

The background features a dark blue gradient with a subtle pattern of white stars and constellations. Overlaid on this are several faint, light blue technical diagrams. These include circular gauges with radial scales and tick marks, some with numbers like 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, and 260. There are also circular arrows indicating clockwise or counter-clockwise rotation, and dashed lines representing paths or orbits.

# ENHANCING WORKER & EQUIPMENT PROTECTION WITH A NEW PASSIVE ARC FAULT MITIGATION TECHNOLOGY

KEN BOX, P.E.

SCHNEIDER ELECTRIC

# WHAT IS ARC FLASH? WHY IS IT SO IMPORTANT?

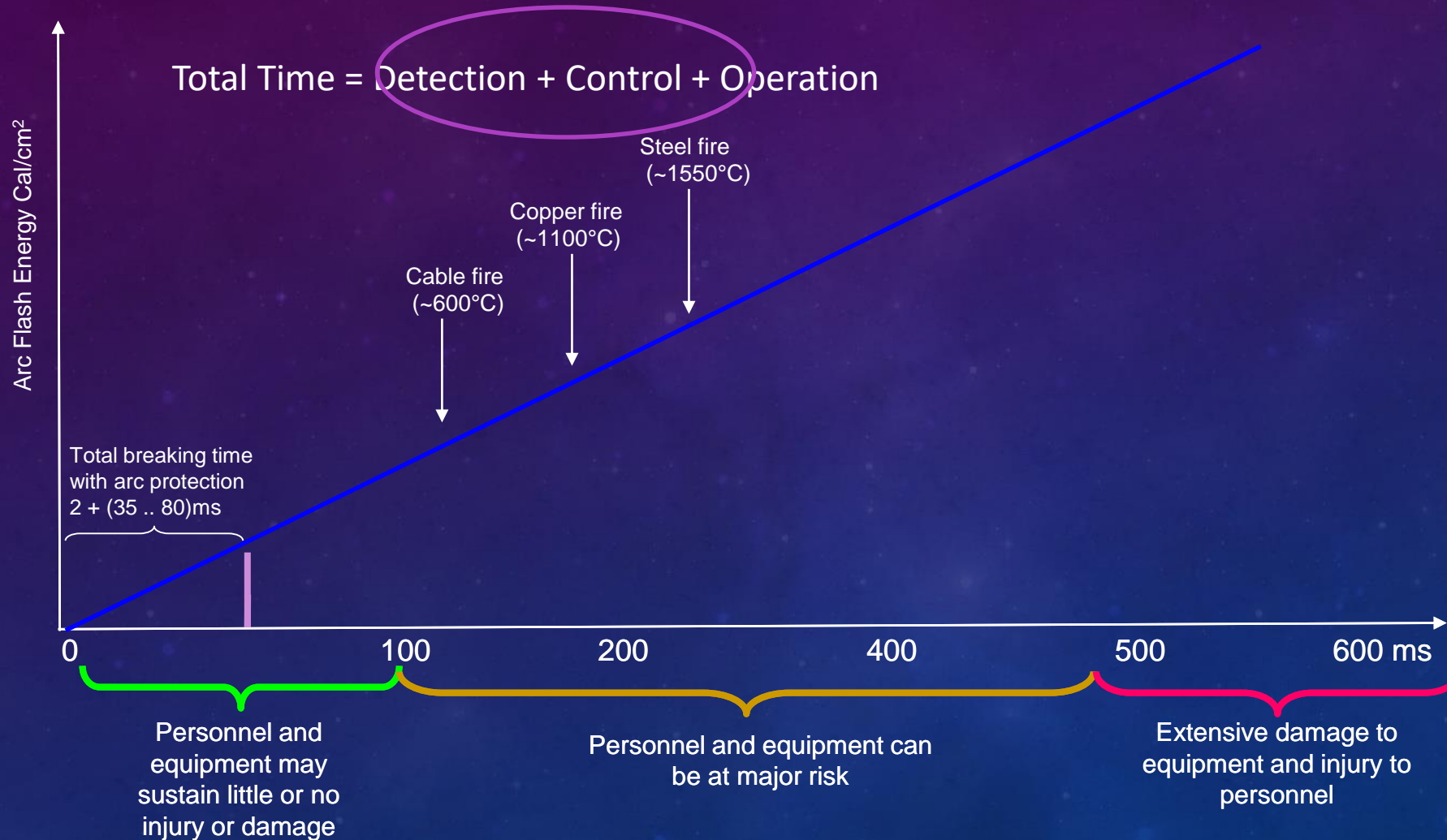


- NFPA 70E, “Arc Flash Hazard” – a source of possible **injury** or **damage** to health associated with the release of energy caused by an electric arc.
- Fault current flowing through air rather than through cables or busbar.
- Can be a **very violent** event
  - Significant light, heat, pressure, sound is released
  - Damage to equipment, injury to workers
  - **80% accidents caused by human error.**
  - **134 fatalities in USA due to arc flash events**

# ARC PHENOMENON

An Arc Flash is developed within one millisecond

## Arc Flash Detection System





# Arc-Rated PPE: Examples



**8 cal/cm<sup>2</sup> Rating**



**40 cal/cm<sup>2</sup> Rating**

This is NOT arc flash reduction....

