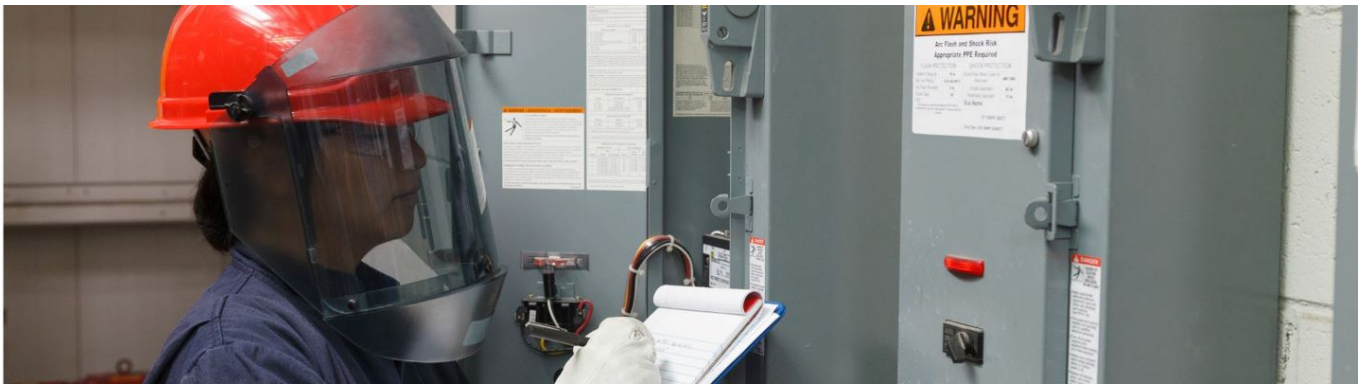

Regulatory Compliance

Whitepaper: Arc Flash Risk Assessment Compliance Guide

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Employees who work on or around energized equipment or machinery are exposed to electrical hazards, including arc flash, daily while on the job. Even in situations where an employee isn't directly working on energized electrical parts, there could be exposure to an arc flash hazard. Employers have a responsibility to identify and protect employees from these hazards. Regulatory bodies, including the Occupational Safety and Health Administration (OSHA) and The National Fire Protection Association (NFPA), regulate, and set the standards for, electrical safety in the workplace.

A requisite step in protecting employees is to perform an assessment of the workplace which identifies hazards, estimates the likelihood of hazard occurrence, outlines potential injuries associated with each hazard and determines the Personal Protective Equipment (PPE) required to work safely around the potential hazard. This four-step process is outlined in OSHA's Risk Assessment and Equipment Selection Standard 29 CFR 1910.132. Specifically, a current and accurate Arc Flash Risk Assessment will help reduce employee exposure to arc flash hazards. Arc flash risk assessments are very complex studies that require a solid foundation in the latest study performance standards and the application of that information to the specific work environment. What follows is a review of arc flash events, an outline of the assessment process and a review of additional compliance needs. In combination, these components will help keep employees safe.

What is an arc flash event?

An arc flash is the release of energy over a very short time period, through an electrical arc. These events are often caused by human error or equipment failure in an electrical system. During the event, energy is released in the form of heat, intense ultraviolet and infrared light, blast pressure waves and intense sound waves. Additionally, smoke, toxic fumes, molten metal and flying shrapnel may accompany the electrical event. In many ways, an arc flash event is very similar to a bomb. A person in proximity to an arc flash blast can suffer severe burns, collapsed lungs, loss of vision, ruptured eardrums, soft tissue injuries, broken bones or even death.

The NFPA defines an arc flash occurrence as "when an electrical current passes through air between ungrounded conductors or between ungrounded and grounded conductors." The temperatures in an arc flash event can reach temperatures of 35,000° F which is three-times hotter than the surface of the sun.

Causes of an arc flash event

There are two major causes of arc flash events:

Human error

The most prevalent cause is human error. Examples of human error include accidental contact of energized circuit parts with conductive tools or body parts, lack of training or insufficient training and installation issues including incorrect wiring or improper labeling.

Equipment failure

The other major cause of arc flash events is equipment failure. These equipment failures can take on many forms and include, loose connections causing arcing or overheating, improper equipment rating for the system in which it is installed and the breakdown of insulation on cables or other energized parts allowing current to flow outside of its intended path. Poor maintenance can exacerbate equipment failures leading to rust, dust, debris, condensation or exposure to water triggering an arc flash event. Transient events from utilities, lightning or events generated from within the facility can also cause an arc flash event. Finally, an employee who is interacting with a piece of improperly maintained piece of equipment needs to be able to recognize possible signs of imminent failure, such as excessive heat or noise.

