Why Perform Arc Flash Evaluations?

Why Test? Series

WHY TEST?

Arcing from an electrical fault produces incredibly high temperatures. It can easily exceed 30,000°F — hotter than the surface of the sun! Air expands dramatically when heated to these temperatures. Arcing also causes metal conductors to vaporize. Copper expands 67,000 times when it is converted from solid to vapor. This rapid expansion of air and metal vapor produce an intensely hot blast. Too often employees who are not wearing adequate Personal Protective Equipment (PPE) are seriously injured or killed if an electrical arc occurs when they are working on electrical equipment.

Burns account for about 80% of all injuries that result from electrical accidents. These burns usually result from exposure to intense heat and molten metal generated by an arcing fault. Such burns are typically second and third degree in nature and can frequently cause death a few days after the accident. Arcing causes air and metal vapor to expand at such a rapid rate that it produces a blast similar to the force of an explosion — enough to throw a worker's body across the room.

Arc flash studies should be used to determine the minimum level of PPE workers must wear when they are near exposed energized equipment. For the past several years OSHA regulations have required hazard assessment and use of appropriate PPE in the workplace. An arc flash study provides a quantifiable assessment of the hazard level.

Before work is performed on or around electrical equipment, it must be deenergized if practical. OSHA Title 29CFR part 1910.333 states: "Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations." If energized work cannot be avoided, OSHA's 1910.335 states: "Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed."

Article 130.1 of the NFPA 70E 2012 Standard for Electrical Safety in the Workplace has similar wording. For situations where the Article 130.1 B (3) exemptions do not apply, it states: "When working within the limited approach boundary or the arc flash boundary of exposed energized electrical conductors or circuit parts .... work to be performed shall be considered energized electrical work and shall be performed by written permit only." It goes on to outline eight required elements that must be included in the written work permit. Performing a 'flash hazard analysis' is a prominent element of the required activities.

The 2011 National Electrical Code (NEC) states in Section 110-16: "Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of the potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment."

NFPA 70E Section 130.5 states: "An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance and the personal protective equipment that people within the arc flash boundary shall use." Equipment shall be field marked with a label containing all the following information:

(1) At least one of the following:
   a. Available incident energy and the corresponding working distance
   b. Minimum arc rating of clothing
   c. Required level of PPE
   d. Highest Hazard/Risk Category (HRC) for the equipment

(2) Nominal system voltage

(3) Arc flash boundary

Arc flash calculations assess the available arc fault exposure at panels and similar equipment locations within a facility. It is noteworthy that the objective of an arc flash study, and current industry practice, is only to determine the level of PPE personnel must wear to limit the incident energy to a curable level (2nd degree burn or less). These methods do not attempt to eliminate all risk or injury resulting from electrical short circuit arcs.

NFPA 70E 2012 Annex D provides information on the method to be used for calculating incident energy levels resulting from arc flash. This method is based on the IEEE 1584-2002 Standard, IEEE Guide to Performing Arc Flash Hazard Calculations.

Depending upon the incident energy levels present at a given location, the minimum required levels of PPE can be determined to withstand the conditions that may be encountered.

Ideally an arc flash study should be done in conjunction with the acceptance testing and engineering studies at the time of commissioning since a short circuit study is required to perform the evaluation. A coordination study (or the equipment settings and manufacturer's time-current-characteristic curves) for the devices protecting all locations to be evaluated is also required to perform the arc flash calculations. Once the arc flash study is completed, the results should be maintained in the facility engineering documentation and incorporated into a published safety manual.

As noted in NFPA 70E Section 130.5: "The arc flash analysis shall be updated when a major change modification or renovation takes place. It shall be reviewed periodically, not to exceed five years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis."

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Electrical Reliability Services
1 (877) 468-6384
www.electricalreliability.com