Photos courtesy of Oberon

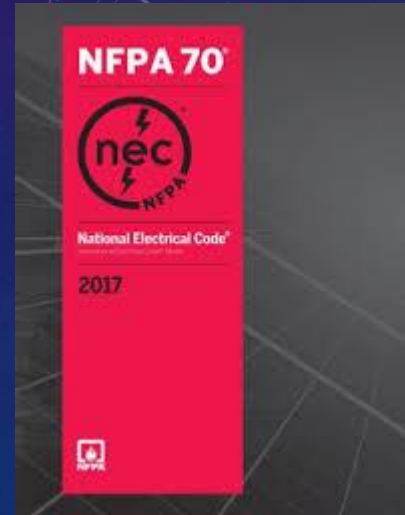
# NEC 2017 - ARTICLE 240.87

**240.87 Arc Energy Reduction.** Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200 A or higher, 240.87(A) and (B) shall apply.

**(A) Documentation.** Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s).

**(B) Method to Reduce Clearing Time.** One of the following or approved equivalent means shall be provided:

- (1) Zone-selective interlocking
- (2) Differential relaying
- (3) Energy-reducing maintenance switching with local status indicator
- (4) Energy-reducing active arc flash mitigation system
- (5) An instantaneous trip setting that is less than the available arcing current
- (6) An instantaneous override that is less than the available arcing current
- (7) An approved equivalent means



# BRAND NAMES FOR THE MAINTENANCE SWITCH

- ERMS Switch
- ARMS Switch
- RELT Switch
- DAS Switch



# RELATIVE COST COMPARISON

- (1) Zone-selective interlocking - \$\$
- (2) Differential relaying - \$\$\$
- (3) Energy-reducing maintenance switching with local status indicator - \$
- (4) Energy-reducing active arc flash mitigation system - \$\$\$\$\$
- (5) An instantaneous trip setting that is less than the available arcing current - \$0.00
- (6) An instantaneous override that is less than the available arcing current - \$0.00
- (7) An approved equivalent means – ????

# 240.87 B (Method 3)

Energy-reducing maintenance switching with  
local status indicator

## What does an “ERMS” switch do?

1. Turns short time delay to zero
2. Lowers the instantaneous trip setting of the breaker via a pushbutton.
3. It is NOT a magic device.





- Will the means really reduce the hazard?
  - Equipment must be labeled for the arc flash hazard that exists in Zone 1
  - Any arc energy reduction means only reduces the hazard in Zone 3, unless equipment is compartmentalized.
  - Remember, I said the ERMS switch wasn't magic!



Zone 1 – Line  
side of main  
device

Zone 2 – Load  
side of main  
device

Zone 3 –  
Downstream  
equipment

## #7 - OTHER APPROVED MEANS...

- “Arc terminator” or “Arc Quencher System” – or crow bar system that creates an upstream bolted fault on all 3 phases within an explosion proof enclosure.
- Current limiting fuses – great at high faults, not so good at low level or ground faults
- Virtual Mains
- Arc Resistant Switchgear & MCC's
- Separate the main device from the downstream breakers
- Remote operation or breakers – doesn't reduce the AFIE level, it simply moves the operator farther away from the problem area.
- Arc Management Enclosure for power conductors & connectors



# Shifting the Protection Paradigm

Unique, simpler & cost effective!

Yesterday!



Today!



Schneider Electric does not encourage or promote energized work on electrical equipment.

