntary consensus standard, OSHA recognizes it as legally binding and has been issuing citations for failure to follow the standard.

In 2002, the Institute of Electrical and Electronics Engineers (IEEE) adopted Standard 1584 that contains specific testing requirements to determine boundary distances for unprotected personnel and the incident energy at the working distance for qualified employees working on energized equipment. This incident energy level is then used to determine the proper personal protective equipment.

These industry standards and regulations apply to all workers who may be exposed to electric hazards. The OSHA regulations mandate the requirements; NFPA 70E defines the steps necessary to meet the OSHA requirements; and IEEE Standard 1584 provides the testing requirements to determine the appropriate levels of personal protective equipment.

RESPONSIBILITIES

To meet these OSHA and NFPA regulatory standards, the procedures listed below must be followed:

- A flash hazard analysis, which requires the services of an outside expert, must be conducted. An analysis should be conducted for each piece of equipment which is serviced while in a “live” state. A flash hazard analysis, as described by NFPA 70E, is “a study investigating a worker’s potential exposure to arc flash energy, conducted for the purpose of injury prevention and the determination of safe work practices and the appropriate levels of personal protective equipment.” The analysis should also take into account the Flash Protection Boundary and the flame-resistant PPE clothing that employees within the Flash Protection Boundary should wear.
- Personal protective equipment as prescribed by the NFPA 70E must be assigned at the outset of conducting a flash hazard analysis due to the need to be in close proximity to the electrical equipment in order to collect the requisite information (e.g. circuit breaker model and type). Refer to Appendix A for required types of protective clothing per Hazard/Risk category. For example, electrical testing within an energized 240V panel board would be Hazard/Risk Category C and would require wearing flame resistant coveralls or a long sleeve shirt and pants, hard hat, safety glasses, arc flash face shield, flash suit hood, hearing protection, leather gloves, and leather work shoes.

In most cases, the level of required personal protective equipment will be reduced after the flash hazard analysis

has been performed and the data has been analyzed. The safest option is always to de-energize as much equipment as possible prior to working on exposed parts.

- A “flash protection boundary” must be established around the equipment. The Flash Protection Boundary is the distance at which a person working any closer at the time of an arc flash may receive permanent injury (the onset of a second degree burn or worse) if not properly protected by flame-resistant clothing. The Flash Protection Boundary must be determined prior to beginning the work and must be communicated by procedural and visual means.
- The proper personal protective equipment must be used. Flame-resistant clothing and PPE must be utilized based on the potential danger to be encountered as determined during the flash hazard analysis or from the Hazard/Risk Table 130.7 in NFPA 70E. The Hazard Risk Table was developed to assist in the selection of the proper PPE based on the specific task to be performed and the incident energy associated with the task. In addition to flame-resistant clothing, other PPE such as insulating blankets, covers, hoses, sleeves, gloves, and head, foot, and hearing protection, must also be provided. Please refer to attached Appendix A for additional information on protective clothing and equipment.

- Employees who are required to perform work on “live” circuits must be trained to understand the specific hazards associated with electrical energy. They must also be trained in safety-related work practices and procedural requirements to provide protection from electrical hazards associated with their respective job. Because of these many dangers, only those qualified employees with the proper training, knowledge, experience, and appropriate PPE are permitted to perform work on “live” circuits. A “qualified employee” is typically an electrician or maintenance employee whose duties require working with or around exposed energized electrical conductors. An “unqualified employee” would include machine operators, process operators, and maintenance employees whose duties do not require working with or around exposed energized electrical conductors.
- The necessary signs and labels must be posted on the equipment to warn of the potential arc flash hazard and provide information on the appropriate PPE.
- Whenever possible, work should not be performed on “live” circuits unless an employer can demonstrate that lockout/tagout procedures cannot be utilized on the type of machinery/equipment being serviced. In all other instances, lockout/tagout procedures should be utilized. Lockout/tagout can prevent the unexpected energizing or start-up of equipment or the release of stored energy, which can cause severe injuries or death and/or damage to the equipment, machinery, and facilities.

TRAINING

Employees who face the risk of an electrical hazard that is not reduced to a safe level shall be trained to understand the specific hazards associated with electrical energy. They shall also be trained in safety-related work practices and procedural requirements to provide protection from electrical hazards associated with their respective job.

Employees working on or near exposed energized conductors or circuit parts shall be trained in methods to release victims from contact with exposed energized conductors or circuit parts. Employees shall be regularly instructed in methods of first aid and emergency procedures, such as approved methods of CPR. Whenever any work is being performed on a “live” circuit, an employee who has been trained in these first aid and emergency procedures must be available to provide assistance.

All employees should be trained so they are aware of the dangers of arc flash; understand the warning labels and signs; and know how to select and use the appropriate PPE.

Topics covered during training should include:

- Standards that govern electrical work and their requirements, including NFPA 70E and others.
- Electrical safety work practices, including lockout/tagout procedures per 29 CFR 1910.147.
- Applicability of other OSHA rules and penalties for non-compliance.
- The difference between “qualified” and “unqualified” workers and work limitations for unqualified workers.
- Comprehensive examples of acceptable and unacceptable work practices, including those in wet or damp locations.
- Use of key interlocking systems.
- Identification of type and level of hazards, including electrical shock and arc flash.
- Identifying energized components and conductors.
- Determining nominal circuit and equipment voltages.
- The use of voltage sensors and meters.
- Interpreting hazard warning labels.
- Safe approach distances to exposed electrical conductors.
- Rules for authorized “energized work” and use of live work permits and job briefings.
- The consequences of poor electrical safety practices to people and equipment.
- PPE requirements, including selection, proper use, and maintenance.
- Required and recommended maintenance and safety inspections.
- Grounds and grounding.

DOCUMENTATION

All switchboards, panel boards, control panels, and motor control centers that may require examination, adjustment, servicing, or maintenance while in an energized state must be labeled to warn qualified persons of the potential electric arc flash hazard.

Proposed changes to NFPA 70E, scheduled for release in 2009, will require warning labels to include either the available incident energy or the required personal protective equipment. The labels must also contain the exact hazards specific to each piece of equipment. Existing labels that do not contain this information will be obsolete and should be replaced.

Additional information such as approach boundaries, voltage, or assumed working distance is also commonly included on arc flash labels.

The National Electric Code (NEC) requires that labels must be located so that they are clearly visible to qualified persons before they begin work. In other words, workers must be able to see and read the label before they are exposed to an arc flash hazard. This includes workers who might not be involved in working on the equipment but are just passing through the area. Labels must be large enough to be legible at distances of up to several yards, depending on the severity of the hazard.

Labels should be kept legible and up to date, since arc flash hazard levels can change any time your electrical system is modified, including changing settings on circuit breakers.

An electric safety program, with clearly defined responsibilities, should be established to control and re-engineer the processes in the workplace to ensure electrical safety, including hazard assessments, labeling of equipment, training programs, energized work permits, and using current-limiting devices to minimize hazards.

An updated and accurate electrical one-line diagram is an essential ingredient for electrical safety. If workers do not have an accurate map of the system, they can be exposed to potential back feeds from alternate sources, energized capacitors, undocumented switching conditions, and unknown voltages, in addition to the problem of not being able to accurately perform lockout/tagout procedures.

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