UNDERSTANDING ARC FLASH

CODE REQUIREMENTS

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ARC FLASH

What is it?

ARC FLASH

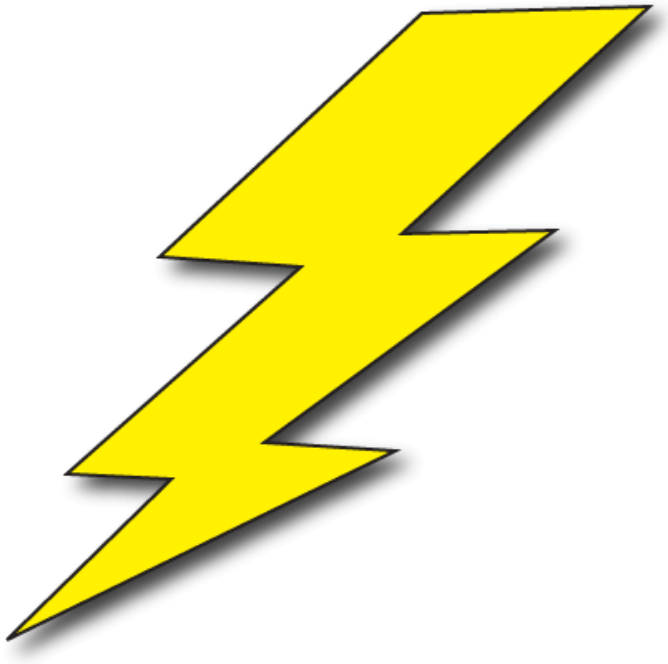
What is it? A Hazardous release of energy by an electric arc.

ARC FLASH

Available Fault Current

Duration of Arc

Distance of Arc to Employee



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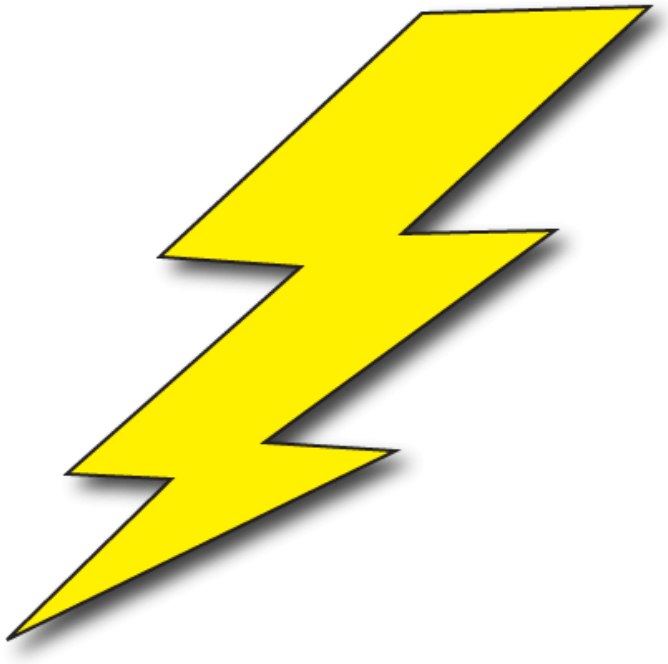


