

Applying the 2024 NFPA 70E

Arc Flash Standard

Suncoast Industrial Services, Inc.

80-6A Industrial Loop N.

Orange Park, FL 32073

904-269-4403

904-269-4404 (fax)

webbysis@suncoastind.com



Suncoast

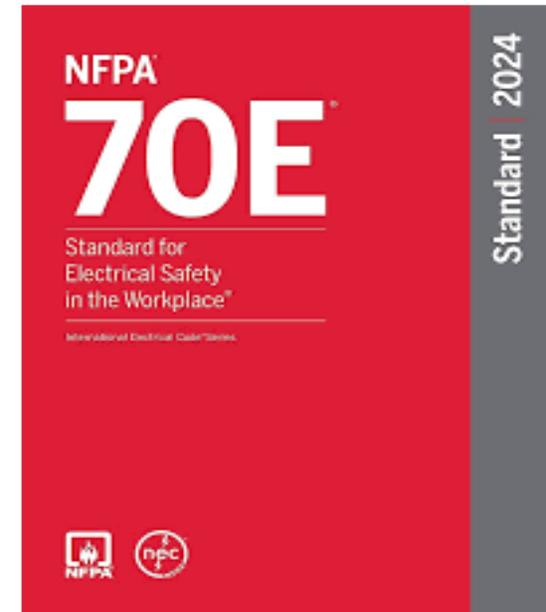
- Suncoast Industrial is an Electrical Engineering and Contracting firm in North Florida. We provide a variety of services including:
 - Arc Flash, Coordination, IR and Load Studies
 - Design of electrical systems (Florida CA 5942)
 - Electrical Equipment Testing
 - Circuit Breaker Testing and Refurbishing
 - Transformer Testing (Megger & TTR) and Oil Analysis
 - Power Cable Testing to 35KV
 - Protective Relay Programming & Function Verification
 - Electrical Contracting (Florida EC-0001022)



Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Electrical Hazard

Definition - A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn or arc blast injury. (Article 100.)



Electrical Hazard

Definition - A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn or arc blast injury. (Article 100.)



Electrical Shock

- Over 30,000 nonfatal electrical shock accidents occur each year
- National Safety Council
 - 1,000 fatalities each year due to electrocution
 - Half of them while servicing equipment 600V or under
- NFPA 70E defines **50V** as the threshold which requires isolation before servicing (NFPA 70E 130.1)



Electrical Shock

- **Levels of AC current to cause shock & electrocution**

1 mA	Not perceptible
5 mA	Slight shock
4 – 6 mA	Trip range of GFI devices
6 – 25 mA	Painful shock
9 – 30 mA	Loss of muscle control, May not be able to “let go”
40 mA for 1 sec.	Ventricular Fibrillation Threshold
50 – 150 mA	Respiratory Arrest

Characteristics of an Arc Flash



Characteristics of an Arc Flash

- When an arc fault occurs, the arc creates a plasma, which has a much lower impedance or much higher conductivity than air
- The energy produced melts components, flooding the air with conductive particles
- Copper expands to 67,000 times its original volume when vaporized
- The flash occurs instantaneously, releasing a huge amount of energy in a very short period of time

Terminology

- **Incident Energy** – The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (Units = cal/cm²)

Which will have the higher current potential?

Bolted

Arcing

(Article 100.)

Circuit Breaker and Fuse Characteristics

Circuit Breaker and Fuse Performance Relating to Fault Currents

- Circuit breakers and fuses are traditionally designed to interrupt rapidly in **bolted** fault conditions
- Arc faults occur at lower current levels
- Greater **incident energy** can be allowed to pass when the current is at a lower value, because of lower tripping time.
- New device designs will reduce the incident energy

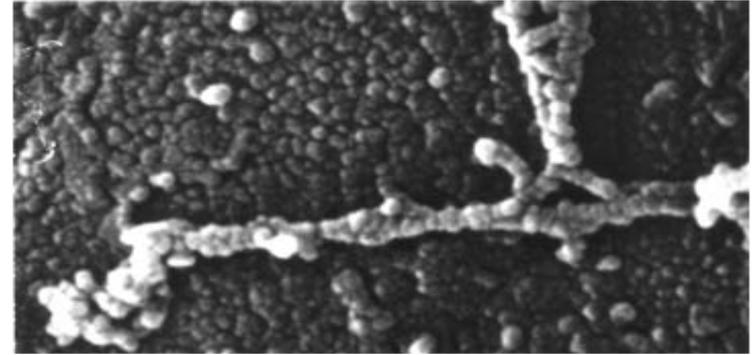
Causes of Arc Flash

- Mechanical
 - Accidental touching, dropping of tools or metal parts
 - Closing into faulted lines
 - Loose connections



Causes of Arc Flash

- Environmental
 - Dust, impurities, corrosion at contact surfaces
 - Failure of insulating materials
 - Snapping of leads due to force – human, rodents or birds



Arc Flash

- Thermal impacts of arc flash temperatures

145°F	Curable Burn
205°F	Cell Death
700°F	Clothing Ignition
1,400°F	Burning Clothing
1,800°F	Metal Droplets
9,000°F	Surface of the Sun

