

Arc-preventative motor control centers



Arc-preventative MCCs enhance personnel safety, protect equipment and support more reliable operations



Available since 2007, the Eaton FlashGard® was the first MCC to provide industry-leading technology to enhance personnel safety and protect equipment.

The risk of an arc flash event is real—an arc flash can instantaneously generate temperatures about four times the temperature of the sun. An arc flash is associated with the explosive release of energy caused by an electrical arc, due to either a phase-to-ground or a phase-to-phase fault. These kinds of faults can result from many factors—a dropped tool, accidental contact with electrical systems, buildup of conductive dust, corrosion or improper work conditions.

An arc flash event creates intense heat, light and concussive force. For example, a 10,000A arc on a 480V circuit is said to have the explosive force of eight sticks of dynamite.

As personnel perform regular maintenance on electrical equipment, it is crucial that they are aware of arc flash dangers, know how to avoid them and use equipment designed to minimize arc flash risks. In recent years, research and development has yielded many advances in electrical safety and much of that research has focused on preventing arc flash events.

Arc flash dangers are a critical issue for companies around the world. Oil and gas, water and wastewater, mining, and utility operations are expected to run continuously, and the systems that power them must also run 24 hours a day, 7 days a week. Arc flash events can endanger employees and equipment powering these industries.

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Powering Business Worldwide

Enhance safety, reduce arc flash risk

Low voltage motor control centers (MCCs) are routinely accessed during maintenance and are designed to help protect personnel and equipment from the danger of arc flash. These MCCs lower the probability of electrical shock and reduce incident arc flash energy during maintenance.

There are guidelines for arc flash prevention and equipment that are intended to help prevent injury and to protect equipment. However, there is room for interpretation, and the applicable standards and guidelines can be confusing.

Applicable codes and standards

The National Fire Protection Agency (NFPA®) Article 70E identifies safe practices for personnel to follow while working on energized electrical equipment. The purpose of NFPA 70E is to provide guidelines to limit injury. Both the National Electrical Code® (NEC®) and the Occupational Safety & Health Administration (OSHA) reference the NFPA 70E standard in their arc flash documentation. A safe and sound electrical safety program is key to enhancing safety. NFPA 70 Article 340.7 states that an employer is responsible for providing training and supervision by qualified personnel to:

- Explain the nature of the hazard
- Develop strategies to minimize hazards
- Provide methods to avoid and protect against hazards
- Convey the necessity of reporting any hazardous incidents

Additionally, the Institute of Electrical and Electronics Engineers (IEEE®) 1584 provides guidelines on how to calculate incident arc flash energy to develop boundaries and to establish personal protective equipment (PPE) requirements. Incident energy is the amount of energy impressed on a surface a certain distance from the source. Its unit of measure is in calories per square centimeter (Cal/cm²). The flash protection boundary is specified as the point where incident energies drop to 1.2 Cal/cm²—the amount of energy that begins to form second-degree burns.



Arc Flash and Shock Hazard

Flash Protection Boundary:	2.9 ft
Incident Energy:	2.3 Cal/cm ²
Working Distance:	18 in
Required PPE Level:	1
Shock Hazard Voltage:	3450 VAC
Limited Approach:	10.0 ft
Restricted Approach:	2.2 ft
Prohibited Approach:	0.6 ft

Equip. ID: Sub23

Low and medium voltage switchgear is used to protect, control and monitor distribution systems and to protect operating and maintenance personnel from arcing faults. Arc flash hazards in switchgear are addressed through the American National Standards Institute (ANSI) C37.20.7 specification that lists testing guidelines for arc-resistant switchgear.

Switchgear that is built to meet arc-resistant standards redirects or channels the arc energy and pressure through a plenum, out the top of the switchgear, regardless of where the arc originated. The guideline looks at internal arcing faults on metal-enclosed switchgear rated up to 38 kV. Equipment tested to this standard protects against the effect of abnormal internal pressure or arc flash as long as all doors and access areas are properly secured.

