

# SC Tri Association Facility Managers Conference



## Arc Flash & Electrical Safety

**RMF Engineering**  
**Dennis Sepavich, PE**

# Agenda

- ❖ **Introductions**
- ❖ **What is an Arc Flash?**
- ❖ **Industry codes and standards**
- ❖ **Personal Protective Equipment (PPE)**
- ❖ **What is involved an Arc Flash Study?**

# Presenter

- ❖ Dennis Sepavich, PE
- ❖ Joined RMF Engineering in 2006
- ❖ Project Manager / Electrical Engineer at RMF
- ❖ Licensed Professional Engineer, 2002 (SC,NC,GA,FL,AL,AK,VA,NY,MA,IL)
- ❖ Licensed Journeyman Electrician, 1992
- ❖ 31 years experience in the Electrical Construction Industry

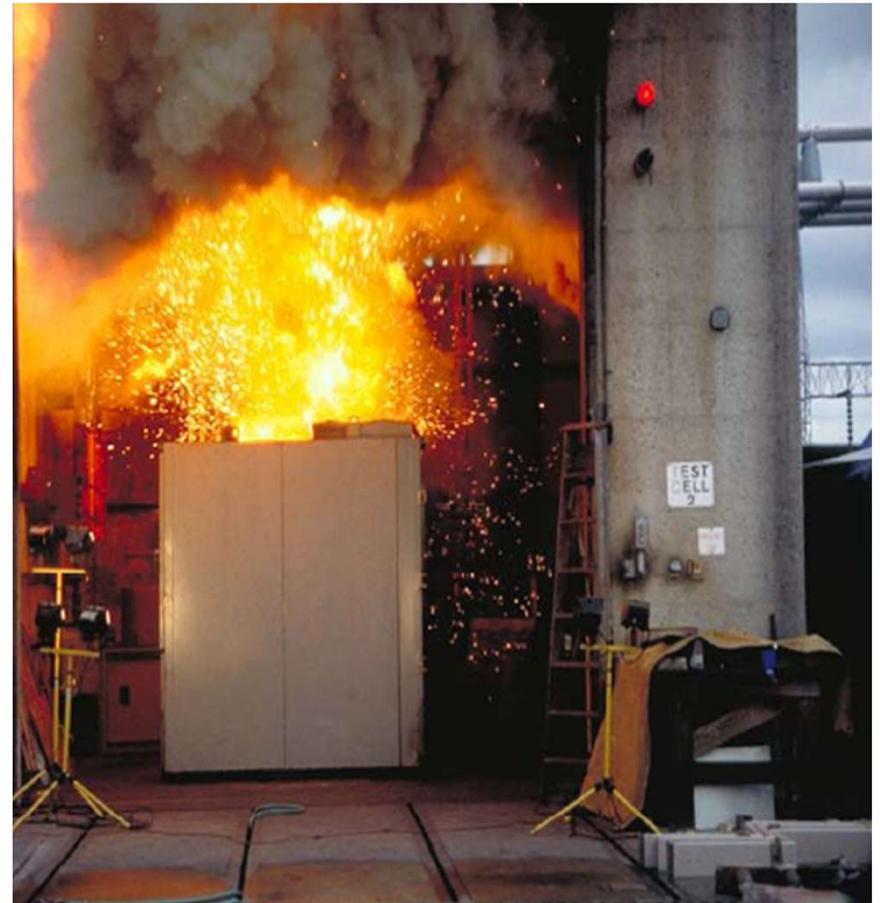




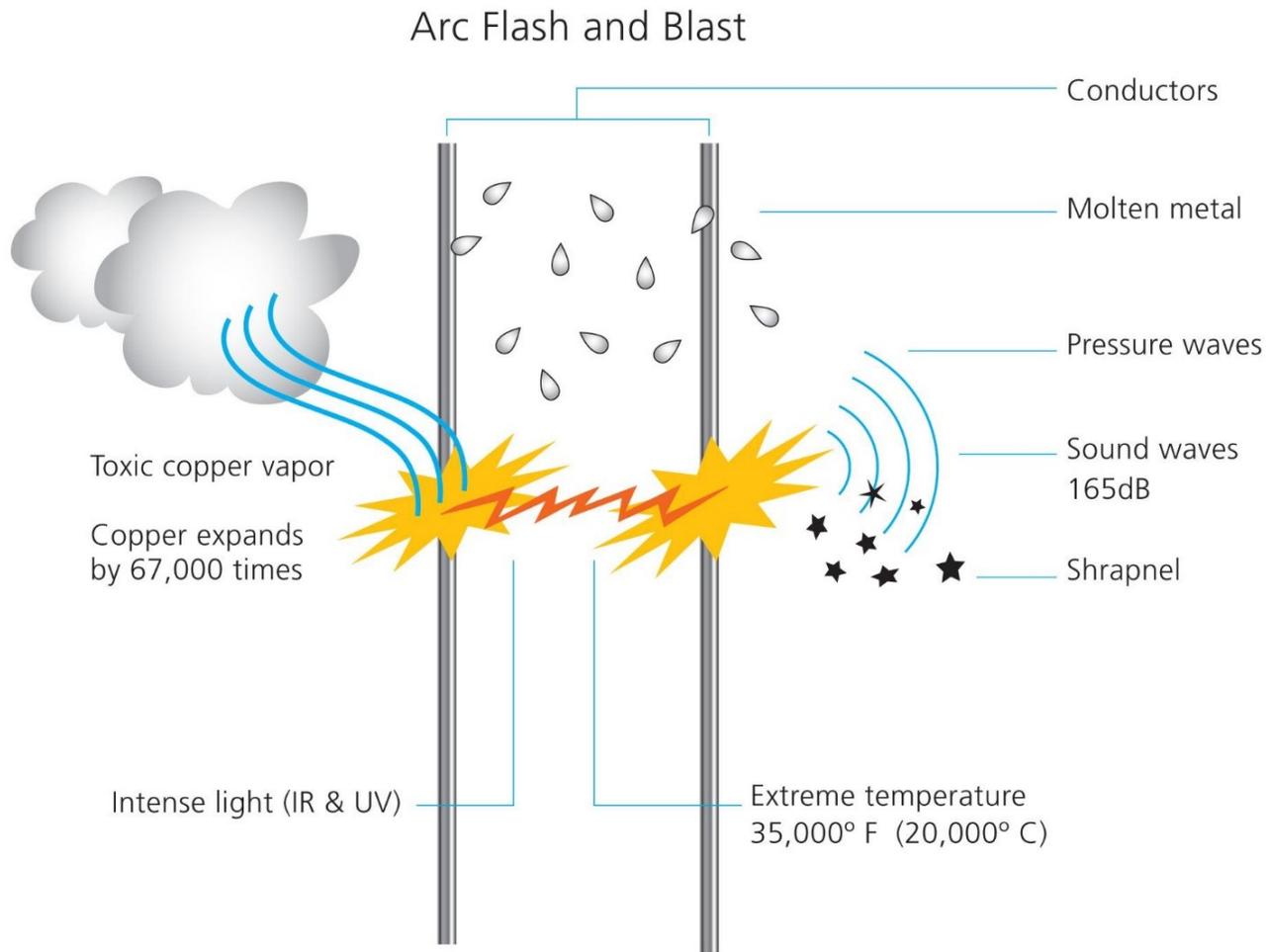