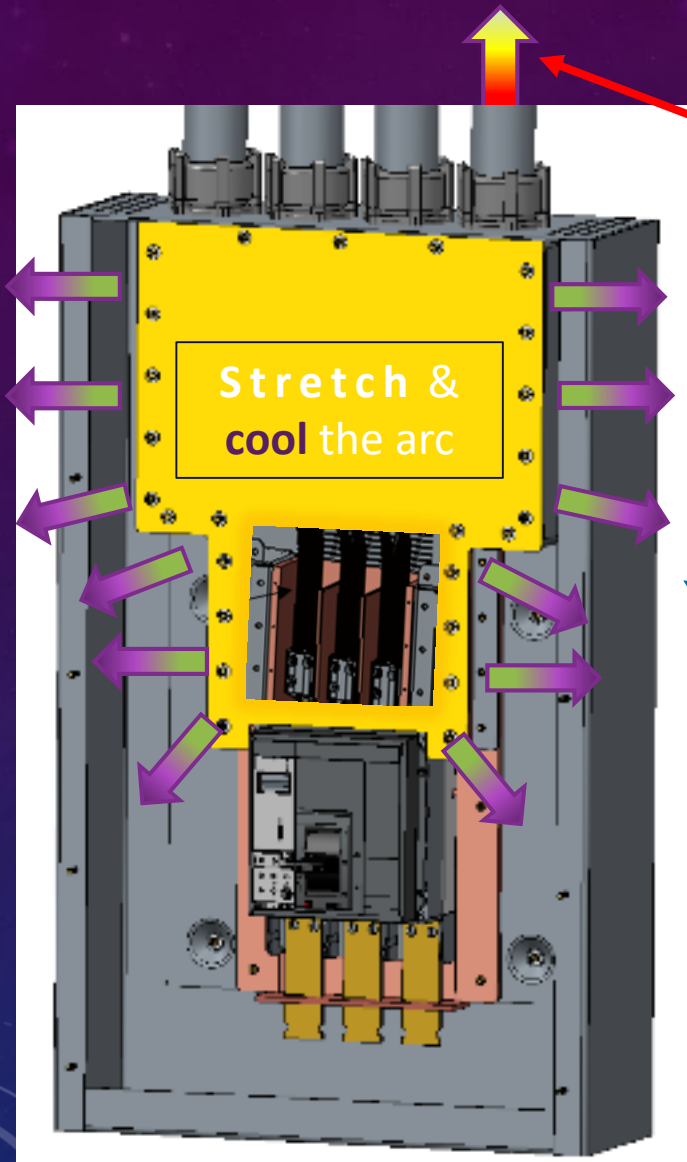




# Traditional MCC Arc Flash Test

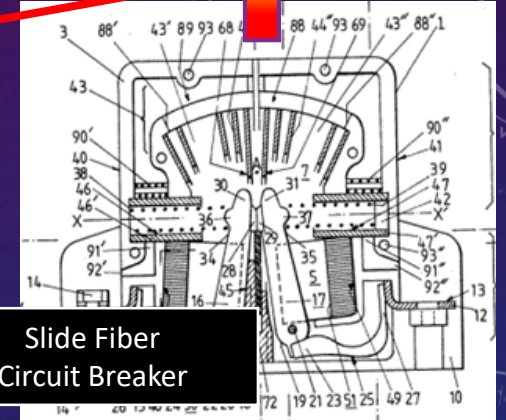


# LINE SIDE ARC ISOLATION MODULE – HOW DOES IT WORK?



EXHAUST

Principle 1 – Use circuit breaker techniques to interrupt arc



Slide Fiber Circuit Breaker

LEAKAGE

Principle 2 – Contain energy and cool leakage to below restrike temperature

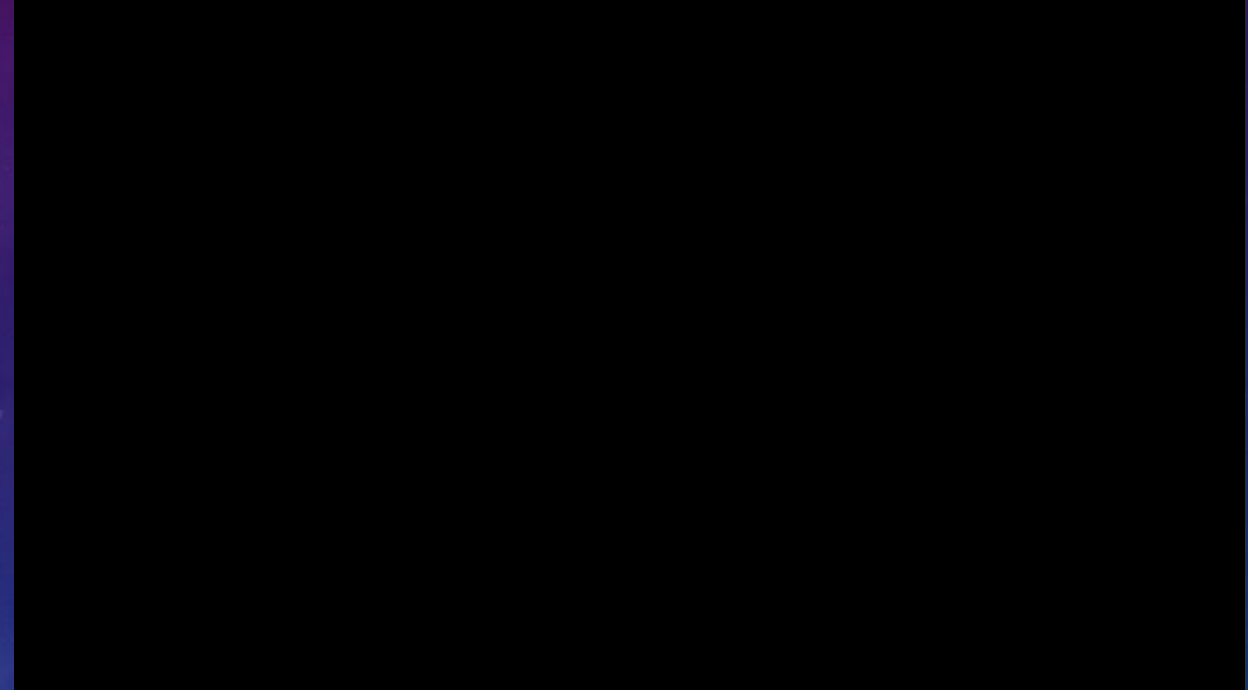


Explosion Proof Switch



# Product Details

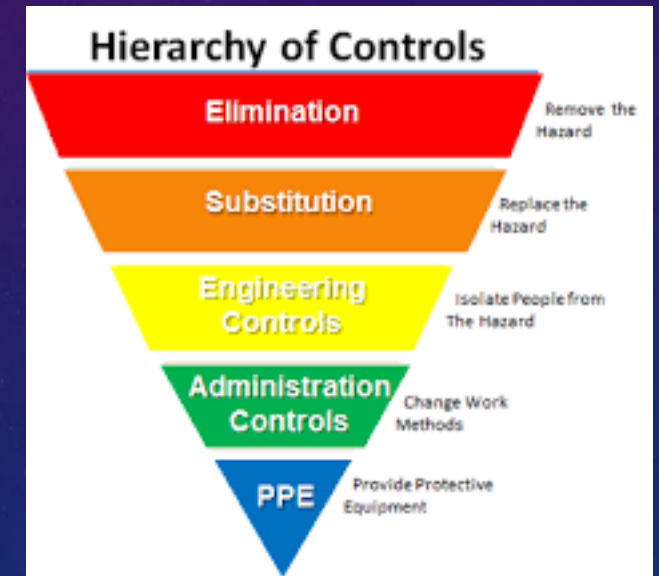
- **1200A Frame MCCB 250-1200A**; MCCB's rated @ 80% (up to 1200A) or 100% (up to 1000A)
- Max. available fault current is 100 kA at 208, 240 and 480Vac, 50kA at 600Vac
- Line side testing was UL® witnessed in accordance with ANSI/IEEE C37.20.7-2017
- MCCs are Listed to UL845 Standard. Available in top or bottom Incoming main section for 3 wire and 4 wire system
- NEMA ratings : NEMA 1, NEMA 1 with gaskets (1A)
- Voltage systems available for 208Y/120V; 480V ; 480Y/277V; 600V 600Y/347; @ 60hz only for the aforementioned voltages
- Lineup depth: 20 inches
- Line Side Isolation + Wireless Thermal Sensors + ERMS