The danger of arc flash is not limited to switchgear. However, the application of ANSI C37.20.7 to MCCs has limitations. At this time, there is no MCC arc flash guideline.

Arc-resistant gear or arc-redirection gear does provide higher levels of safety for personnel in the vicinity of the equipment, but does not address a common cause of electrical accidents—mistakes. The overwhelming number of arc flash accidents occur during maintenance or troubleshooting.

Room for confusion: arc resistant vs. arc preventative

A common misconception in the industry is that the use of arc-resistant switchgear in MCCs adds significant safety margins for any electrical worker in the area. The major flaw in this assumption centers on how electrical workers perform equipment maintenance.

Most MCC compartment doors need to remain closed to meet the thrust of arc-resistant guidelines. But much electrical maintenance requires working with the doors open; eventually, personnel need to access the interior components and connections. That may be more dangerous with arc-resistant gear than with non-arc-resistant gear. Opening the door may form conditions where the path of least resistance for the pressure wave is no longer the safe path of the plenum at the top of the gear, but out through the open door to maintenance personnel.

That is not to say that arc-resistant gear should be avoided. The key is applying guidelines to the equipment that they were designed to address. Improving operator and electrical worker safety from arc flash incidents is necessary. It is crucial to find arc-resistant gear that lets electrical workers perform maintenance with little risk of arc flash exposure.

At this time, the arc-resistant designation applies only to switchgear tested to meet ANSI C37.20.7. MCCs need to be accessed for maintenance, so closed-door operation requirements fall short, given normal operating procedures. MCCs are routinely accessed for a variety of reasons—connecting or disconnecting starters or feeders, adjusting trip settings, replacing fuses, adding motor loads and general troubleshooting. To make adjustments, access to the interior of the unit buckets is necessary.

Yet, this means that the MCC does not provide the highest level of personnel protection. In MCCs, the predominant cause of arc flash incidents is due to the operator plugging in or removing a unit from a live bus with the unit door open.

Maintaining a deadfront barrier, like connecting and disconnecting MCC starter or feeder units while the unit is closed and providing insulated components or connections, significantly reduces the possibility of an arc flash incident.

Arc flash preventative designs are relevant to MCCs. Closed door operation, in combination with safety interlocks, addresses this arc flash safety need.

What makes for arc flash preventative MCCs?

The strategy: prevention and protection. Key strategies are used to help safeguard employees against injuries from electric shock, arc flash burns and arc blasts:

1. Multiple insulation and isolation features enable arc flash prevention.
2. Unlike conventional MCCs, arc-preventative MCC design enables units to be disconnected and reconnected to the vertical bus with the door closed; maintaining a closed door during these operations increases operator safety.
3. A series of safety interlocks ensures that doors cannot be opened and that units cannot be removed from the structure while the stabs are connected to the vertical bus.
4. Each unit contains visual indicators that report the position of the isolation shutters and the stabs, providing maintenance personnel with additional assurance that dangerous voltages are not present inside the unit when service is required.

Testing by IEEE 1584P can be conducted to verify that closed door operation provides considerably lower risk category than the risk Category 3 assigned by the NFPA 70E Table 130.7 (c)(9)(a) for insertion and removal of MCC units. Beyond thermal hazards, a closed door provides better protection from shrapnel, noise, gases and blinding light. Remote operated racking devices are available so that an operator may advance and retract the stabs from upwards of 15 feet, which places the operator outside the arc flash boundary.

Arc-preventative MCCs: application example

When motors are geographically dispersed throughout a facility, the motor starters are aggregated in an MCC. The motor starters are segregated into individual units or buckets within the MCC for ease of isolation and maintenance. Each bucket is connected to the MCC power bus through rear-mounted stabs.

Insertion or removal of the buckets is done manually with the MCC door open. Accepted practice allows electrical personnel to physically push the bucket onto the main bus by hand. While the MCC should be de-energized during this action, plant operation usually demands that the MCC maintains power, creating arc flash and electrocution hazards.