Arc flash events — the numbers

- 5 to 10 arc flash accidents occur every day in the US[1]
- More than 2,000 people are treated annually in burn centers with arc flash injuries[1]
- Approximately 1 death per day occurs from arc flash incidents[1]
- $1.5M average cost of medical treatment[1]
- 8 to 12 months away from work[1]
- $10 to $15M average litigation cost[2]

Employers who take all of the necessary steps to protect and train their employees from an arc flash event have a much lower likelihood of an incident occurring. Lower incident rates translate to reduced litigation costs and fines for employers should an incident occur, provided that the incident was caused by employee negligence or failure to comply with employer policies.

How is an arc flash risk assessment performed?

An arc flash risk assessment is performed to identify arc flash hazards in an electrical system and to identify PPE to mitigate the hazard. To accurately determine an arc flash hazard, three pieces of information must be known about each point in the electrical system (bus) to determine the incident energy and arc flash hazard at that point:

1. How much current flows to each bus.
2. How long the current flows.
3. How close a person could be standing to the bus.

Short circuit study

A short circuit study is executed to determine how much current flows to each bus. This process requires data collection on the physical electrical system to determine its electrical characteristics. Information about wires, cables, conduits and transformers defines the impedance of the system which is used to determine the available fault current at each bus. Information about breakers and/or fuses defines the operating time of overcurrent protective devices for each bus. Knowing the fault current and clearing time of the overcurrent protective device allows for the magnitude and duration of the fault current to be determined at each bus. How close a person is standing to the bus is called the working distance and is typically assumed to be 18 inches below 1000V. The information from the short circuit study is subsequently used in the arc flash study, protective device coordination and device evaluation.

The first step in an arc flash risk assessment is the data collection phase. On-site data collection involves gathering information about the physical characteristics of the electrical system that is used to characterize its electrical properties. One-line diagrams, equipment submittal documents and equipment documentation are all useful at this stage. While completing on-site data collection, all precautions should be taken to protect the engineer from electrical hazards and arc flashes. These precautions can include de-energizing, engineering practices and the use of PPE. The utility company is contacted at this point and asked to provide information about its connection.

Once data collection is completed, it is typically entered into modeling software along with the utility company's contribution. The data is used to create an interactive model in a one-line diagram format. After the model is complete, the engineer can run various simulations and scenarios. These scenarios allow the engineer to determine the worst possible arc flash hazard, give insight on mitigating hazards, improve device coordination and identify inadequate devices.

Protective device coordination study

A comparison of the operating characteristics of breakers is done to determine if the protective device closest to a fault will operate. Well-coordinated systems isolate faults in the system and minimize outages due to the opening of a protective device. Recommendations should be made to ensure that the device immediately upstream of a faulted bus will operate, localizing the fault.

Arc flash study

To determine the worst possible arc flash hazard for a bus, calculations must be performed using the information from the short circuit study. All of the data from the arc flash labels will be derived from this study. This includes the determination of incident energy and personal protective equipment.

Device evaluation

Device evaluation determines if the equipment and protective devices are adequate for the available fault currents in the system. It is imperative to have equipment and devices rated to interrupt the fault current safely without damage or failure. The device evaluation is completed by comparing the available fault current determined during the short circuit study to the interrupting rating of the device or equipment.

What should be included in an arc flash risk assessment?

Several useful tools are generated during a thorough assessment that help those involved in the risk assessment make informed decisions. The most-common deliverables are labels on electrical equipment and a physical report with the findings.

Arc flash labels

An arc flash label is required for any piece of equipment that could require examination, adjustment, service or maintenance while energized. Remember, arc flash events are often caused by human error, and working on a piece of equipment while energized creates the potential for an arc flash incident to occur. To comply with NFPA 70 110.16, equipment including, but not limited to, switchboards, switchgears, panel boards, industrial control panels, motor control centers, production line equipment cabinets and safety disconnect switches, must have labels that inform qualified persons of the arc flash hazard potential. The preceding applies to any piece of equipment operating at 50V or above. This label must be permanently affixed to the equipment, must not be handwritten and must be durable enough to withstand the environment in which it is installed.

The label must include the following:

- Nominal system voltage and shock boundaries
- Arc flash boundary
- Incident energy and working distance OR PPE category
- Minimum arc rating of PPE

*Continue reading this compliance guide in its entirety **here** to learn about reporting requirements and additional steps to becoming and remaining compliant.*

1. Campbell, Richard B and Dini, David A, Occupational Injuries From Electrical Shock and Arc Flash Events, Fire Protection Research Foundation, March 2015 *https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and....* ashx?la=en
2. Jennifer Busick, Don't Let Arc Flash Cost You, EHS Daily Advisor, August 19, 2015 *https://ehsdailyadvisor.blr.com/2015/08/dont-let-arc-flash-cost/*

