Reducing Arc Flash Hazards and Minimizing Risk

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***Approximately 2,000 people in the U.S** are treated each year for severe arc flash burn injuries, according to the National Fire Protection Association (NFPA). Arc flashes are responsible for as many as 80 percent of all electrical-related injuries. In North America, about five to 10 arc flash events occur each day.*

Users of electrical equipment do their best to help manage safety hazards and reduce risk. For many, the importance of mitigating arc flash safety risk goes beyond improving employee safety. It's also about protecting capital investments, minimizing legal implications and reducing the often substantial financial costs associated with electrical incidents. Arc flash safety equipment can deliver positive, business-enhancing benefits when effectively implemented, while also mitigating risk and reducing costs.

But without a clear understanding of the present risks, industry standards and the role arc-resistant motor control centers (MCCs) play in helping contain arc energy, applying technology where needed on the factory floor can be a blurry challenge.

Feel the Heat

An electric arc flash is the result of an arc fault that superheats the air around it, expanding and creating a pressure wave within an electrical enclosure. This arc plasma vaporizes everything it comes in contact with, such as copper, insulating materials, bolts and even steel enclosures. This massive heat and energy wave can inflict serious injuries, including severe burns, damaged hearing from the powerful sound waves, impalement from projectiles and impaired eyesight from the high-intensity flash.

One characteristic that makes an arc flash such a dangerous event is the extreme temperature involved, reaching up to 35,000 degrees Fahrenheit – almost four times the surface temperature of the sun. Moreover, the pressure wave from the blast can be the equivalent to that of a hand grenade.

The causes of arc flash events are usually accidental. In industrial settings, many things could compromise the air space that acts as insulation to prevent electrical energy from igniting an electrical arc. The cause of the arc flash could be as simple as a rodent, snake, dust or water accidentally entering the electrical equipment, or it could be human error, such as an employee accidentally leaving a tool inside the enclosure or forgetting to tighten a connection. Other events result from poor or improper maintenance of facilities and equipment.

Knowing the Risks

Effectively mitigating arc flash risks begins with a risk assessment. Performing a thorough assessment helps identify the areas of arc flash risk within a plant and pinpoint the best people, processes and technologies to minimize those risks.

Engineers, safety professionals and third-party safety specialists can collaborate to properly identify risks and determine the appropriate mitigation measures.

Standards Intensify the Focus

Historically, electric codes and equipment design and safety standards did not directly address arc-flash hazards. They only addressed protection from fire, electrocution and shock hazard. Standards like NFPA 70E – Electrical Standard for Safety in the Workplace have put more focus on providing a practical, safe working area for employees by helping to reduce the hazards associated with electrical energy, including arc-flash risks.

As codes and standards continue to evolve to raise the awareness of potential hazards, users of electrical control products are looking for leading-edge products capable of delivering higher levels of safety. Arc-resistant motor control centers (MCCs) and intelligent control systems can fulfill that need in many applications. These systems offer improved safety features along with remote operation and monitoring capabilities.

While prevention is a key part of the solution, sometimes arc flash events can occur regardless of best intentions. This is where advanced control and protection technologies can play a vital role.

Framework of an Effective Design

Arc-resistant control products are designed to contain the arc energy and direct it away from personnel. This type of equipment is designed and tested to control arc flash exposure by controlling the spread of the arc or channeling the high temperature and pressure wave away from personnel. Some systems include remote monitoring and control capabilities designed to minimize the amount of time personnel are required to be near the equipment, helping to further reduce the safety risk.

Arc-resistant control equipment, including low voltage (LV) and medium voltage (MV) control centers, are designed, tested and built to contain and redirect the energy away from personnel. The level of protection for those working around arc resistant equipment is defined by an Accessibility Type.

The ability of arc resistant control equipment to provide Type 2 or 2B accessibility, as defined in IEEE standard C37.20.7-2007, is another important aspect to understand. Type 2 accessibility helps shield personnel on the front, rear and sides of the enclosure from the effects of an internal arc fault. Type 2B accessibility allows control compartment doors to remain open while retaining the cabinet's arc resistant capabilities.