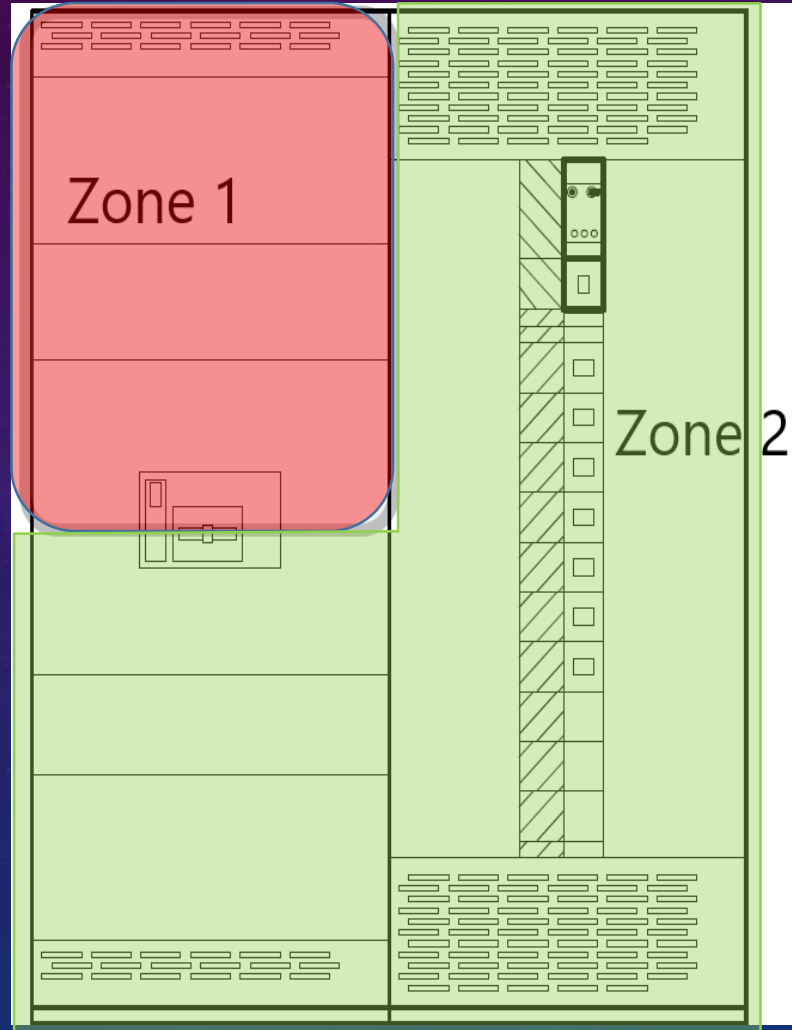
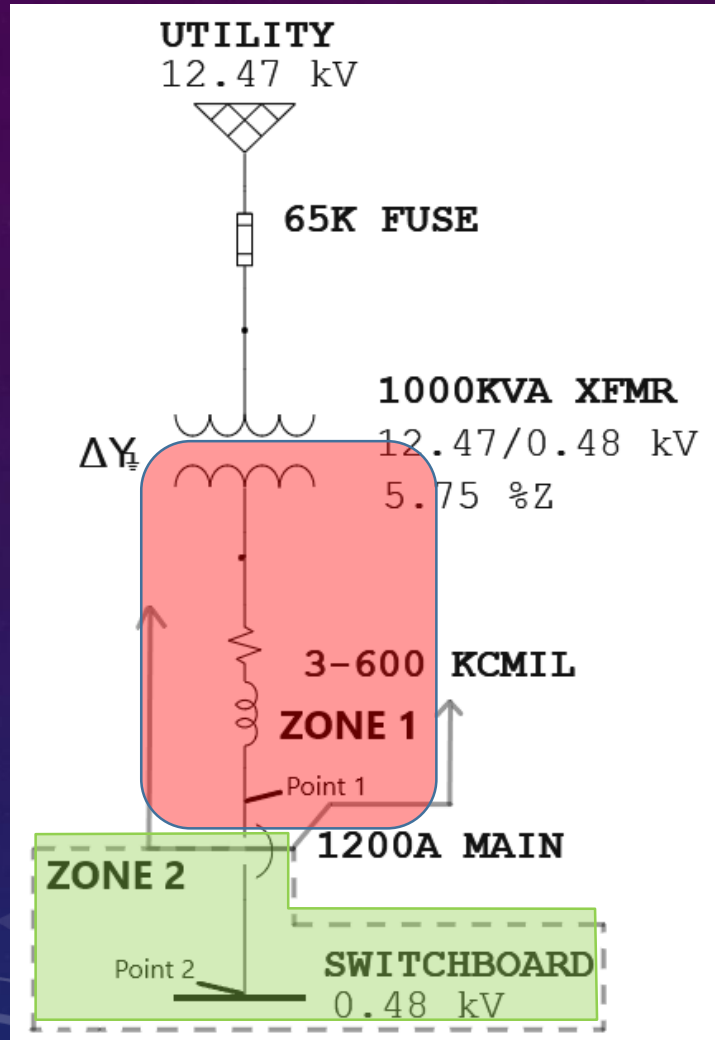


- Reduces the likelihood of arc flash propagation from line to load side and from load to line side
- Passive construction helps ensure arc flash protection is “always on”
- Limits arc damage, allowing quick and inexpensive recovery
- Provides additional engineering control against exposure to arc flash
- Reduces arc flash incident energy exposure during LOTO operations.
- Line side protection and reduced risk of arc flash incidents while performing OSHA and NFPA 70E approved tasks.