Available Fault Current

$$\frac{\text{Voltage at the Fault}}{\text{Impedance at the Fault}}$$

Three-Phase
Bolted or Arcing

System Voltage

Low Voltage

277/480
120/208
50 – 120

Transmission

345 kV
161 kV
138 kV
69 kV

Distribution

25 kV
15 kV
4.16 kV
2.4 kV

Wind Farms

34.5 kV

Stationary Batteries

48 V DC
125 V DC

One Source

Multiple Sources

Contact Impedance

Transmission Lines
Different Lengths
Different Sizes

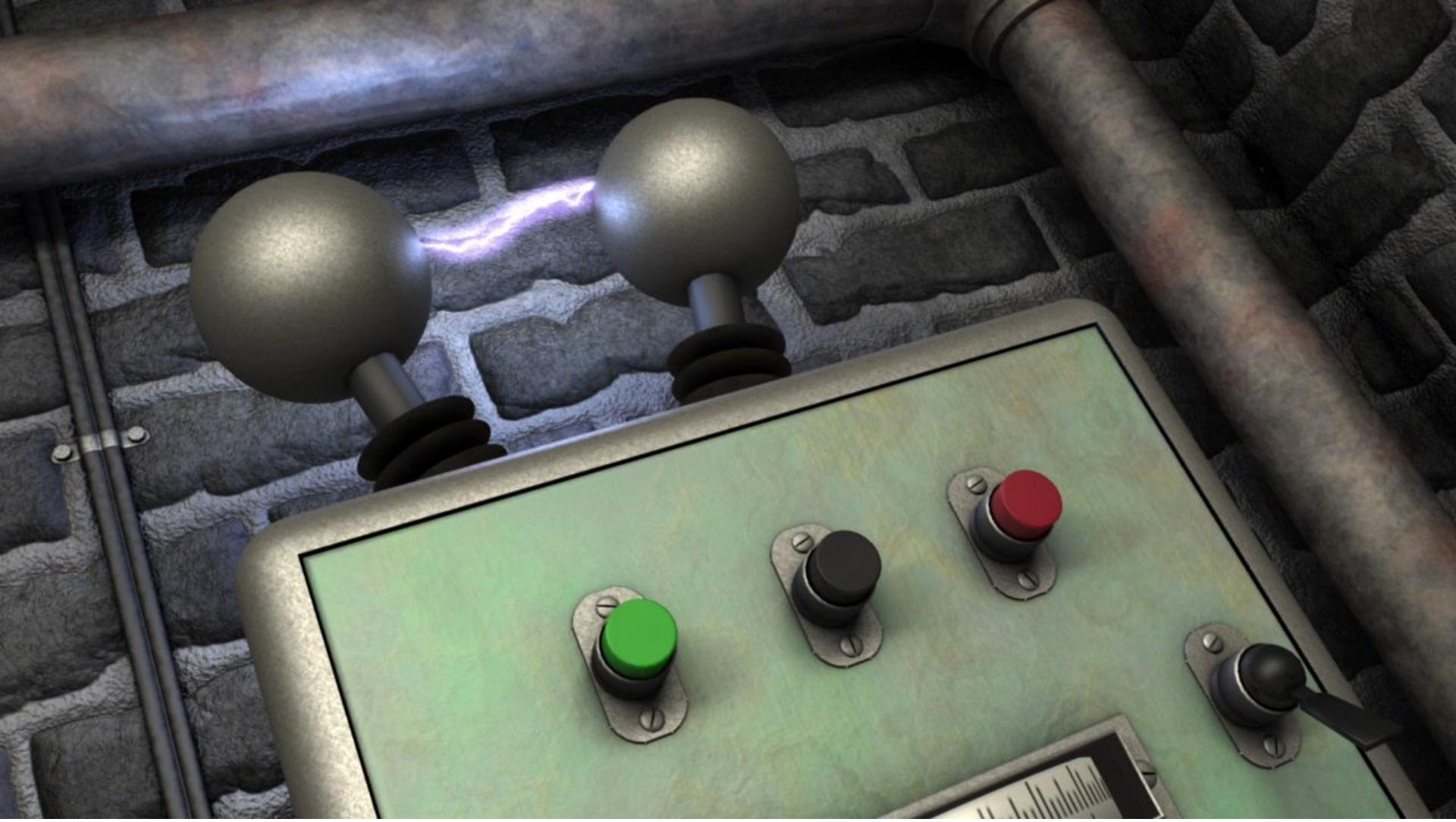
Impedance at the Fault

Radial Connection

Transformers
Various Sizes
Various Designs

Looped Connection

Aspen – Milsoft – CYME Model



An electric arc moves

ARC FLASH

Available Fault Current

Duration of Arc

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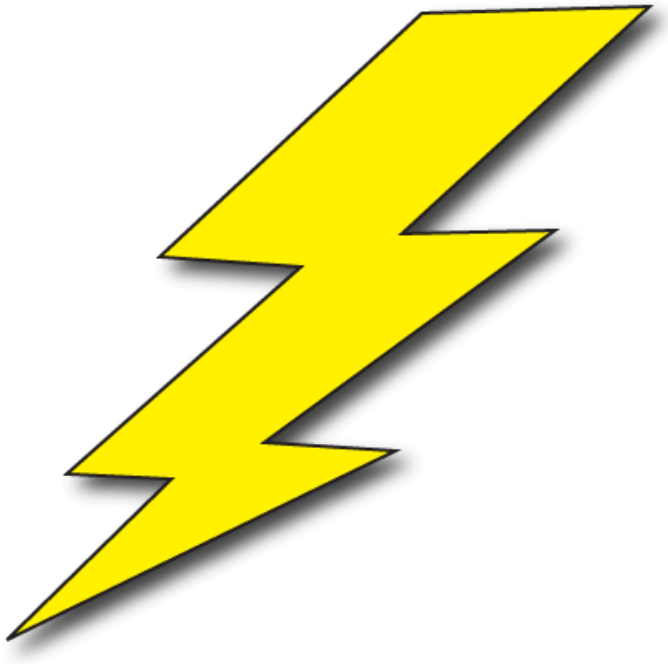