**WHAT IS AN ARC FLASH?**

# What is an Arc Flash

- ❖ A rapid release of energy due to an arcing fault between two electrical conductors (bus bars)



# What is an Arc Flash



# Arc Flash Accident

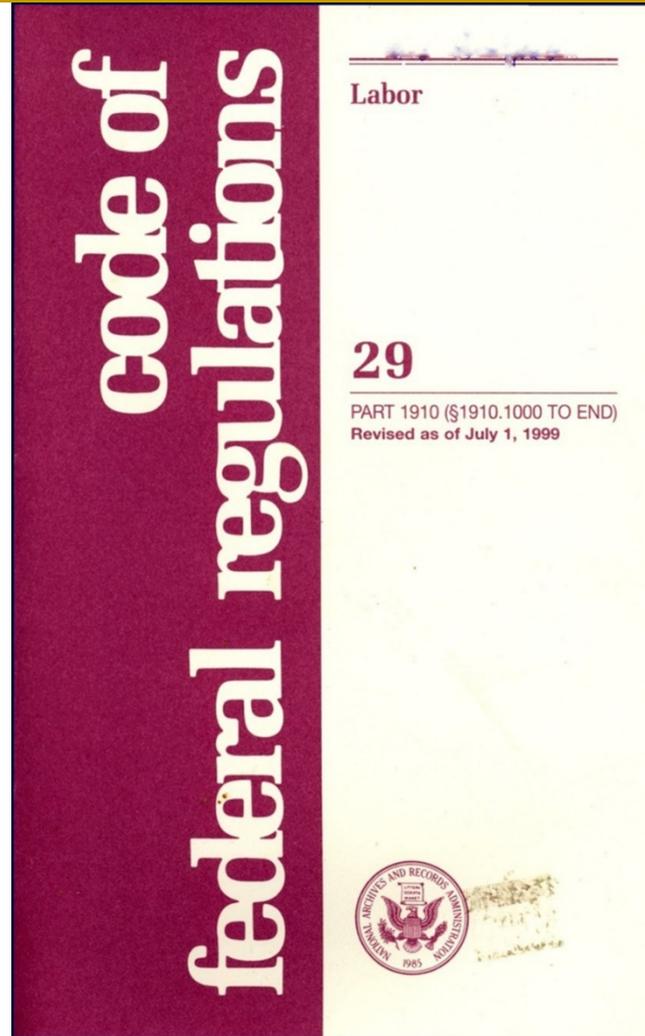




# **CODES AND STANDARDS**

# Industry Standards

- ❖ OSHA 1910.132(d) Hazard Assessment and equipment selection
- ❖ OSHA 1910.312(f) Training



# Industry Standards

- ❖ National Electrical Code
- ❖ 110.16 Arc Flash Warning Label



# Industry Standards

- ❖ National Electrical Code
- ❖ 110.24 Field Marking  
Available Fault Current

**! WARNING**

**Maximum available fault current:  
14,046 Symmetrical RMS Amperes  
Date: 12/10/2013**



# Industry Standards

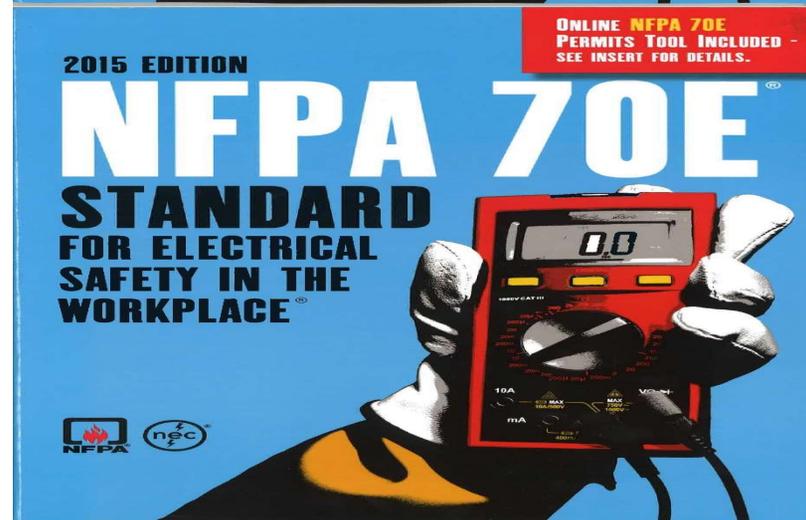
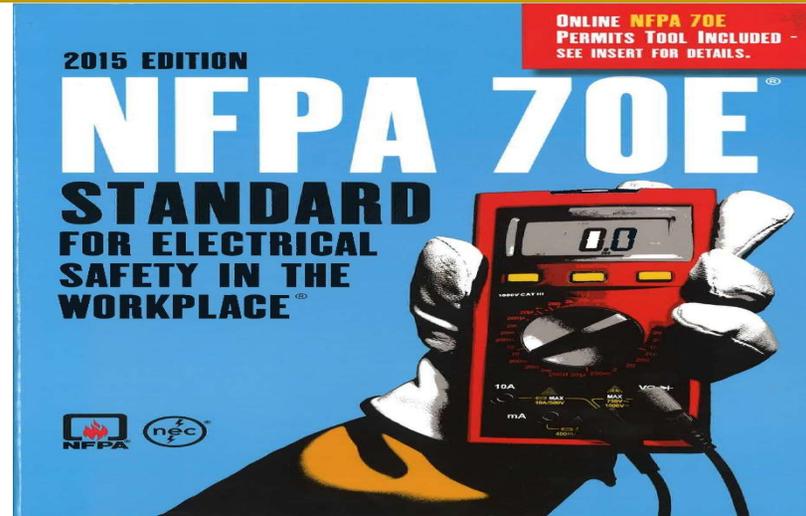
- ❖ NFPA 70E
- ❖ Article 130 – Electrically Safe Working Conditions