## NFPA 70 E



# Zone Coverage or Man to Man?



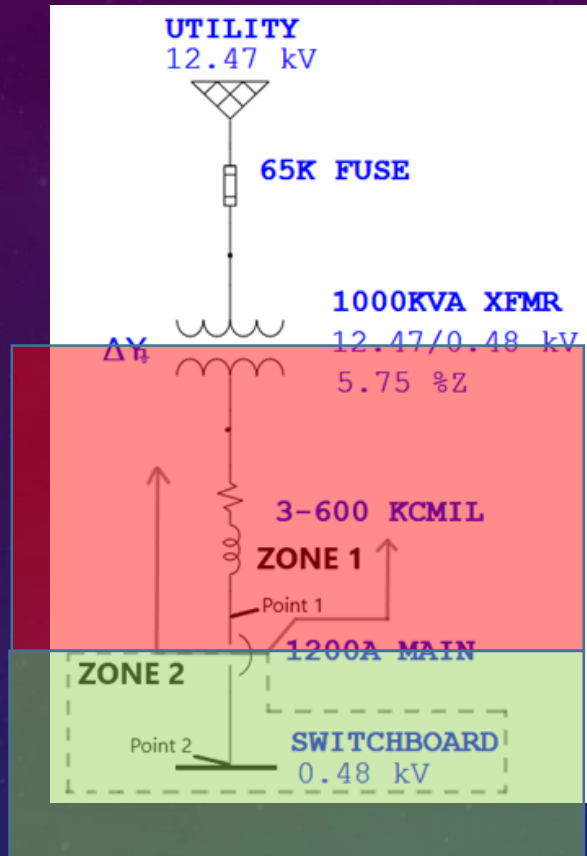
- Calculations with “typical” parameters per IEEE 1584-2018:

**Zone 1 IE = 15.6 cal/cm<sup>2</sup>**

**Zone 2 IE = 1.6 cal/cm<sup>2</sup>**

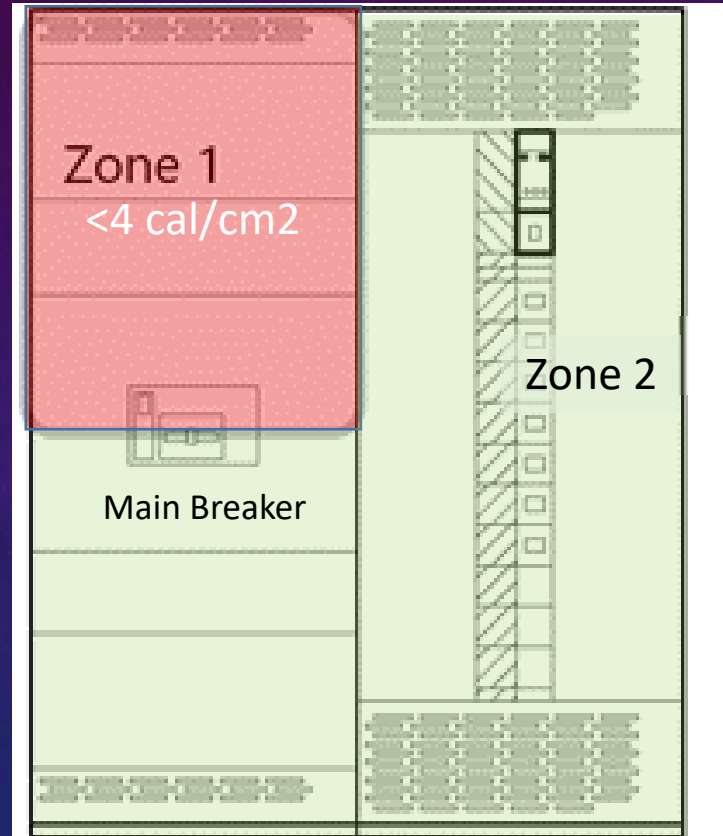
- Recommend barriers between vertical sections