For example, the periodic testing and troubleshooting of motor starters requires the main power to remain on, in order to perform any meaningful tests or troubleshooting. Because the equipment is powered, electrical personnel are exposed to dangerous arc flash conditions. The main power stabs in conventional MCC circuits feed a control-power transformer via a short-circuit protective device such as a circuit breaker or a fuse. The control-power transformer reduces the 480V alternating current (AC) incoming voltage to 120 Vac for the control circuits. Control circuits powered by the transformer include pushbutton stations, timers, relays and programmable logic controllers (PLCs).

A means to connect and disconnect individual unit starters with the door closed keeps the arc flash boundary secure, while remote operating stations assure that operators remain outside the arc flash boundary. Additional safety features to prevent injury from electric shock, arc flash burn and arc-blast impact include: isolation and insulation of the current-carrying bus and components, finger-safe covers and components, mechanical interlocks to prevent inadvertent energization and access to live components, and control circuits that use voltages below electrocution hazard levels.

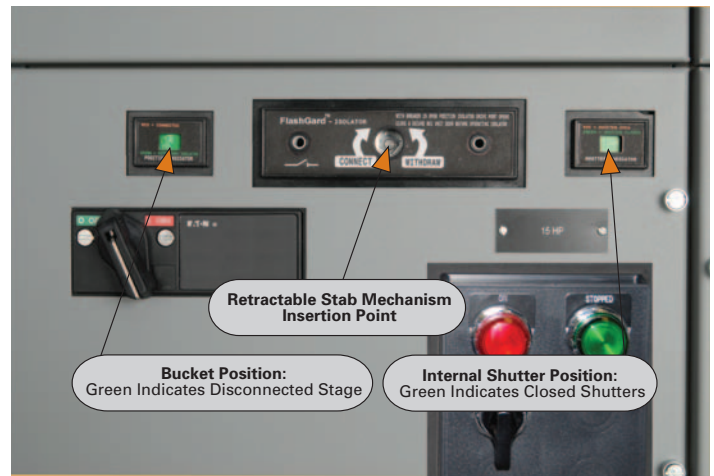
Arc-preventative MCCs specified

Despite a gap in the arc flash guidelines, there are MCCs designed to enhance personnel safety and to protect equipment from arc flash hazards. Arc-preventative MCC design focuses on:

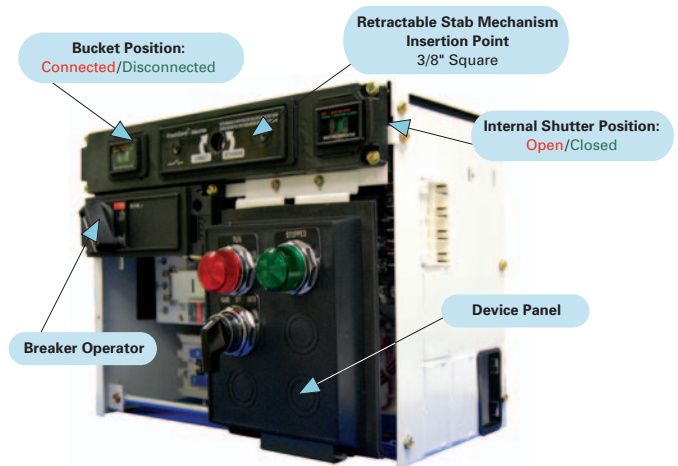
- Enhancing safety through training, labeling, analysis and solutions that reduce exposure to dangerous situations
- Avoiding extra costs by reducing or eliminating unplanned downtime and equipment damage, and enhancing safety through improved safety practices
- Mitigating risk by meeting or exceeding the standards from NFPA 70E and IEEE 1584P

Arc-preventative MCC design addresses prevention through insulation and isolation. The horizontal bus is insulated; an arc-free insulated bus and barrier system reduces the possibility of arcing phase-to-phase and phase-to-ground short circuits. Active interlocks provide positive mechanical disconnect and prevent insertion or withdrawal of the MCC bucket while the stabs are engaged or extended.