Rugged structural designs and a well-supported, isolated and insulated bus system are critical for arc resistant equipment to withstand the effects of an arc flash event. Two-side sheets on every section and robust bus support designs also contribute significantly to the ability of the equipment to contain and redirect the arc flash energy.

Additional options, such as blown-fuse indication, exterior viewing windows on unit doors, arc tested infrared viewing windows and finger-safe component barriers, are just a sample of the available options that help provide further protection and reduce the risk of personnel making contact with energized components.

One of the newest features in LV and MV MCC technology is the use of built-in networking and preconfigured software. By including a built-in industrial network, based on an open protocol, along with MCC monitoring and configuration software, users can remotely monitor, configure and troubleshoot the MCC, minimizing the need for personnel to enter into an arc flash boundary zone.

Clearing the Confusion

In considering any arc-resistant control equipment, it's important to understand the performance criteria that must be met before the equipment can be classified as an arc-resistant design. "Arc-resistant," as it applies to electrical equipment like MV MCCs, is a recognized industry term defined by IEEE C37.20.7-2007. The standard defines the test requirements that must be met and the expected performance the equipment must deliver in the event of an arc flash.

In many cases, motor controls that are not arc resistant simply cannot withstand the effects of internal arcing faults for the tests prescribed in the IEEE standard. Instead of achieving the advanced level of protection being sought, many users instead are relegating their strategy (perhaps unknowingly) to one based solely on preventive measures. This limited approach may not fully address arc flash dangers and may only protect a small scope of users.

By not implementing tested arc-resistant equipment designs, users may be failing to address the possibility that an arc flash could occur in any unit, not just the unit that is being worked on. It disregards the safety of nonelectrically qualified personnel who may be in the vicinity of the electrical equipment and unaware of the potential hazards of the equipment. In other words, no matter how much prevention is practiced, a chance remains that an arc fault could occur in equipment during normal operation.

A fundamental approach to arc-flash safety must include all personnel, electrically qualified and nonqualified. Arc faults can occur during normal operation without any specific human action and affect someone simply "minding their own business," such as walking by the equipment or sweeping the floor in the equipment room.

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Sticking to the Standards

In the case of LV MCCs, another area of confusion centers on the claim that keeping the doors of an MCC closed during insertion and removal of power stabs provides a lower risk, and therefore allows users to adhere to a reduced level of required PPE. The reality is no industry standard allows users to reduce the risk category of an MCC application just because the door is closed.

According to NFPA 70E, PPE levels are to be determined by either using the "default" hazard/risk category tables contained in the standard or by calculating the expected arc flash incident energy using one of the methods described in the standard. Furthermore, for the closed-door activities described in the default tables, the hazard/risk category assumes that no abnormal condition (like an arc fault) will occur, or if it does, the unit door will remain closed. This is a potentially fatal assumption if the equipment is not rated as arc resistant.

Even if reducing the risk category by keeping the door closed on a LV MCC were allowed, the real question is: Will the door stay closed in the event of a fault in the unit? The reality is that during an internal arcing fault, the doors of equipment that is not arc resistant may come open, even if they were properly closed and latched per the manufacturer's specifications. This could increase personnel exposure to the effects of the arcing fault, perhaps even exceeding the capabilities of the PPE selected based on the default tables.

Diligence Pays Off

All users of electrical control equipment in an industrial environment are responsible for performing risk assessments to identify arc flash hazards. An assessment defines potential arc-incident energy levels adjacent to particular electrical equipment and yields the required level of PPE needed when working near energized electrical equipment. In addition, the data an assessment yields is required for labeling all electrical equipment, as defined in the National Electrical Code and NFPA-70E.

Ultimately, the best prevention against exposure to an arc flash is a safety program that complies with the requirements outlined in the NFPA 70E standard and implements arc resistant control equipment. Beyond that, the most important advice is "shut it off."

Because of high-production volumes and the use of multiple and differing automation systems in a single plant, identifying and significantly reducing potential hazards can be a complex task. This means manufacturers must be diligent in their training practices and highly selective in their technology choices to increase workplace safety in compliance with present safety standards. With advances in arc resistant control and protection technology designed to help deliver improved safety, increased productivity and greater cost-savings, users of electrical equipment can more easily mitigate arc flash safety risk.

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Publication SAFETY-WP015A-EN-P –July 2012