# 3 Levels to Consider



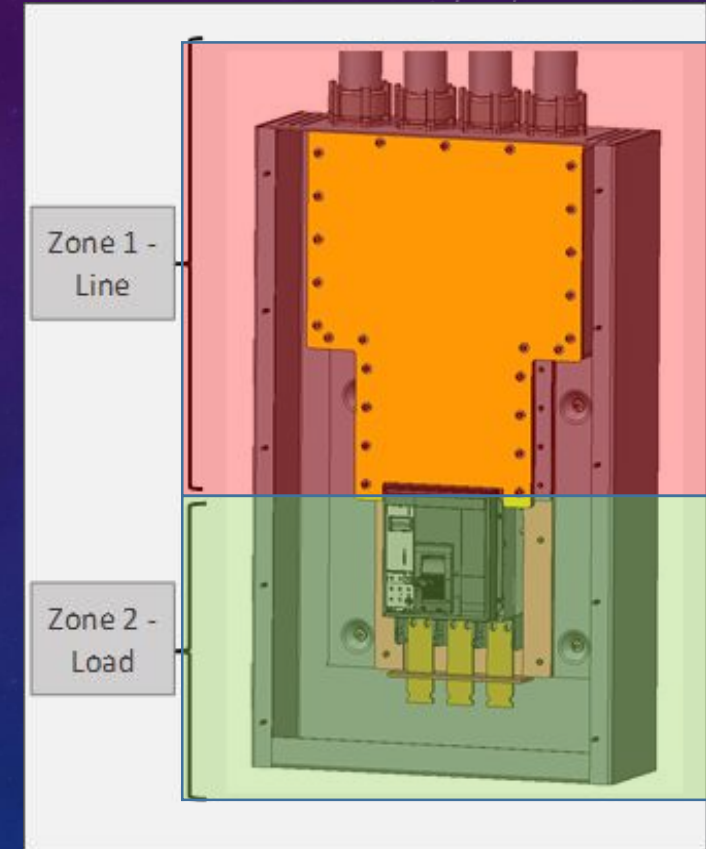
System Level

- Calculations with “typical” parameters per IEEE 1584-2018:



Electrical Equipment Level

**Zone 2 IE = 1.6 cal/cm<sup>2</sup>**



Component Level

**Zone 1 IE = <4 cal/cm<sup>2</sup>  
with the technology**



# HIERARCHY OF HAZARD CONTROL

MOST  
EFFECTIVE

**ELIMINATION**

Removing the hazard at its source

**SUBSTITUTION**

Replacing a severe hazard with a less severe one

**ENGINEERING  
CONTROLS**

Blocking the hazard from affecting employees

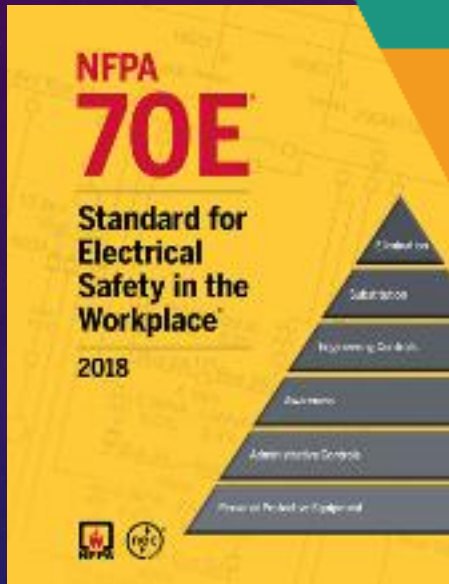
**ADMINISTRATIVE  
CONTROLS**

Providing info for safe decision  
Using safe work procedures

**PPE**

Using protective clothing

LEAST  
EFFECTIVE



# NFPA 70E – Hierarchy of Hazard Control

- NFPA 70E indicates that PPE is the last line of defense to protect personal.
- However, PPE will not protect the equipment.
- The "new technology" incorporates 3 levels of control.
- Elimination - Minimization and Engineering Controls.



# Perform thermal measurements of line side connections without exposure to energized conductors

## Challenge

On load, capture the resistive effect (temperature increase) on the LV MCC termination cables using a thermal camera without removing any cover and disrupting continuity of service.

## Solution

We offer sensors to detect abnormal temperatures which may lead to electrical equipment damage.

### Thermal sensor

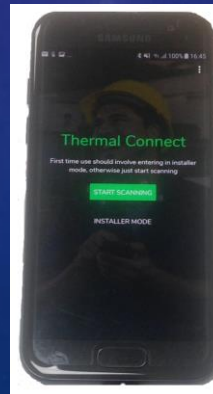
- Wireless thermal sensors factory installed to monitor line connections
- Sensors are self-powered and wireless, using ZigBee premium protocol for communications

### Scalable :

- Thermal connected Apps: Nearby stand-alone detection.
  - Easy temperature access during maintenance.
  - Data storage possibility in a remote repository