Independent shutter mechanisms automatically isolate both the vertical bus and the unit power stabs when the motor control unit is withdrawn. The shutter position indicator provides further verification of the bucket's safety status—indicating whether the internal isolation shutters are open or closed.



A critical component of arc-preventative MCCs is a retractable stab mechanism. This component enables the stabs to be disconnected or reconnected to the vertical bus with the unit's door closed.



Also, an optional remote racking system extends the operator's safety zone to a maximum of 15 feet while disconnecting or reconnecting the unit power stabs to the vertical bus during maintenance or bucket replacement.

The movable assembly of the retractable stab mechanism free wheels in both directions at the end of travel to prevent over torquing and damaging the housing and movable components. Visual indicators should provide quick, positive verification of stab position.

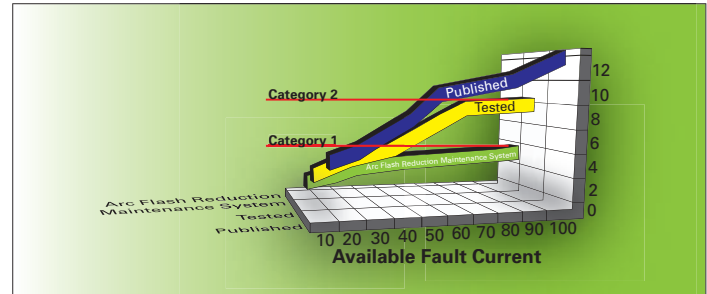
Additionally, for maintenance personnel, the cabinet itself is the main defense against arc exposure. Substantial steel panels with doors can be securely latched to suppress dangerous effects of an arc flash and provide a barrier between the flash and the operator.

Through-the-door controls and indicators help plant personnel perform routine operations without having to open the enclosure. Even when maintenance personnel do need to open MCC doors, visual indicators help personnel to verify the bucket position from outside the enclosure.

Arc-preventative MCCs specified

- Arc-free insulated bus and barrier system reduces possibility of arcing phase-to-phase and phase-to-ground short circuits
- Active interlocks prevent insertion or withdrawal of the MCC bucket while the stabs are engaged or extended
- Independent shutter mechanisms automatically isolate both the vertical bus and the unit power stabs when the motor control unit is withdrawn
- Through-the-door voltage present indicator
- Remote connect and disconnect racking motor accessory
- Automatic insulation tester to monitor insulation integrity
- Load-side stabs up to 180A to safely remove the unit without removing the motor leads
- Padlock accessory locks the unit door closed and is engineered to allow access by qualified personnel
- Substantial steel panels with doors that can be securely latched

Arc-preventative MCC designs can also be used in conjunction with an Arcflash Reduction Maintenance System™ to reduce the amount of energy available to produce an arc flash. Less energy means less danger and less damage should an arc event occur.



Arcflash Reduction Maintenance System Mitigation

An Arcflash Reduction Maintenance System is an optional plug-in module that can be applied to the main breaker and permits the operator to add an instantaneous trip setting to temporarily reduce the breaker's normal trip threshold during maintenance. If the breaker is in this setting, it will open much quicker when an arc fault occurs. Clearing the fault faster and limiting its impact on downstream circuits means the Arcflash Reduction Maintenance System can greatly reduce the level of energy available during an arc flash event.

Enhance personnel safety and protect equipment for more reliable operation

A strategic approach to arc flash safety involves education, a robust safety program and state-of-the-art equipment engineered to help prevent personal injury and property damage. Solutions engineered to address arc flash dangers are helping to solve critical safety issues, while reducing downtime and increasing building efficiency.

There are MCCs engineered to protect equipment and personnel from the danger of an arc flash. Minimizing the impact and the exposure to higher PPE levels in industrial environments means increased uptime and enhanced personnel safety. These MCCs lower the probability of creating a short-circuit phase-to-phase or phase-to-ground fault, while also lowering the probability of electrical shock and reducing incident arc flash energy during maintenance.

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