Why Perform Arc Flash Evaluations?

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 2009 Standard for Electrical Safety in the Workplace has similar wording. For situations where the Article 130.1 (3) exemptions do not apply, it states: "If live parts are not placed in an electrically safe work condition .... work to be performed shall be considered energized electrical work and shall be performed by written permit only." It goes on to outline eleven required elements that must be included in the written work permit. Performing a 'flash hazard analysis' is a prominent element of the required activities. Article 130.3 states: "A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use."

The 2008 National Electrical Code (NEC) states in Section 110-16: "Switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling occupancies 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."

While the NEC requires basic marking, this marking does not tell the worker what is the extent of the hazard, or what level of PPE is needed. It becomes the worker's task to assess the hazard and determine the level of PPE needed. This task frequently exceeds the worker's ability and an accurate assessment simply isn't performed. Arc flash studies should be performed at any commercial or industrial facility served at 208V or higher. The arc flash values and minimum PPE requirements should be posted at the applicable equipment locations. PPE requirements would then be clearly available for any maintenance personnel or contractors working on energized equipment.

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 circuits.

NFPA 70E 2009 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.

The short-circuit, coordination and arc flash studies and associated documentation will need to be updated when changes are made to the distribution system or utility supply.