### Smart Phone



### Dongle connector



### ZigBee receiver dongle



### NFC TAG



### Thermal sensor





# Thermal measurements simplified

## Thermal scans today

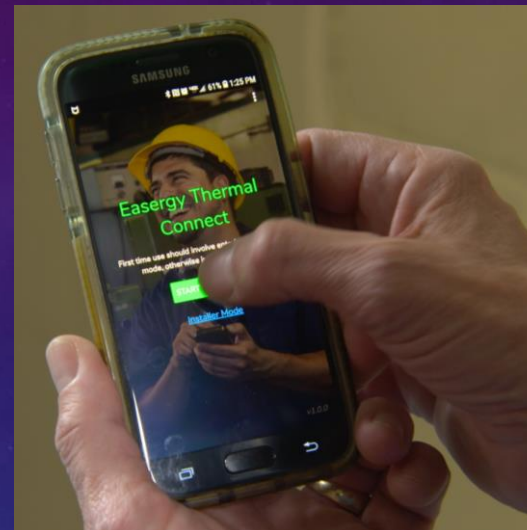


## Thermal measurements tomorrow

1



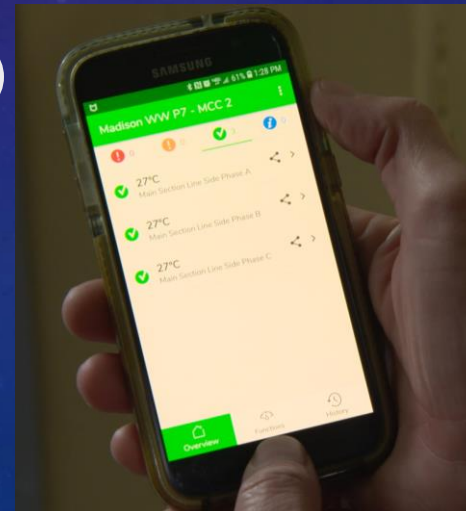
2



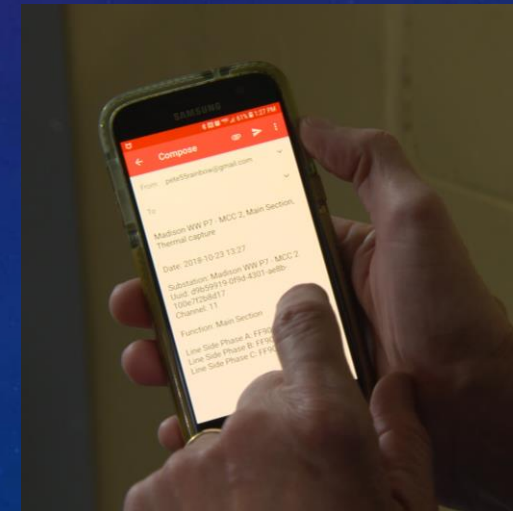
3



4



5



# A new level of arc flash protection!



- *Enhance arc flash mitigation*
- *Industry-first patented technology*
- *Embedded thermal measurements for line side*
- *Simplified maintenance*
- *No special commissioning required for arc flash protection*
- *Retrofit main breaker ArcBlok section to installed base of MCC's*
- *Simple and quick recovery after arc event*
- *Line Side Isolation tested to IEEE C37.20.7 for arcs initiated in line side conductors*

# ENHANCING WORKER AND EQUIPMENT PROTECTION THROUGH PASSIVE ARC-FAULT MITIGATION

Copyright Material IEEE  
Paper No. ESW-2019-17

Antony Parsons, P.E.  
Member, IEEE  
Schneider Electric  
9101 Burnet Rd., Ste. 202  
Austin, TX 78758, USA  
aparsons@ieee.org

Tim Faber,  
Member, IEEE  
Schneider Electric  
3700 Sixth Street SW  
Cedar Rapids, IA 52404, USA  
tim.faber@schneider-electric.com

Mark A. Metzdorf, P.E.  
Senior Member, IEEE  
BP Products North America Inc.  
150 W. Warrenville Road  
Naperville, IL 60563, USA  
mark.metzdorf@bp.com

**Abstract** – Existing arc flash standards like IEEE 1584 and 1584.1 present models that can be used to estimate incident energy levels in power distribution equipment but provide limited direction regarding how equipment construction should be considered in the calculations. Users performing arc flash risk assessments are left to apply engineering judgement when considering how barriers or isolation of components should be considered. This can lead to risk assessments that are inconsistent or incorrect.

hazards is not straightforward in real-world equipment. The risk assessment should include evaluating the zones of protection of system protective devices, as well as the impacts of equipment construction. This can be difficult for personnel not familiar with arc flash analysis methods or who lack detailed knowledge of electrical equipment construction.

This paper reviews selected existing industry practices and equipment construction features that create barriers that may provide some degree of arc flash protection, and then