Duration of Arc

Time in
seconds or cycles

Transmission

- Relays
  - Differential
  - Distance
    - Zones
- Breaker Op time
- Circuit Switcher

Distribution

- 25 – 15 – 4.16
- TCC
- Reclosers/OCRs
- Fuses

Duration of Arc

Transmission

- Relays
  - Differential
  - Distance
    - Zones

- Breaker Op time
- Circuit Switcher

Time in
seconds or cycles

Distribution

- 25 – 15 – 4.16
- TCC
- Reclosers/OCRs
- Fuses

Low Voltage

- Circuit Breakers
- Transformer fuses – Slow
- Designed to remove failed transformer

480 v
- – If OPEN will self extinguish
- – If Confined will continue until a device interrupts

120 v – won't maintain Arc

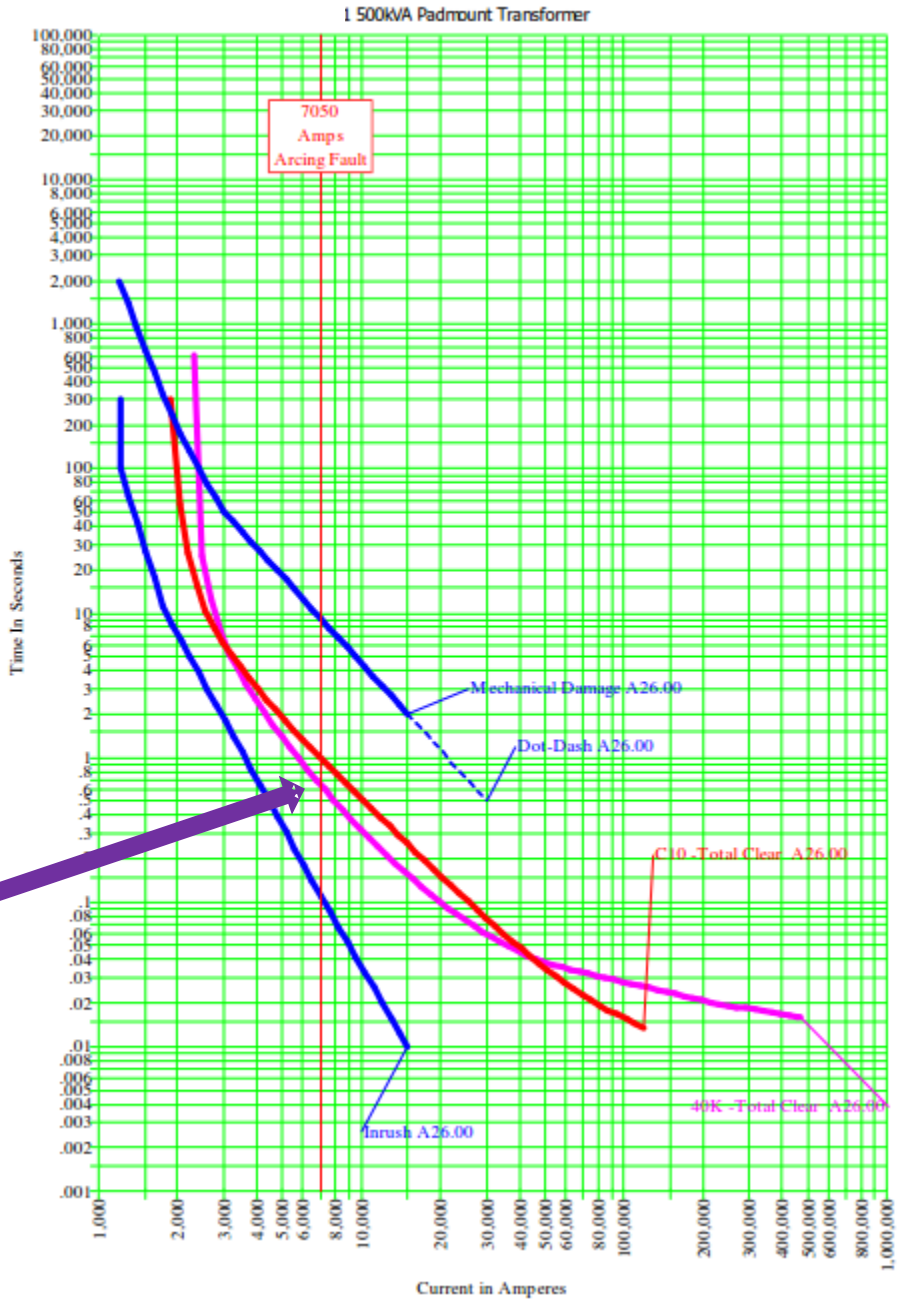
DC no internal fuse at Batteries

"Assume 2 sec."

DC network has fuse