## (A) Energized Work.

(1) **Additional Hazards or Increased Risk.** Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.

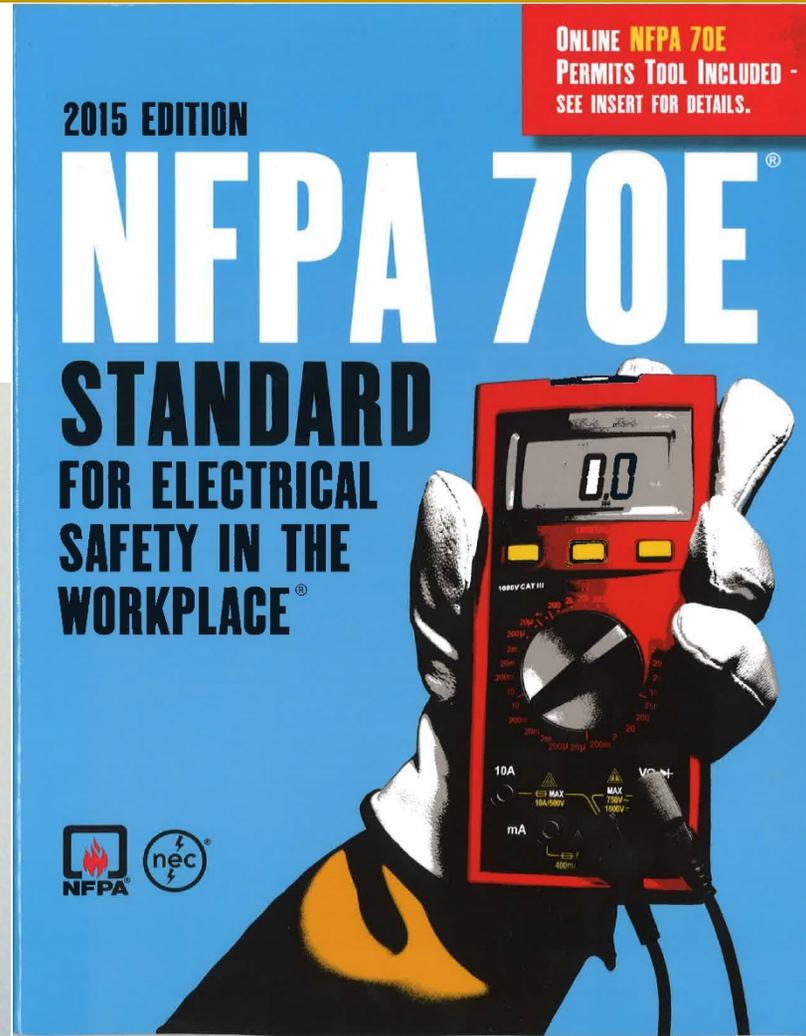
(2) **Infeasibility.** Energized work shall be permitted where the employer can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations.

(3) **Less Than 50 Volts.** Energized electrical conductors and circuit parts that operate at less than 50 volts shall not be required to be de-energized where the capacity of the source and any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arcs.



# Industry Standards

- ❖ NFPA 70E
- ❖ Article 130 – Lockout/Tagout



# Industry Standards

- ❖ NFPA 70E
- ❖ Energized Work Permit

**ENERGIZED ELECTRICAL WORK PERMIT**

**PART I: TO BE COMPLETED BY THE REQUESTER:** Job/Work Order Number \_\_\_\_\_

(1) Description of circuit/equipment/job location: \_\_\_\_\_

(2) Description of work to be done: \_\_\_\_\_

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage: \_\_\_\_\_

Requester/Title \_\_\_\_\_ Date \_\_\_\_\_

**PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:**

(1) Detailed job description procedure to be used in performing the above detailed work: \_\_\_\_\_  **Check when complete**

(2) \_\_\_\_\_

**(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:** \_\_\_\_\_

Requester/Title \_\_\_\_\_ Date \_\_\_\_\_

(b) Necessary arc flash personal and other protective equipment to safely perform the assigned task \_\_\_\_\_

(c) Arc flash boundary \_\_\_\_\_

(5) Means employed to restrict the access of unqualified persons from the work area: \_\_\_\_\_

(6) Evidence of completion of a job briefing, including discussion of any job-related hazards: \_\_\_\_\_

(7) Do you agree the above-described work can be done safely?  Yes  No (If no, return to requester.)

