



# Arc fault protection solutions Leveraging technology to improve safety and reliability

Power and productivity  
for a better world™



# Arc flash regulations

## Mitigating technologies

According to NFPA 70E, arc flash incidents occur five to ten times each day. The occurrence of an arc fault is the most serious fault event within a power system. The destructive impacts can lead to severe injury of operating personnel, costly damage of switchgear, and long system outages. Arc flash exposes workers to high temperature plasma, pressure shock waves, toxic gases, and blast fragments. The produced plasma can reach temperatures of up to 35,000°F. Arc flash can be deadly to personnel, cost millions of dollars in repairs, and idle industrial facilities.

OSHA issued new regulations that became law in July 2010. The new regulations are far more demanding than previous ones, and place responsibility for safety on employers.

ABB can help you comply with the new regulations by:

- Providing training (required every three years)
- Collecting data, performing modeling and conducting arc flash studies (required every five years). OSHA regulations required completing an initial study by April 15, 2015
- Assessing your system and recommending the best strategies to comply with OSHA and minimize incident energy

What are the ways to minimize operator exposure to electrical hazards when working with switchgear and electrical distribution systems? It's been determined there are four primary methods for controlling risks.

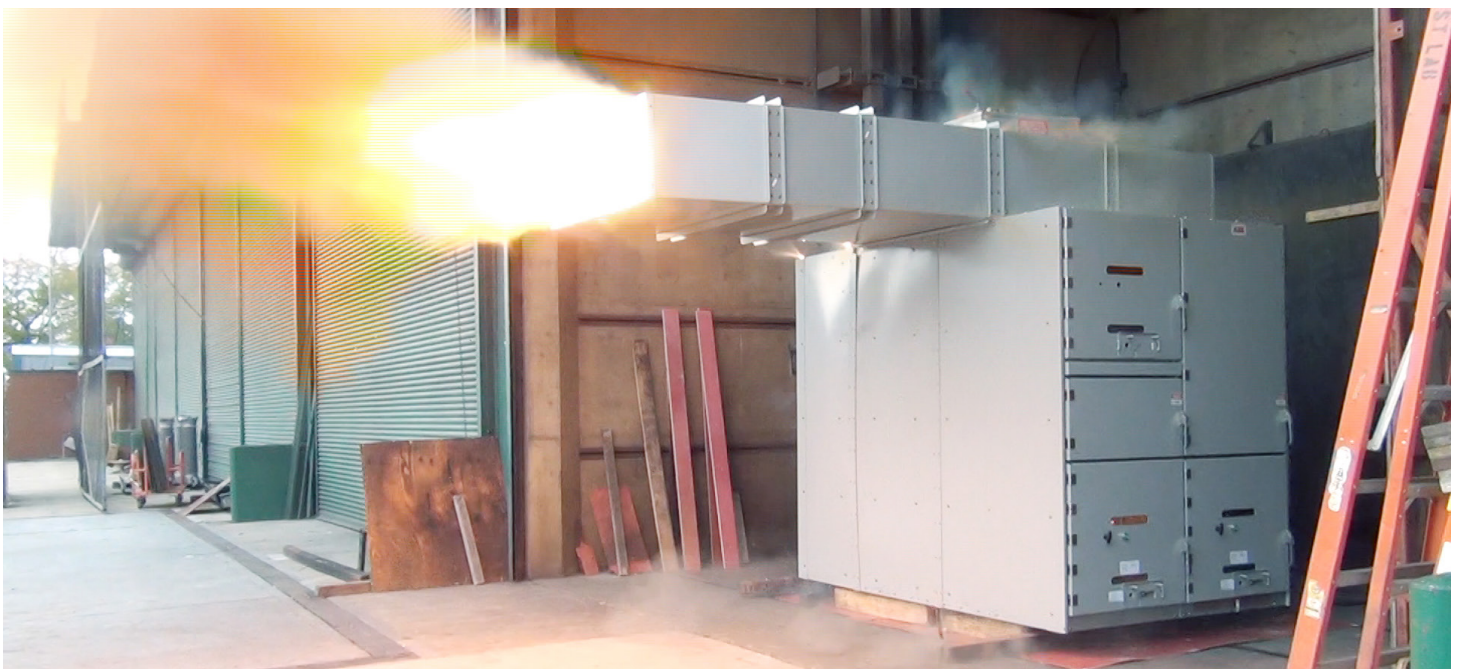
### Methods for controlling risks

1. Reduce fault current

2. Reduce arc duration (clearing time)

3. Minimize personnel exposure

4. Increase working distance





# Methods for controlling risks

## 1. Reducing fault current

### Strategies

Reducing fault current can be accomplished using the following technologies:

- New design
  - Reduce transformer kVA size
  - Increase transformer impedance
- Existing systems
  - Deploy current limiters
  - Use ultra-fast earthing switch (UFES)
  - Install current limiting fuses
  - Install current-limiting reactors

#### Deploying electronic triggered current limiters

- Applying Electronically Triggered Current Limiting (ETCL) Device to short circuits



SafeGear® HD with plenum

### Solutions

#### Electronically triggered current limiting devices

Fast-operating interrupting device (intelligent switch) that limits short circuit current to a level that breakers & buses can withstand, protecting them from damage.

- Solve short-circuit problems in new and extended systems
- Optimum solution for interconnection of switchgears
- The short-circuit is limited at the first current rise (0.6 ms)
- The peak short-circuit current cannot be reached
- Tried and tested technology – thousands of ABB's  $I_s$ -limiters are installed worldwide