Time Current Curves

Calculation indicates that the transformer fault will clear at 0.6418 seconds due to the upstream 40K line fuse.

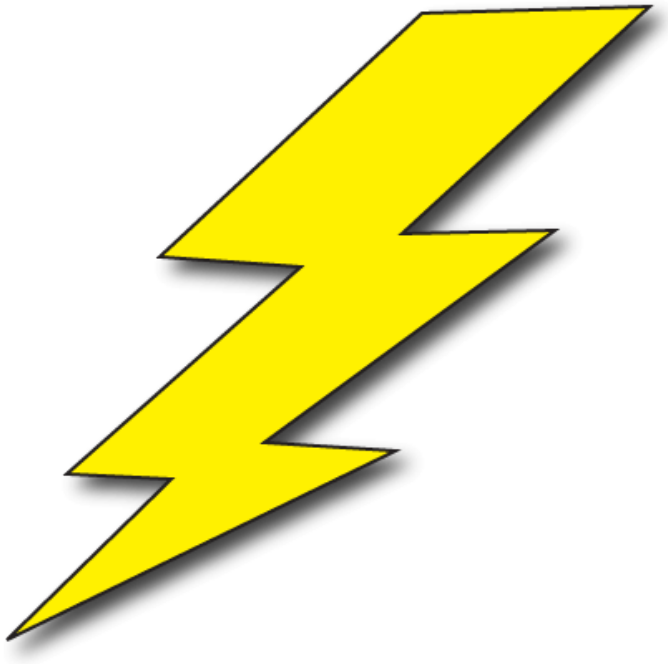


ARC FLASH

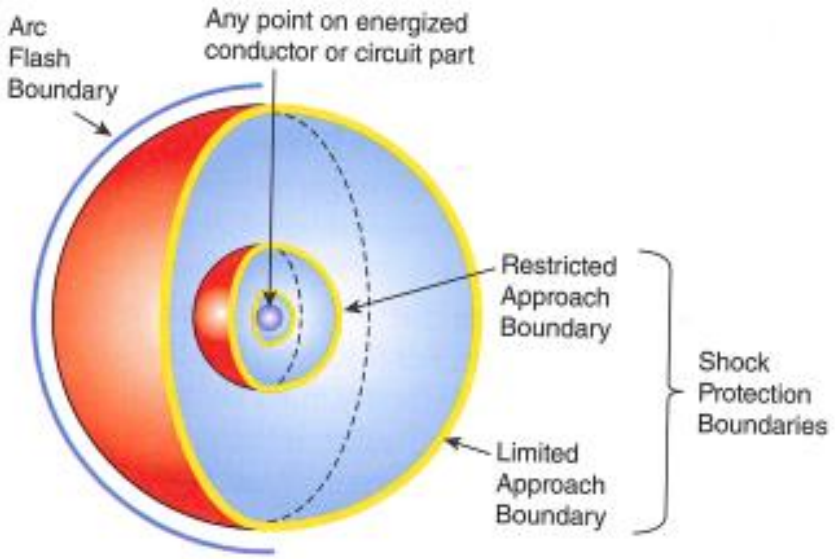
Available Fault Current

Duration of Arc

Distance of Arc to Employee



Distance of Arc to Employee



Distance of Arc to Employee

(For Energized Electrical Work)

NESC Work Rules "Approach Distance"

Incident Energy Boundary – depends on what you wear and how close you need to get to the work

Level 0	1.2 Cal	(No FR Clothing)
Level 1	4 Cal	PPE Category 1
Level 2	8 Cal	PPE Category 2
Level 3	25 Cal	PPE Category 3
Level 4	40 Cal	PPE category 4

1.5 ft to Glove – 4.0 ft to use a Hot Stick

Standards

What standard(s) do I follow ?

