Arc Flash Studies

Educational Series: Why Test?

VERTIV.

Electrical Reliability Services

Why Is Arc Flash a Concern?

Arcing from an electrical fault produces incredibly high temperatures. It can easily exceed 30,000°F, which is 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 similar to an explosion and is enough to throw a worker's body across the room. 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.

The majority of all injuries resulting from electrical accidents are burns. These burns usually result from exposure to intense heat and molten metal generated by an arcing fault. They are typically second- and third-degree burns and can frequently cause death a few days after the accident.

How Can We Mitigate Risk?

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, regulations from the Occupational Safety and Health Administration (OSHA) have required hazard assessment and use of appropriate PPE in the workplace. An arc flash study provides a quantifiable assessment of the hazard level.

What Kind of Regulations Apply to Arc Flash Hazards?

Before work is performed on or around electrical equipment, it must be deenergized if practical. OSHA 29 CFR 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 130.2 of the latest edition of NFPA 70E Standard for Electrical Safety in the Workplace® has similar wording. For situations where the exemptions of Article 130.2(B)(3) do not apply, it states that an energized electrical work permitis required. It goes on to outline nine required elements that must be included in the written work permit. Performing an arc flash risk assessment is a prominent element of the required activities.

The National Electrical Code (NEC) states in Section 110-16: “Electrical equipment, such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures, and motor control centers that is in other than dwelling units and is likely to require examination, adjustment, servicing, or maintenance while energized, shall be field or factory marked to warn qualified persons of potential electric arc flash hazards. The marking shall meet the requirements in 110.21(B) and be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.”

NFPA 70E Section 130.5A states: “An arc flash assessment shall be performed:

1. To identify arc flash hazards
2. To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
3. To determine if additional protective measures are required, including the use of PPE.”

NFPA 70E Section 130.5C states: “When the additional protective measures include the use of PPE, the following shall be determined:

1. Appropriate safety-related work practices
2. The arc flash boundary
3. The PPE to be used within the arc flash boundary.”

NFPA 70E Section 130.5H states: "Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that is in other than dwelling units and that is likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one of the following:
    a. Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(a) or 130.7(C)(15)(b) for equipment, but not both
    b. Minimum arc rating of clothing
    c. Site-specific level of PPE"

What Is an Arc Flash Study?

Arc flash studies 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 (second-degree burn or less). These methods do not attempt to eliminate all risk or injury resulting from electrical short circuit arcs.

NFPA 70E Annex D provides information on the methods for calculating incident energy levels resulting from arc flash Section D.4 outlines the IEEE 1584 Guide for 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 being 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's engineering documentation and incorporated into a published safety manual.

How Frequently Should an Arc Flash Study Be Conducted?

As noted in NFPA 70E Section 130.5G: "The incident energy analysis shall be updated when changes occur in the electrical distribution system that could affect the result of the analysis. The incident energy analysis shall also be reviewed for accuracy at intervals not to exceed five years."