#### Ultra fast earthing switches (UFES)

Application with a primary MV current limiting UFES, a fast acting earthing switch can be applied at any location between the fuse's load side and the transformer's primary connection. Can operate as fast as 4 ms, therefore reducing the magnitude of incident energy under certain conditions to below 1 cal/cm<sup>2</sup>.

# Methods for controlling risks

## 2. Reduce arc duration (clearing time)

### Strategies

Reducing the duration of an arc flash can be accomplished by using:

- Maintenance switches(LV)
- Zone selective interlocking
- Bus differential
- Fast earthing switches 4 ms
- Light detection relay (REA) < 2.5 ms
- $I_s$ -limiter 0-6 ms



UFES™ kit

### Solutions

#### ABB REA light detection protection in conjunction with UFES

- Light detection protection is based on both optical light and phase overcurrent or ground overcurrent.
- It uses fiber optics technology to sense the light flash and enable very short clearing times (AND/OR) technology.
- Since many arc faults start as a single phase fault, the neutral current should be measured. This results in clearing the fault in early stages

# Methods for controlling risks

## 3. Increase working distance

### Strategies

Increasing the working distance is more straightforward than reducing fault current and can be achieved by:

- Determining minimum approach distance
- Using a remote racking device
- Employing remote control panels
- De-energizing equipment
- Using technology to work further from energized equipment
- Installing warning labels (paint floor)
- Ensuring appropriate PPE for the hazard level



SmartRack™ remote racking device

### Solutions

When switchgear is not remotely controlled, an effective option is to operate the breakers via a remote relay cabinet or “SCADA” AND remotely rack the breakers with a remote racking device.

#### ABB SmartRack™

The SmartRack™ electric remote racking device is intended to enable technicians with the process of racking ABB medium voltage circuit breakers and associated equipment. The main function of the device is to perform the racking operation with minimal manual interaction. This allows the operator of the device to maintain a significant distance between themselves and the circuit breaker while racking is performed as compared to the traditional hand-crank method of racking.

The SmartRack electric remote racking device is able to perform this complex task through the use of a programmable logic controller and servomotor. Throughout operation, the controller and motor are in constant communication allowing the device to accurately position a circuit breaker or other device in the

switchgear cell. The racking device incorporates an actuator to operate the interlock lever which eliminates the need for an additional unit to perform this task or for additional manual interaction.