OSHA ?

IEEE ?

NFPA ?

NESC ?

Standards

- IEEE 1584 – IEEE Guide for Performing Arc-Flash Hazard Calculations
- National Electrical Safety Code – NESC 2012
  (IEEE C2-2012)
- 29 CFR 1910.269 (OSHA)
  (Electric Power Generation, Transmission, and Distribution)
- National Fire and Protection Agency – NFPA 70E
  (Standard for Electrical Safety in the Workplace)

Personal Protective Equipment (PPE)

Shirt & Pants = 4 Cal/cm^2 system	Safety glasses, hearing protection
Shirt & Pants = 8 Cal/cm^2 system	Safety glasses, hearing protection + face shield
Shirt & Pants + Coveralls + Hood = 25 Cal/cm^2 system	Safety glasses, hearing protection
Moon Suit + Hood = 40 Cal/cm^2 system	Safety glasses, hearing protection





Personal Protective Equipment (PPE)

Face Shield with Shirt, Pants & 8 Cal/cm^2 system

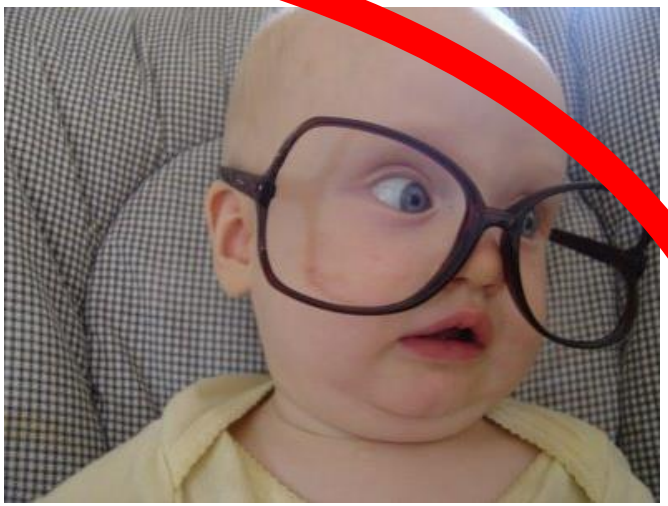
8 Cal/cm^2 Shirt, Pants & Cotton Underwear W/O Face Shield (4 Cal system)

25 Cal/cm^2 Next Level PPE

Personal Protective Equipment (PPE)

40 Cal/cm^2 system

Personal Protective Equipment (PPE)



INDURA Ultra Soft
Flame Resistant Fabrics

CLOTHING ON MANIKIN

Top 10 - Clip 5

Pant = INDURA® Ultra Soft® Style 451 9oz; After 100 Industrial Launderings
Shirt = INDURA® Ultra Soft® Style 301 7oz; After 100 Industrial Launderings

EQUIPMENT

100 Amp Disconnect

TEST PARAMETERS

Voltage = 480
Amperage = 11 kA
Cycles = 12
Distance = 12"
"Arc in a Box"

CALCULATED ENERGY

Per IEEE 1584

10.4 cal/cm²

MAIN MENU

Top 10 Video Clips
No Manikin Clips
NON-FR Clips
INDURA Ultra Soft Clips

Return to Top 10 Index

Explosions created by 70E Solutions at KEMA Powertest

QUIT


DANGER
HIGH
VOLTAGE
1. 29. 2009


X1
X3


ON
TRIP
OFF

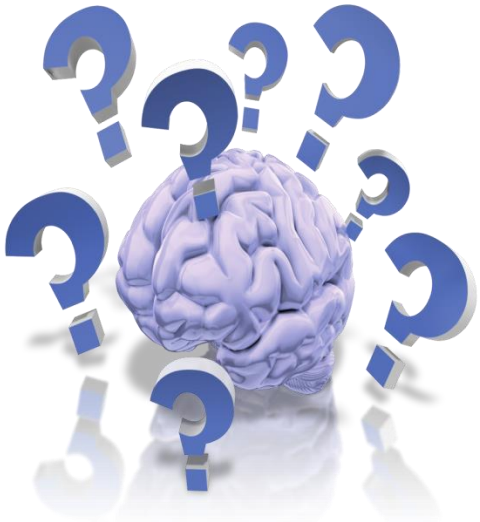
So what should I do?