Electrically Qualified Person(s) \_\_\_\_\_ Date \_\_\_\_\_

Electrically Qualified Person(s) \_\_\_\_\_ Date \_\_\_\_\_

**PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:**

Manufacturing Manager \_\_\_\_\_ Maintenance/Engineering Manager \_\_\_\_\_

Safety Manager \_\_\_\_\_ Electrically Knowledgeable Person \_\_\_\_\_

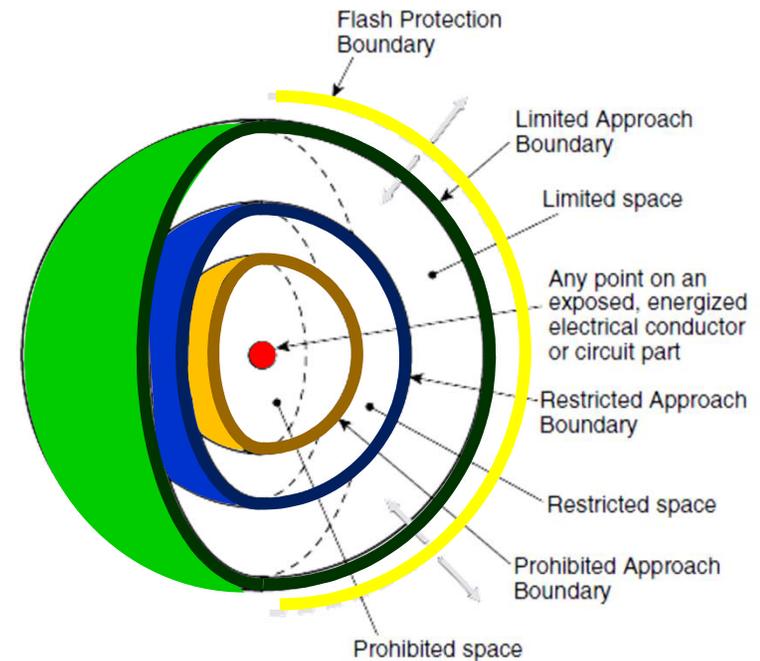
General Manager \_\_\_\_\_ Date \_\_\_\_\_

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

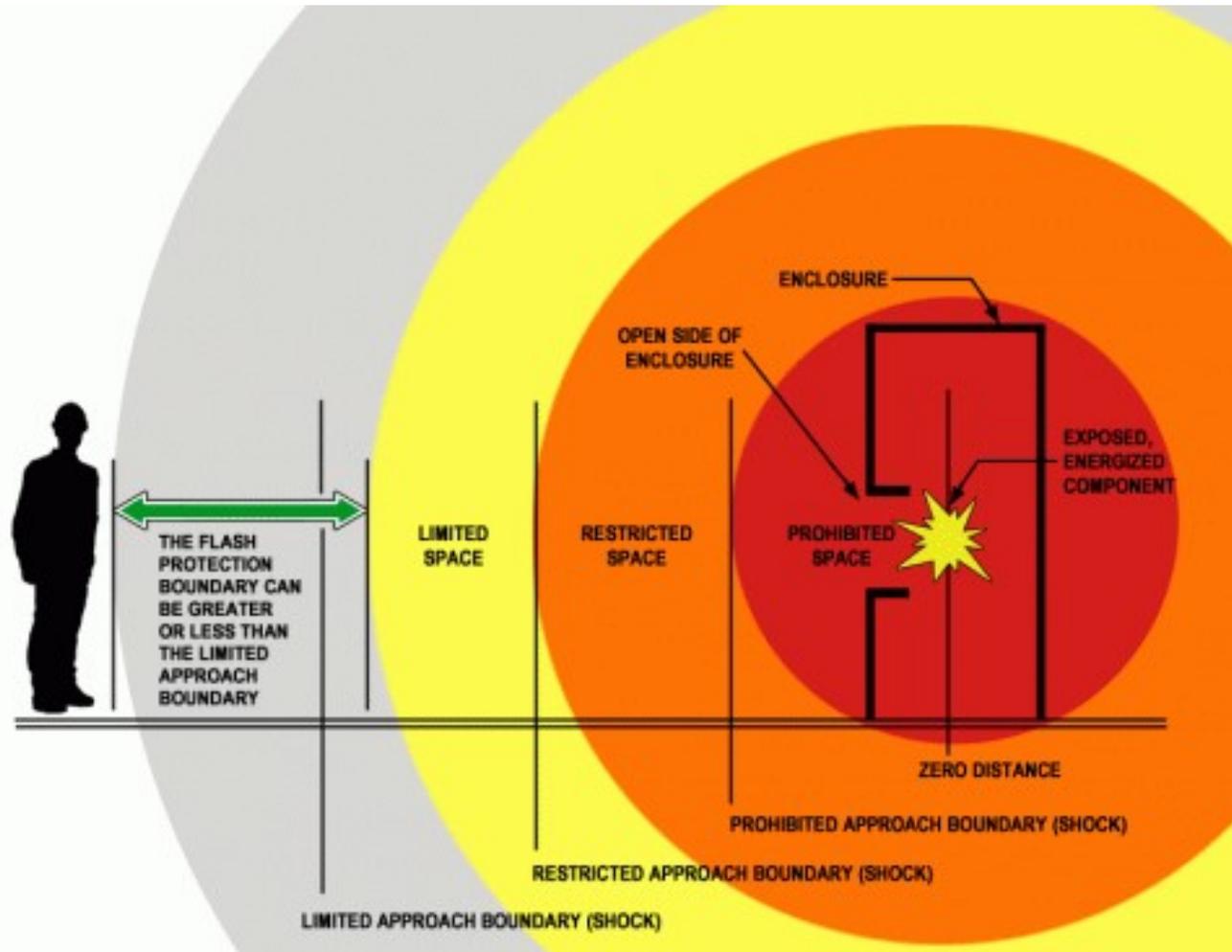
© 2014 National Fire Protection Association NFPA 70E

# Industry Standards

- ❖ NFPA 70E
- ❖ 130.5 Arc Flash Risk Assessment



# Industry Standards



# Industry Standards

- ❖ IEEE 1584
- ❖ Guide for Performing Arc Flash Hazard Calculations

IEEE Std 1584™-2002

## IEEE Guide for Performing Arc-Flash Hazard Calculations

Sponsor

**Petroleum and Chemical Industry Committee**  
of the  
**Industry Applications Society**

**Abstract:** This guide provides techniques for designers and facility operators to apply in determining the arc-flash hazard distance and the incident energy to which employees could be exposed during their work on or near electrical equipment.

