Expertise, our source of energy

ARC FLASH HAZARD SOLUTIONS

MITIGATING THE HAZARDS OF ARC FLASH

The Explosive Power of an Arc Flash

The many intense hazards created by arcing faults in today's industrial power systems arise from two factors — the tremendous amounts of power that can be delivered to such arcs and the workers' close proximity to them.

When an arcing fault is established, current passes through ionized air. Large volumes of ionized gases, along with molten metal from the vaporized conductors, are rapidly expelled. As the arc runs its course — generally in less than 0.2 seconds — electrical energy continues to be converted into extremely hazardous forms of energy, including:

- Intense heat capable of causing severe, often fatal burns, even beyond typical working distances.
- A thermoacoustic shock wave that can result in ruptured eardrums, collapsed lungs, or fatal injuries.
- Molten metal, at temperatures typically exceeding 1900°F, reaching distances of several feet.
- Shrapnel that can impact a nearby worker at high velocity, resulting in physical trauma.
- Blinding light, which can cause immediate vision damage and increase the potential for future deterioration.
- Toxic gases, including combustion byproducts and copper oxides.
- Contact with energized components — the explosive nature of an arc fault increases the possibility that an energized conductor or component will make contact with workers in the area.

WHY ARC FLASH IS A VITAL — AND TIMELY — TOPIC

If previous statistics hold true, the explosive energy released during arcing faults will send more than 2,000 workers to burn centers this year.

An arc flash event can occur in any type of plant and can result from something as simple as a tool accidentally dropped on an energized part and can be significantly magnified by improper overcurrent protection. The cost to human life can be incalculable. The cost to a business, in medical expenses, equipment replacement and downtime, can easily exceed $1 million.

Today, that cost can also include significant fines by OSHA. By meeting the requirements of NFPA 70E, Standard for Electrical Safety in the Workplace, OSHA is likely to judge that an employer "acted reasonably" in protecting its workers from arc flash hazards.

As an employer, you also have a moral responsibility to protect your employees from harm. And now, the financial and legal obligations inherent in electrical accidents are even great.

Mersen Can Help You

Mitigate Arc Flash Hazards

IT'S YOUR RESPONSIBLITY TO PROTECT YOUR PEOPLE AND EQUIPMENT

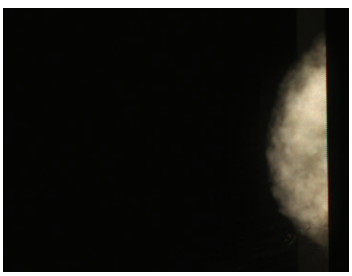
Personal protective equipment is a worker's last line of defense against arc flash hazards. In addition, here are ways to reduce the risk to workers:

- **Upgrade branch circuit fuses to Mersen's Amp-Trap 2000® current-limiting fuses.** Extensive testing to IEEE 1584 test protocols has shown that these fuses — our A6D Class RK1, A4BQ Class L, and AJT Class J — limit arc flash incident energies to very low values for arc fault currents within their current-limiting range. Applied properly, they can reduce the incident energy levels to below the NFPA70E threshold of 1.2 cal/cm^2 for arc rated PPE.
- **Perform an arc flash analysis.** Our experienced team of solution engineers can recommend arc flash analysts who can analyze your electrical system's levels of arc flash and other electrical hazards in accordance with NFPA 70E and OSHA. A standard analysis includes arc flash, shock and other hazards assessment, warning labels for electrical equipment with incident energy calculations, arc flash protection boundary calculations, and required PPE. Reports include recommendations for remediation of improperly rated equipment.
- **Make sure you have the right fuses on hand.** Obsolete and out-of-stock fuses increase the potential for dangerous misapplications. Mersen's Fuse Control™ inventory analysis inventory analysis of your fuse spares can help ensure that your inventory is complete and up to date. We provide detailed recommendations for consolidations, help manage the transition, and train your employees. Our reports include a summary of Total Cost of Ownership reductions.
- **Provide safety training for your staff.** In addition to in-depth seminars on arc flash hazards designed for engineers and safety managers, we provide electrical protection safety training for electrical workers, purchasing professionals, and storeroom personnel.
- **Minimize the likelihood of shock by specifying IP20 finger-safe devices for your electrical equipment.** Mersen offers a complete line of finger-safe products, including disconnect switches, UltraSafe™ fuse holders, and our FSPDB, the industry's first finger-safe power distribution block.
- **Consult with our Solution Engineers.** Our Solution Engineers can help keep you up to date on evolving safety issues and on code and standard changes. They can work with you and your analysts to help develop solutions that can significantly reduce arc flash energies.

