Your Global Automation Partner

TURCK

Minimizing Arc Flash Exposure in Industrial Applications

White Paper - W1000

Industrial environments present multiple safety challenges, including fire hazards that require proactive safety measures to minimize potential risk. Arc flash hazards cause thousands of injuries a year, resulting in serious burns and in some cases, even death. Electrical accidents can contribute significant costs to businesses in lost property, injuries and loss of life. With today's dependence on industrial networking, which requires frequent interaction with energized equipment, the risk of igniting an arc flash could increase significantly.

To reduce the potential for injuries or deaths from arc flash incidents, the Occupational Safety and Health Administration (OSHA) has issued regulations designed to promote workplace safety. Concurrently, the National Fire Protection Association (NFPA) also provides codes and standards, research, training and education to reduce fire and other hazards. Together, these two organizations set the industry standard for practices and procedures that influence workplace safety.

This white paper will discuss the definition of an arc flash, including its risks, consequences and causes, industry standards to protect against arc flash and a solution to minimize arc flash exposure.

DEFINING ARC FLASH

An arc flash is an explosive blast of flame, debris, sound and force—the severity of which is determined by the distance from the arc and the amount of energy available. An arc flash can occur anywhere in an electrical system and is caused by a phase-to-phase fault or when the affected electricity is provided a low impedance path to ground, or phase-to-ground fault. The fault causes rapidly excessive heating of air molecules, ionizes and vaporizes conductive metal materials and generates a densely-concentrated blast of pressure formed by light and heat energy. The arc flash blast can propel molten metal, shrapnel

and tools through the air, causing a serious risk to facility personnel and occupants. An arc flash usually lasts under one second but can reach up to 35,000 degrees Fahrenheit, which can result in critical burns when in contact with human skin.

Risks, Consequences and Causes

Arc flash can result in serious injuries, including flash burns, hearing loss, vision loss, trauma and, in some cases, death. The intense heat can ignite or melt clothing that is not flame resistant. Up to 80 percent of all electrical injuries are burns resulting from an arc flash and ignition of flammable clothing. Electric arc is measured in calories, a unit of measure for heat or energy; one or two calories/cm2 will cause a second-degree burn on human skin. Only clothing tested to meet specific calorie ratings should be worn in industrial environments with arc flash risks present.

In addition to injuries, arc flash can cause significant business consequences including equipment damage, production downtime, non-compliance with industry regulations and poor public image. These consequences can negatively affect a business by resulting in increased operation/equipment costs.

While there are many causes of an arc flash incident, the most common are human error, the absence of preventive maintenance procedures and electrical systems or legacy equipment that are not designed to prevent an arc flash. Arc flash can occur because of human error as a result of unsafe work processes during maintenance activities or when operating with certain tools that may put operators at risk. Preventive maintenance procedures are also important, as neglecting to inspect electrical equipment, in addition to periodically testing and operating the equipment's moving parts that are manufactured to clear electrical faults, can potentially cause arc flash incidents. Lastly, an improperly designed electrical system or system modifications and legacy equipment can result in arc flash hazards.

INDUSTRY STANDARDS

Occupational Safety and Health Administration (OSHA)

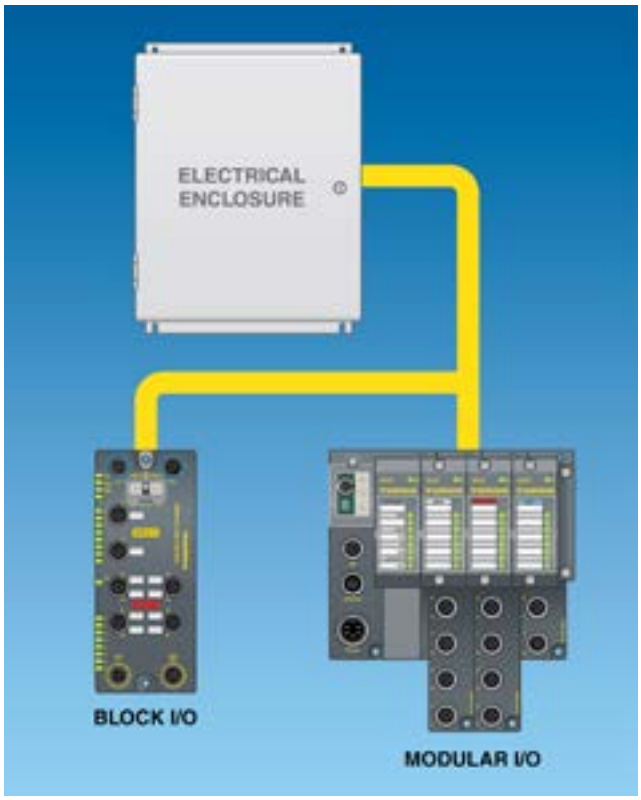
The Occupational Safety and Health Administration (OSHA) is a branch of the US Department of Labor established in 1970. Its mission is "to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships and encouraging continual improvement in workplace safety and health."