**Keywords:** arc fault currents, arc-flash hazard, arc-flash hazard analysis, arc-flash hazard marking, arc in enclosures, arc in open air, bolted fault currents, electrical hazard, flash protection boundary, incident energy, personal protective equipment, protective device coordination study, short-circuit study, working distances

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# Industry Standards

- ❖ IEEE 1584
- ❖ Includes Incident Energy Calculation equations used by software programs

IEEE Std 1584™-2002

## IEEE Guide for Performing Arc-Flash Hazard Calculations

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**PERSONAL PROTECTIVE  
EQUIPMENT**

# Personal Protective Equipment

## ❖ Shock Hazard Protection



# Personal Protective Equipment

## ❖ Arc Flash Protection



8 calorie suit



12 calorie suit



40 calorie suit

# Personal Protective Equipment

## ❖ Arc Flash Protection



100 calorie suit

# WHAT IS INVOLVED IN AN ARC FLASH STUDY?

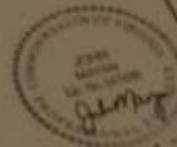
## ARC FLASH ANALYSIS

Loudoun County  
Public Schools  
TUSCARORA  
HIGH SCHOOL

801 North King Street Leesburg, VA

FINAL REPORT

1 JUNE 2014



**ANGER**  
SAFE PPE EXISTS  
IZED WORK PROHIBITED  
Flash Hazard Boundary  
Flash Hazard at 10 ft  
DO NOT WORK ON LIVE  
Shock Hazard when cover is removed  
Ground Clearance  
Unlisted Apparatus  
Restricted Apparatus  
Prohibited Apparatus  
06/20/14  
001 0000

**ARNING**



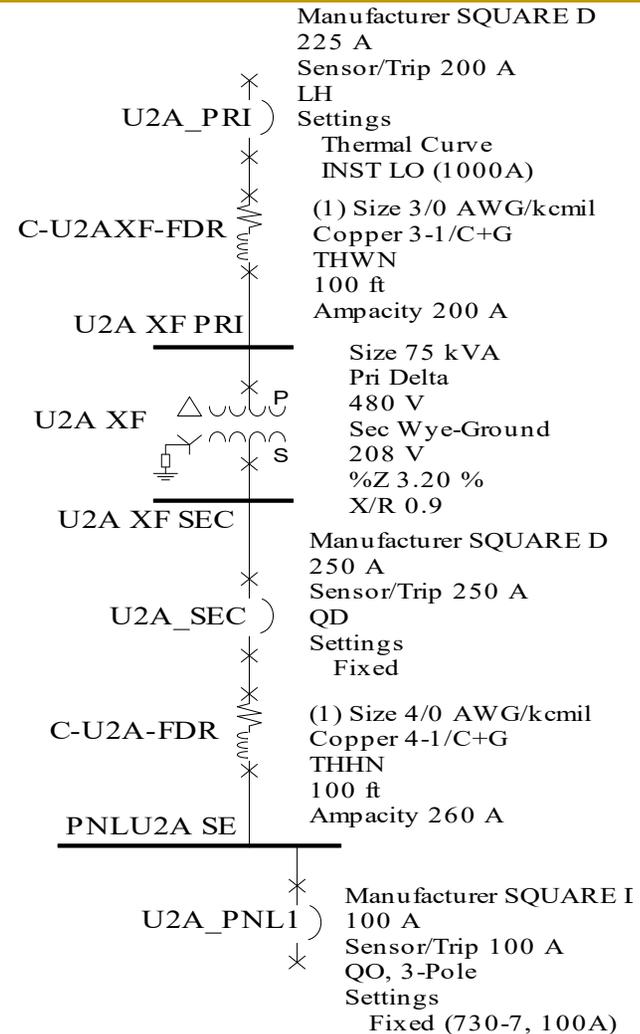
# What is involved in an Arc Flash Study

- ❖ Data Collection
- ❖ Document existing conditions (Voltage, Ampacity, circuit breaker settings, feeder sizes and conductors lengths)



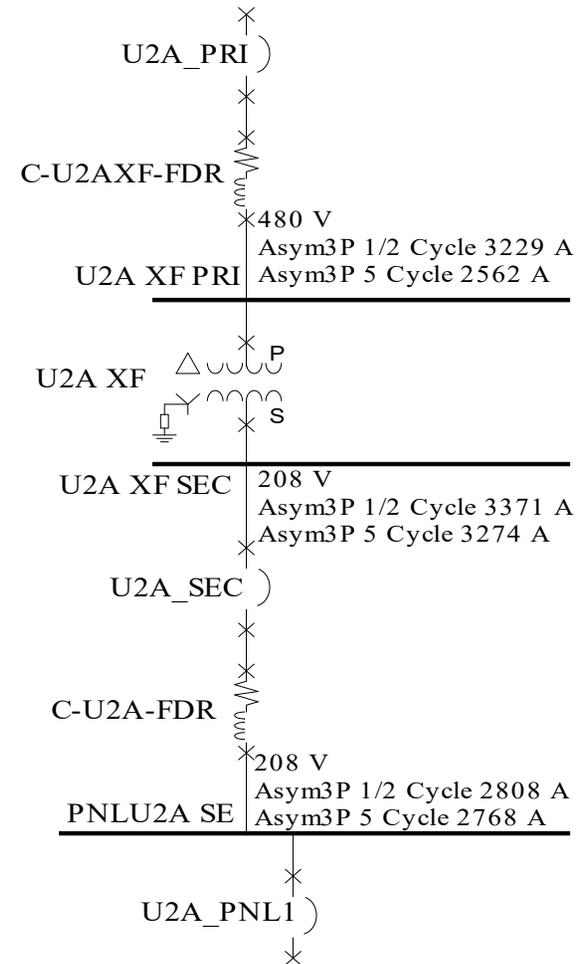
# What is involved in an Arc Flash Study