REDUCING ARC FLASH ENERGIES WITH CURRENT-LIMITING FUSES

These photos, taken from high-speed digital video shot in our high-power test lab, illustrate the significant reduction in arc flash energies possible with current-limiting fuses.

A 22.8kA fault current is delivered to a circuit protected by a circuit breaker with a clearing time of 6 cycles. The resulting incident energy measured at 18" from the conductors was 8.14 cal/cm^2, making Category 3 the minimum PPE required.



In the photo (left), Mersen's Amp-Trap 2000® A6D600R fuse interrupts the 22.8kA fault before the arc can fully develop, limiting the incident energy measured at 18" from the conductors to 0.25 cal/cm^2 and the minimum PPE required to Category 0.

Arc Flash Regulations

Being responsible for your workers' safety means being up to date on the various regulatory and consensus standards applicable to arc flash hazards. The four major industry standards that have the most impact are OSHA regulations, NFPA 70, NFPA 70E, National Electrical Code® and IEEE Standard 1584. Here is a summary of those regulations.

OSHA STANDARDS

OSHA standards mandate that employers provide a safe workplace. For example, OSHA Standard 29 CFR Part 1910, Subpart S, addresses safety- related practices for electrical work. It makes clear that, with very few exceptions, equipment must be de-energized before work is performed, and lockout/tagout procedures must be followed.

However, if equipment cannot be de-energized prior to work, the standard requires that:

- Employees are properly protected by personal protective equipment (PPE) appropriate for the work being performed.
- Employers perform an electrical hazard assessment to determine if hazards are present or likely to be present, select the necessary PPE, and communicate those selection decisions to each affected employee.

See the OSHA Standards for specific text from Subpart S. In addition, OSHA 29 CFRPart 1910 contains many other sections that pertain to electrical safety and arc flash hazards. They address safety requirements, personal protective equipment, and general environmental controls, such as lockout/tagout.

THE NFPA 70E STANDARD

For details on how to conduct an electrical hazard assessment or how to select PPE, you must look to national consensus standards.

NFPA 70E, Standard for Electrical Safety in the Workplace, is one of the foremost consensus standards for electrical safety. Developed by the National Fire Protection Association, it addresses employee protection from the electrical hazards of shock and arc flash.

NFPA 70E is considered by OSHA to be the recognized industry practice for electrical safety. Recent inclusion of reference to ANSI Z10, American National Standard for Occupational Health and Safety Management System, is now emphasizing risk control techniques to achieve higher orders of safety that minimize that effect of worker error.

In its standard interpretation of the relevance of NFPA 70E, OSHA states:

Industry consensus standards, such as NFPA 70E, can be used by employers as guides to making the assessments and equipment selections required by the standard. Similarly, in OSHA enforcement actions, they can be used as evidence of whether the employer acted reasonably.

Chapter 1 of NFPA 70E provides guidance on establishing electrically safe work conditions and developing such safety-related work practices as a safety program and worker training. And while it emphasizes that working on live parts is "the last alternative work practice," NFPA 70E contains extensive requirements for working on energized electrical conductors or circuit parts that have not been put into an "electrically safe condition." One of the requirements is electrical hazard analysis, which includes arc flash hazard analysis.

Arc Flash Regulations

NFPA 70, THE NATIONAL ELECTRICAL CODE®

While the NEC has traditionally addressed installation techniques intended to prevent fire, electrocution and shock hazard, it now contains requirements related to arc flash hazards.

Section 110-16, Flash Protection, requires that markings be placed on switchboards, panelboards, industrial control panels and motor control centers to warn qualified persons of potential arc flash hazards. Section 240.67 and 240.87 mandate clearing time reduction methods to reduce the magnitude of arc flash hazards for circuits 1200A or greater.

IEEE STANDARD 1584 TM-2018

IEEE Standard 1584 provides techniques for performing a comprehensive arc flash hazard analysis. Its systematic, ten-step approach enables designers and facility operators to predict the incident heat energy at the expected worker location should an electrical arc flash were to occur. Of course, there are other benefits to performing an electrical hazard analysis. By providing an in-depth look at your plant's electrical system, it supplies data that can be used to improve overall system performance, reduce downtime and manage costs.