Perform an assessment if you have not

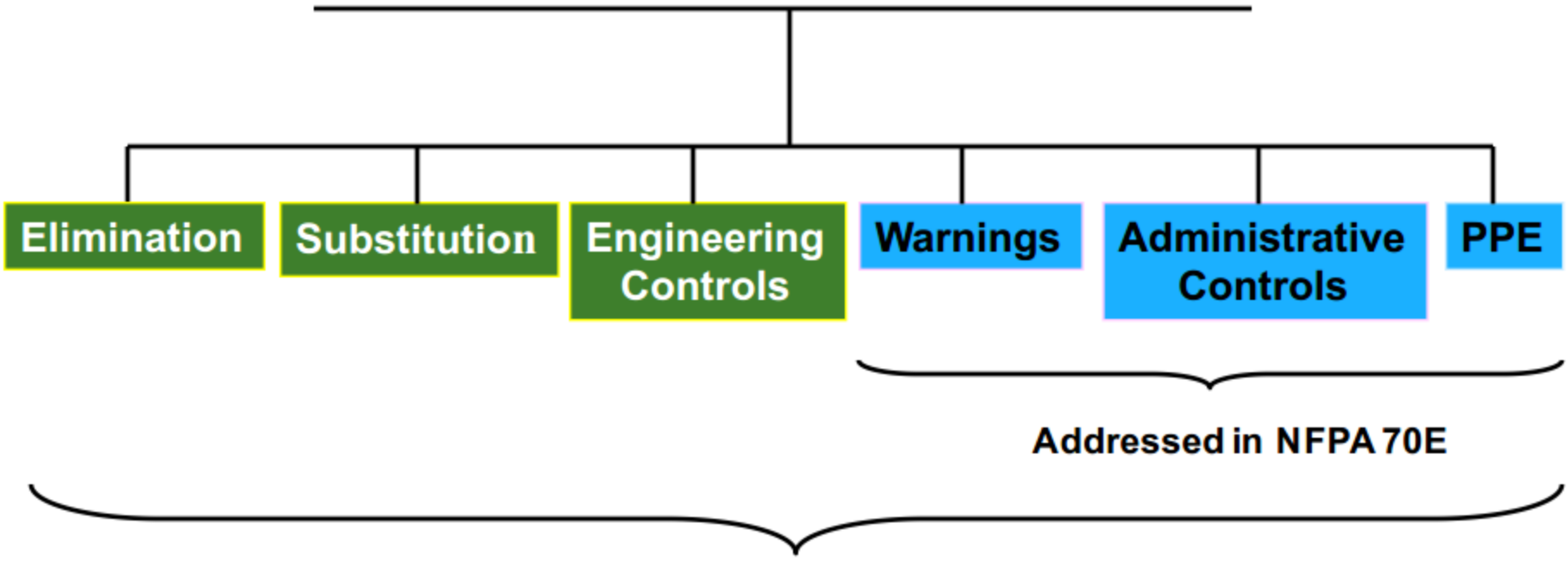
- Identify hazards
- Assess risks
- Implement risk control measures

Come up with procedures to perform energized work

Mitigate hazardous areas



Risk Control Measures



ANSI Z10 provides the framework to enable decisions and actions in all risk control measures

⚠ WARNING

Arc Flash and Shock Hazard
Appropriate PPE Required

ARC FLASH PROTECTION		SHOCK PROTECTION	
Working distance:	**15 in**	Shock hazard when cover is removed:	**480 VAC**
Incident energy:	**1.6 cal/cm²**	Limited approach:	**42 in**
Arc flash boundary:	**18 in**	Restricted approach:	**12 in**
Category:	**# 1**	Prohibited approach:	**1 in**
		Glove class:	**0**