- ❖ Develop One-Line Diagram
- ❖ Input field data into one-line diagram format in software program



# What is involved in an Arc Flash Study

- ❖ Short Circuit Study
- ❖ Determine the fault current at each bus in the electrical distribution system



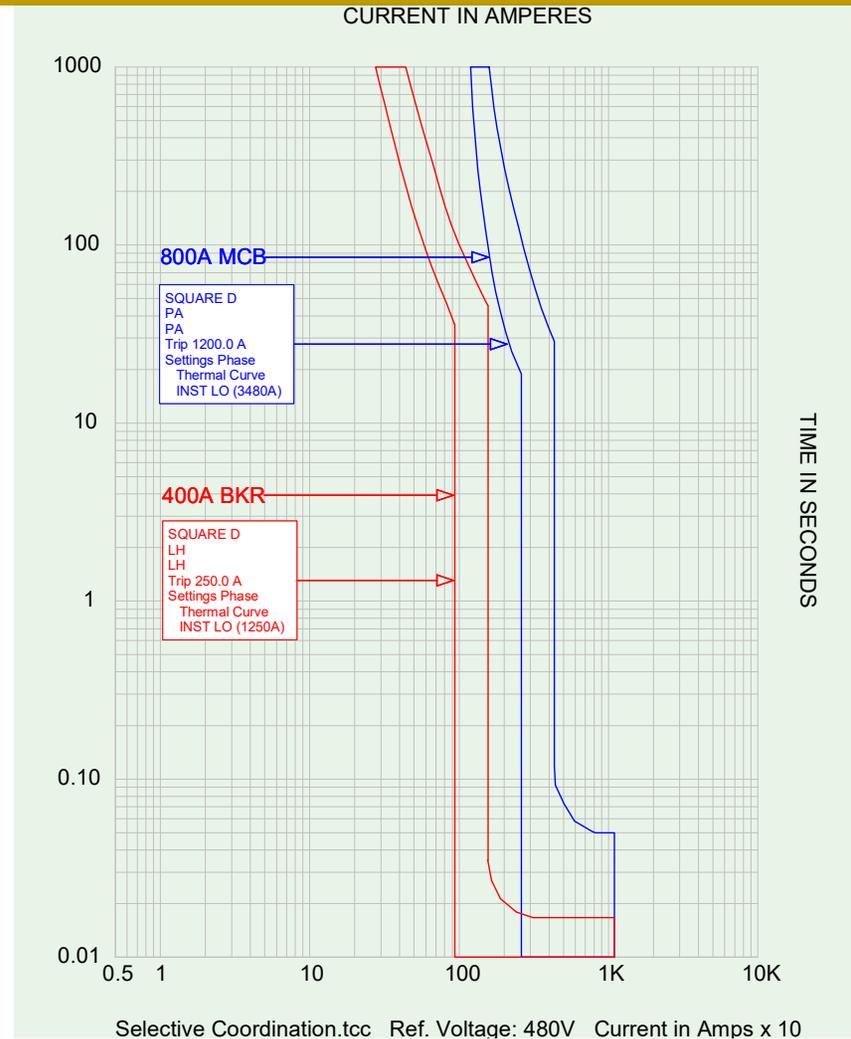
# What is involved in an Arc Flash Study

- ❖ Short Circuit Study
- ❖ Identifies any circuit breakers that may not be rated for the available fault current (over duty)
- ❖ Presents a serious safety hazard



# What is involved in an Arc Flash Study

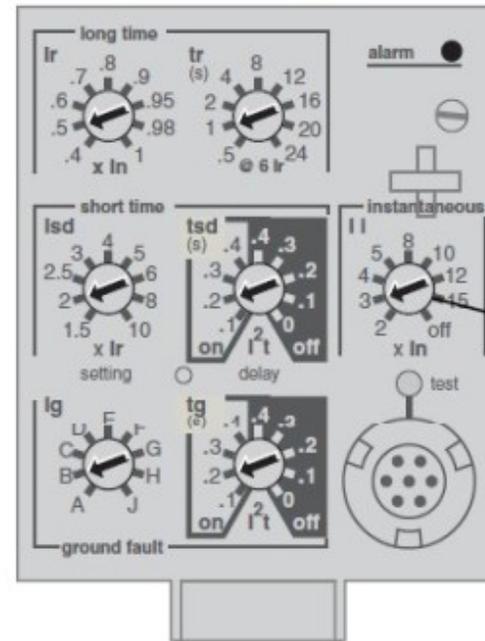
- ❖ Protective Device Coordination
- ❖ Compare time current curves to ensure the overcurrent device closest to the load trips first (Selective Coordination)



# What is involved in an Arc Flash Study

- ❖ Protective Device Coordination
- ❖ Circuit Breakers with adjustable electronic trip units may be able to be adjusted to lower the incident energy which reduces the arc flash hazard