# Methods for controlling risks

## 4. Minimize personel exposure

### Strategies

Seventy-five percent of arc flash incidents happen in the presence of an operator so minimizing personnel exposure is critical.

- Arc resistant switchgear deflects arc flash energy and explosion products
- Magnetically-actuated breakers: one moving part, less maintenance
- Warning labels required by code
- Proper PPE within minimum approach distances; Need risk assessment study and compliance with new law



AMVAC™ magnetically-actuated circuit breaker

### Solutions

#### Metal-clad switchgear – arc venting

Characteristics of arc resistant switchgear designs :

- Robust construction to direct gases to exhaust chambers
- Vent flaps designed to open under pressure and safely expel gases
- Special ventilation
  - Under normal conditions, open to allow air to flow
  - Under arc fault conditions, slams shut to prevent exit of gases
- Double wall construction with 3/16" air gap is very effective in resisting burn through
- Closed door racking and operation of circuit breakers, PT's, CPT fuses

#### ABB SafeGear HD arc resistant switchgear

- 63 kA metal-clad arc-resistant air insulated switchgear
- Tested to IEEE C37.20.2-1999 and C37.20.7-2007
- Seismic certified to IBC Region D

#### Plenum design

- Sealed duct across top of switchgear, covering all vent flaps
- Sized and shaped to minimize turbulence and back-pressure
- Allows room for cable trays and conduit entry
- Channels gases safely out of building, through wall penetration and vent

#### Magnetically-actuated breaker

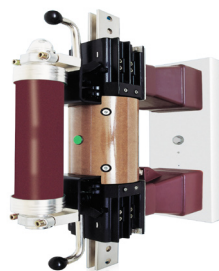
- The magnetic actuator operating mechanism requires maintenance every five years
  - Consists of only 1 moving part, no springs utilized
  - Replaces spring mechanism, motor, open coil, close coil
  - Capable of a high number of operations
- Coil protection eliminates frequent failure of traditional coils
  - Current is only held on the coils for 45 ms – eliminates burning of coils as in traditional spring charge mechanism
  - One coil used for closing and one coil for opening

# Methods for controlling risks

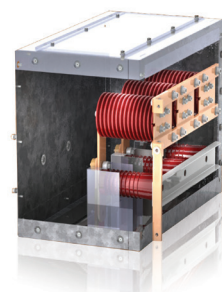
## Summary

### Rules and remedies

- Several regulators and a new law
- Reduce fault currents for a new design
- Reduce fault currents for an existing design
- Minimize arc duration
- Increase work distance/remote control
- Minimize personnel exposure and maintenance



$I_s$ -limiter™



UFES™ ultra fast earthing switch

### How can ABB help?

ABB can provide assistance and training to aid in understanding the OSHA law. We can conduct risk assessment studies to determine compliance with the OSHA law and, finally, ABB can provide you the most advanced technologies for arc flash mitigation to comply with the new law.

Risk	Strategy	ABB Solution
Reducing fault current	Electronic current limiters	$I_s$ -limiter
	Fast grounding switch	Ultra Fast Earthing Switch (UFES)
Reducing arc duration (clearing time)	Light detection protection	REA light arc detection system
		Relion 615 series relays
		Relion 620 series relays
Increase working distance	Use technology to work further from energized equipment	SmartRack remote racking device
Minimize personnel exposure	Arc resistant switchgear deflects arc flash energy and explosion products	SafeGear
		SafeGear HD
	Magnetically-actuated breakers: one moving part, less maintenance	AMVAC circuit breaker
	Conduct risk assessment study	Risk assessment study to determine compliance with new law, identify warning labels required by code, and determine proper PPE within minimum approach distances

For more information on ABB arc fault protection solutions, visit <http://new.abb.com/medium-voltage/apparatus/arc-fault-protection>

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