Mersen Amp-Trap 2000® Fuses

For Arc Flash Mitigation

In laboratory tests, Mersen's Amp-Trap 2000 A6D, A4BQ and AJT fuses have generated excellent results, limiting the energy delivered to arc faults to very low values for fault currents within their current-limiting range. Because this energy reduction reduces the amount of heat generated, the use of these fuses typically minimizes the level of personal protective equipment (PPE) required, allowing personnel to work more easily, efficiently, and safely.

AMP-TRAP 2000 AJT, CLASS J FUSES

The ideal choice for new applications of 600A and less, AJT fuses offer excellent current-limiting performance for short circuits and time delay for overloads, as well as:

- **The best degree of arc energy mitigation.** When applied properly for expected arc fault currents, these fuses can reduce incident energies at a working distance of 18″ to less than 0.25 calorie/cm^2.
- **Unique Class J dimensions.** Interchanging fuse classes can lead to compromised protection and coordination. Non-interchangeable Class J dimensions eliminate this problem.
- **Type "2" protection for motor starters.** The AJT has been certified by starter manufacturers to provide Type "2" No-Damage short-circuit protection for NEMA and IEC starters.
- **Ability to be used as a cable protector.** The blades on the AJT (70A – 600A) are designed to accept lugs and can be installed as cable limiters — a feature to consider in special situations where current limitation might otherwise be impossible.

AMP-TRAP 2000 A4BQ, CLASS L FUSES

Designed for applications over 600A, Mersen A4BQ fuses have an interrupting rating of 300kA and a unique design that delivers excellent performance in arc flash situations. They offer:

- **The best degree of arc energy mitigation.** Lower current-limiting thresholds and let-thru energies are key features of the A4BQ line. When fuses up to 1600A are applied properly for expected arc fault currents, incident energies at a working distance of 18″ can be reduced to Category 0 PPE levels.
- **Easier system coordination.** Combine A4BQ fuses with other Amp-Trap 2000 fuse classes, and you can ensure a fully coordinated system by sizing upstream fuses at only twice the ampere rating.
- **Easy downsizing.** Feeder fuses often have larger ampere ratings than are needed. Downsizing should be considered when it would lead to substantial incident energy reduction with the hole pattern in its blade. Any A4BQ can be downsized to 100A without reducer hardware.

Mersen Amp-Trap 2000® Fuses

For Arc Flash Mitigation

AMP-TRAP 2000 A6D OR A6D-R, CLASS RK1 FUSES

The ideal choice for upgrading existing applications of 600A and less, A6D fuses offer excellent current-limiting performance for short circuits, time delay for overloads, and the same dimensions as Class H, Class K and Class RK5 fuses. They also deliver:

- **The best degree of arc energy mitigation.** When applied properly for expected arc fault currents, A6D fuses can reduce incident energies at a working distance of 18″ to less than 0.25 calorie/cm^2.
- **Easy upgrade to Class RK1 protection.** With the same overall dimensions as Class RK5, Class K and Class H fuses, our A6D fuses make upgrading a simple change that can dramatically reduce incident energies. Streamline your inventory and train your workers in circuit protection safety. Access our Fuse Control™ Program today for comprehensive inventory analysis and upgrade services. To learn more visit: ep-us.mersen.com/fusecontrol.
- **Type “2” protection for motor starters.** The A6D has been certified by starter manufacturers to provide Type “2” No-Damage short-circuit protection for NEMA starters.

VISIT MERSEN’S ArcFlash™ INFO CENTER

Arc flash safety is an expansive topic, and one that continues to evolve. Mersen’s Arc Flash Info Center is a valuable, 24/7 source of current information. Visit ep-us.mersen.com/resources/arcflash-info-center/, and you’ll find more about current-limitation, other suggestions for reducing arc flash energies, and an online calculator you can use to determine incident energies and PPE categories for Mersen fuses. You can also register for our “keep me informed” alerts, and be the first to know about new arc flash solutions.

Should you have specific questions about arc flash hazards, arc flash hazard mitigation, or electrical protection in general, contact your Mersen sales representative or field engineer, or contact our Technical Services applications engineers at TechnicalServices.EP@mersen.com. Protecting your workers from the hazards of arc flash is a big responsibility, but it doesn’t have to be a difficult task. With our assistance, you’ll see how Mersen products and services can help mitigate arc flash hazards.

Mersen
Expertise, our source of energy

MERSEN IS A GLOBAL EXPERT IN ELECTRICAL POWER AND ADVANCED MATERIALS

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