Micrologic 6.0A Trip Unit



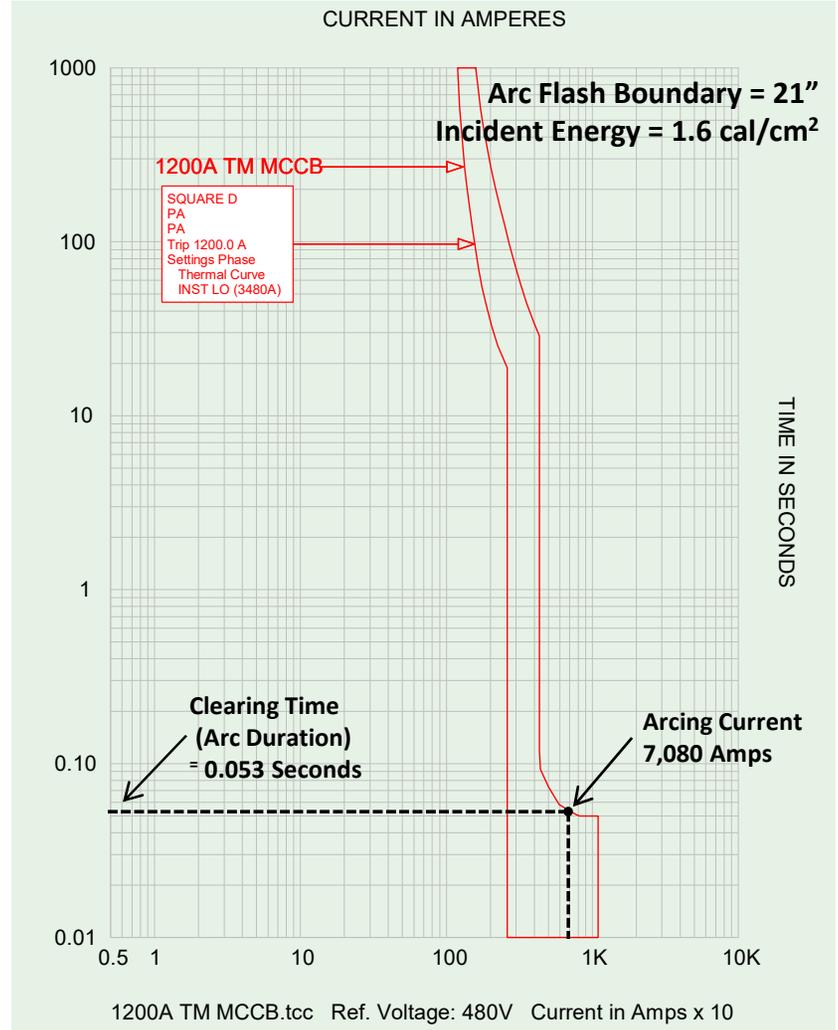
# What is Involved in an Arc Flash Study

- ❖ Arc Hazard Analysis
- ❖ Calculate the incident energy at each bus
- ❖ Dependent on level of arcing fault current
- ❖ Clearing time of upstream device