Equipment Name: 17 07/28/2015

Arc Flash Analysis by: Allgeier, Martin

Mitigation

De-energize

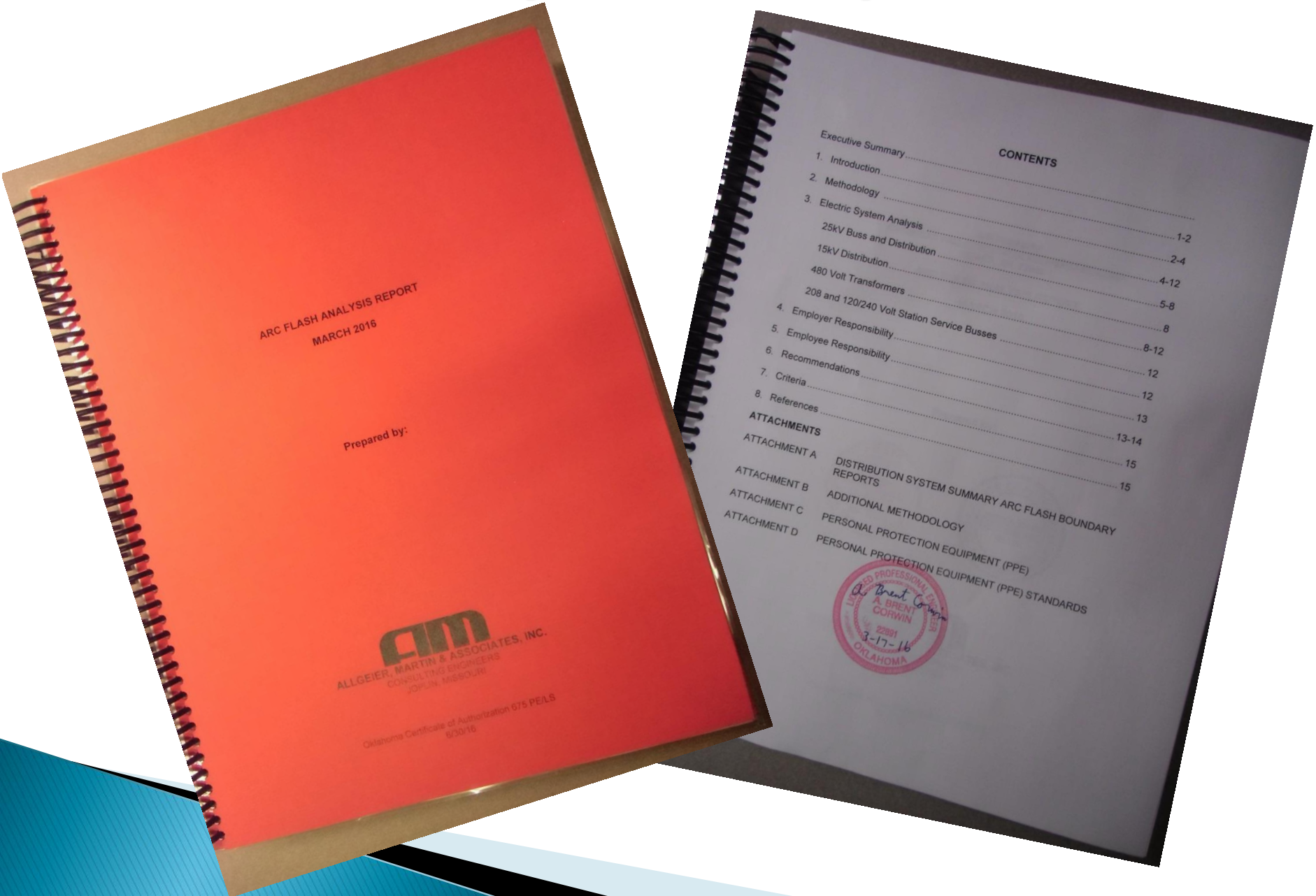
Use a faster clearing curve or device

Set OCR's to "One Shot"

Use arc sensing equipment

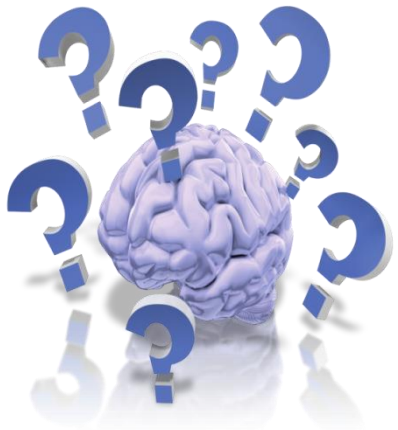
Sticks can be used to increase your distance from an Arc Potential

Analysis Lifespan



Wrap Up Questions?

- If you encounter an Arc Flash event, could you get burned?
- Should your Carhartt's FR rating match your PPE?
- Does time affect Arc Flash?



Be SAFE!

Wear the correct PPE

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