Under paragraph 5a1 (OSHA 1910.132), the General Duty Clause, it is the employer's responsibility to identify risks and hazards in the workplace and to seek out appropriate protective garments and equipment for the protection of workers. It states that each employer "shall furnish a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

In making this hazard risk assessment, the employer must consider the risks present and the most appropriate means of addressing those risks.

National Fire Protection Association (NFPA)

Established in 1869, the National Fire Protection Association (NFPA) serves as the world's leading advocate of fire prevention and is an authoritative source on public safety. The NFPA's purpose is to "reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training and education." The NFPA's 300 codes and standards influence every building, process, service, design and installation in the United States, as well as many of those used in other countries.



The NFPA publishes both the NFPA 70 National Electrical Code (NEC) and the Standard for Electrical Safety in the Workplace (NFPA 70E). These publications are nationally recognized as providing the industry's acceptable standard practices used by federal, state and local building authorities to regulate safe electrical installation and maintenance. The current NFPA 70E standard specifically addresses host employer and contract employer responsibilities. The host employer is responsible for advising the contractor of known hazards and other information about the work site. The contractor employer is responsible for instructing his or her employees on the hazards communicated by the host employers and for ensuring that the contract employees follow required rules and work practices. NFPA does not levy fines, and is not part of OSHA, but it is very influential as a best practices model. NFPA codes are often cited by OSHA in the assessment of fines.

Virtually any facility housing electrical equipment falls under NFPA 70E/CSA-2462 guidelines—especially in enterprises dependent upon heavy machinery operations, including:

- Aluminum
- Automotive
- Chemical
- Commercial Printers
- Computers and Chips
- Food Processing
- Hospitals
- Metal Fabrication
- Paint
- Petroleum
- Pharmaceutical
- Power Generation
- Pulp and Paper
- Transportation

Within each of these operations are workers that risk an electric arc flash within the flash protection boundary while performing tasks such as removing or installing circuit breakers, low-voltage testing, working on control circuits with energized parts exposed, racking circuit breakers or starters and removing bolted covers of energized parts or equipment.

PROTECTING AGAINST ARC FLASH HAZARDS WITH DISTRIBUTED I/O

While there is no solution that can completely eliminate the risk of arc flash hazards, there are solutions that minimize engineer, technicians and maintenance workers' exposure to such risks. Since there is a potential for an arc flash occurrence every time the electrical enclosure is opened, being able to take distributed I/O equipment out of the electrical enclosure, which may contain live voltage with sufficient energy for an arc flash event, and mount it in the field, minimizes risk exposure and ensues continued connectivity.

While flame-resistant apparel can provide workers with protection against arc flash, it can be cumbersome, time-consuming and laborious to put on. Further, engineers and maintenance workers require frequent access to distributed I/O equipment and controls, so an efficient, safe method for personnel interaction is key. Mounting equipment and controls outside the electrical enclosure enables engineers to access it without opening the enclosure. This not only ensures the same level of connectivity and communication, but also enhances operator safety.

For additional flexibility and enhanced application suitability, distributed I/O products are engineered for durability. Featuring IP ratings, such as IP65, IP67, IP68 and IP69K, these products can reliably perform in dusty, wet and harsh environments without fear of environmental ingress, with some even withstanding heavy washdown conditions and total submersion. This allows distributed I/O products to be effectively removed from the electrical enclosure and exposed to the application environment without malfunctioning, causing network faults or service interruptions. Distributed control with a sufficient IP rating can also be removed and mounted externally from the electrical enclosure significantly reducing the amount of time needed inside of the enclosure to work on the PLC. Network switches, and power supplies that carry a rating of IP67 or higher can also be removed from the electrical enclosure. Ultimately, the more components placed outside of the enclosure equals less time needed for workers to spend in the cabinet resulting in a safer environment.

Turck Inc. | 3000 Campus Drive, Minneapolis, MN 55441 | T +1 800 544 7769 | F +1 763 553 0708 | www.turck.com