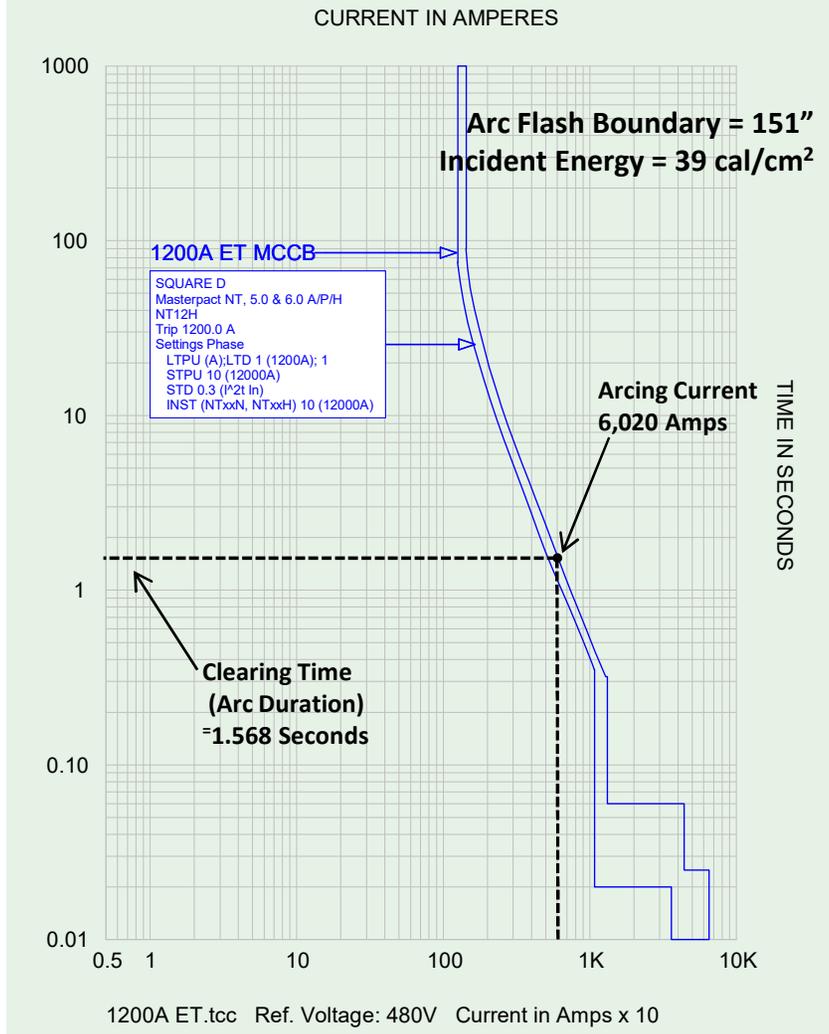
# Example

- ❖ 1200 Amp MCCB with adjustable instantaneous trip



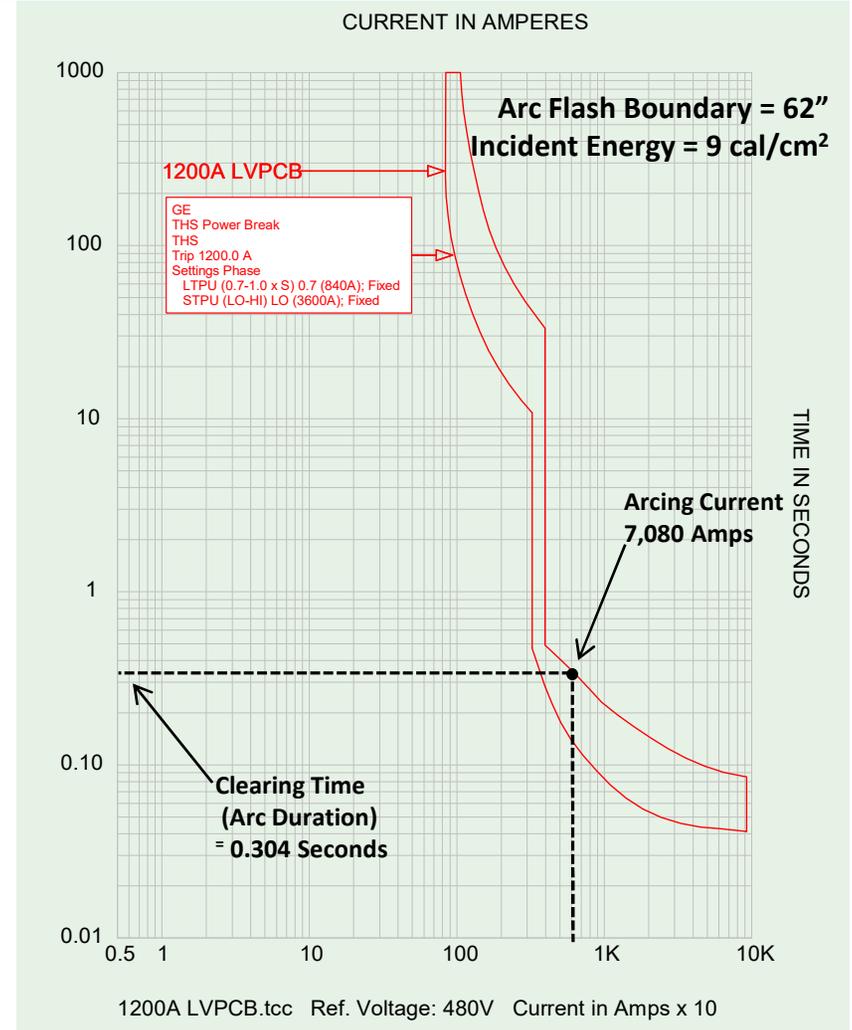
# Example

- ❖ 1200 Amp LVPCB with electronic trip unit



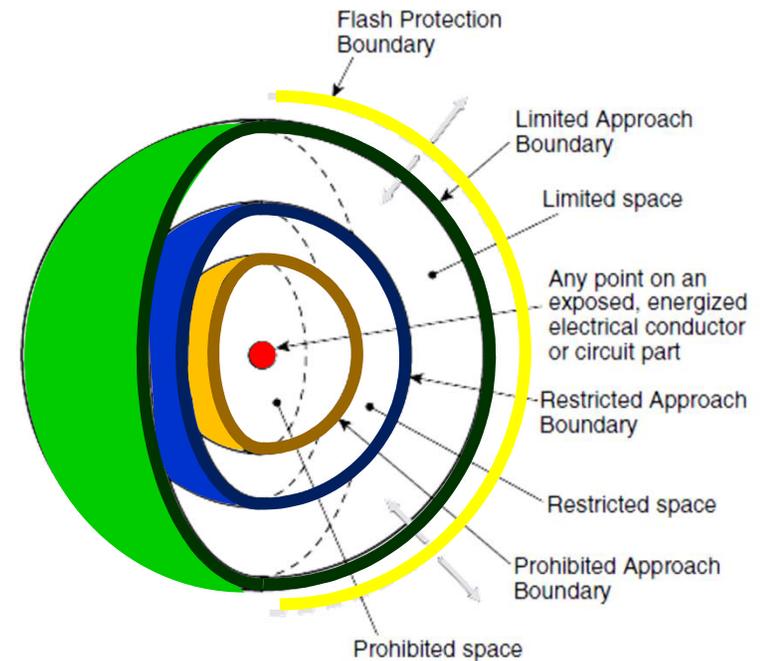
# Example

- ❖ 1200 Amp Power Circuit Breaker w/o instantaneous protection



# What is involved in an Arc Flash Study

- ❖ Arc Hazard Analysis
- ❖ Determine the Arc Flash Boundary
- ❖ Distance where unprotected person can receive a 2<sup>nd</sup> degree burn  $>1.2 \text{ cal/cm}^2$



# What is involved in an Arc Flash Study

## ❖ Arc Flash Label

 <b>WARNING</b>	
<b>ARC FLASH &amp; SHOCK HAZARD</b>	
480V	Nominal System Voltage
4 Ft 8 In	Arc Flash Boundary
3 Ft 0 In	Limited Approach Boundary
1 Ft 0 In	Restricted Approach Boundary
25.7	Incident Energy (cal/cm <sup>2</sup> )
<b>PPE Required:</b> Arc-Rated Long-sleeved Shirt, Pants or Coverall Hard Hat, Balaclava, Face Shield (rated equal to or greater than listed Incident Energy) Safety Glasses or Goggles Hearing Protection (ear canal) Leather Footwear	
<b>Shock Protection:</b> Gloves Class 00, Voltage-rated Tools	
Equipment ID: Panel #123      Location: Main Building	
Date of Arc Flash Risk Analysis: 1-1-15	

2015 NFPA 70E: PPE Categories removed from the label

ARC FLASH BOUNDARY

INCIDENT ENERGY

Personal Protective Equipment

Date the Study was completed

# What is involved in an Arc Flash Study

- ❖ Arc Flash Labels
- ❖ Place labels on the equipment



# What is involved in an Arc Flash Study

- ❖ Keep it current
- ❖ Review and update the study when any changes are made to the system
- ❖ Minimum every 5 years



# Why perform Arc Flash Studies

- ❖ Prevent worker injury or death
- ❖ Avoid or reduce litigation associated with an electrical injury
- ❖ Comply with codes and standards to avoid citations and fines



# Summary

- ❖ Basic understanding of arc flash
- ❖ Overview of codes and standards associated with arc flash and electrical safety
- ❖ Overview of what goes into an arc flash study



**Occupational Safety  
and Health Administration**





# THANK YOU!!!

Dennis Sepavich, PE  
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