Arc Flash

Arc Flash core temperatures can exceed 35,000° F

3rd degree burns form when skin is exposed to 200° F for less than 1/8th of a second

Example of an arc fault

Arc Flash Burn

- Over 2,000 severe injuries/year
- Can kill at distances of 10 ft
- Cost of treatment can exceed \$1,000,000/case
 - Does not include litigation fees or process loss
- Treatment can require years of rehabilitation
- Victim may never return to work or retain quality of life



Arc Blast

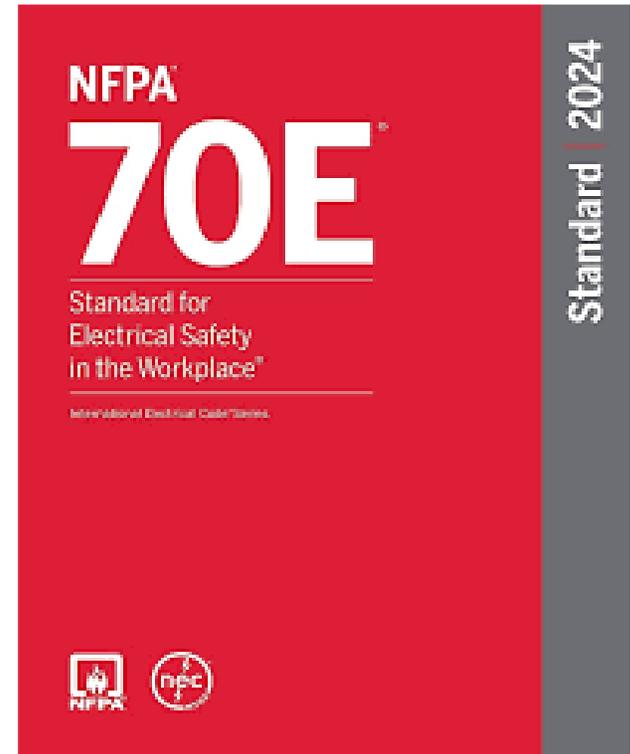
- High pressure
 - Copper expands 67,000 times as it vaporizes
 - Air expands when vaporized
 - Sound pressure > 160dB (car horn 115dB)
 - Debris accelerated to 700 mph
- People killed with no external sign of injury



Agenda

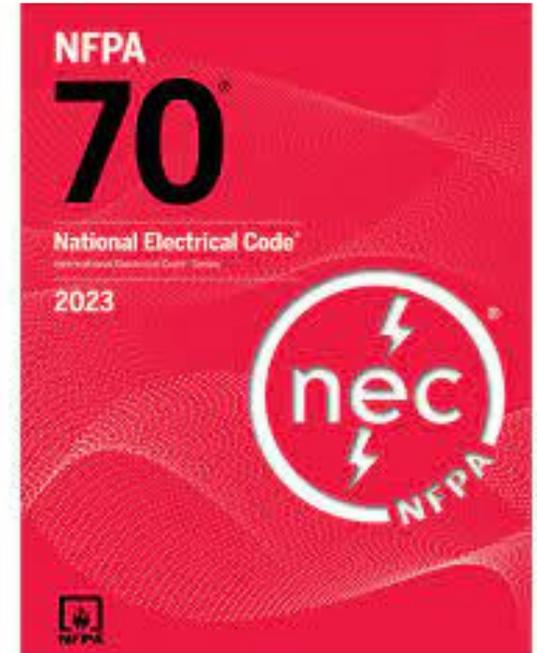
- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



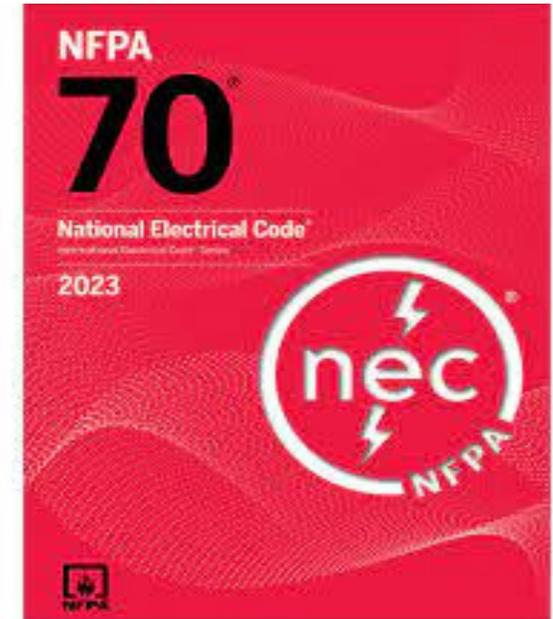
Codes & Standards

- National Electrical Code 2023 - NFPA 70 – 2023 Edition



Codes & Standards

- National Electrical Code 2023 - NFPA 70 – 2023 Edition
- OSHA 1910 Subchapter S – Occupational Safety & Health Act



U.S. Department of Labor
Occupational Safety & Health Administration



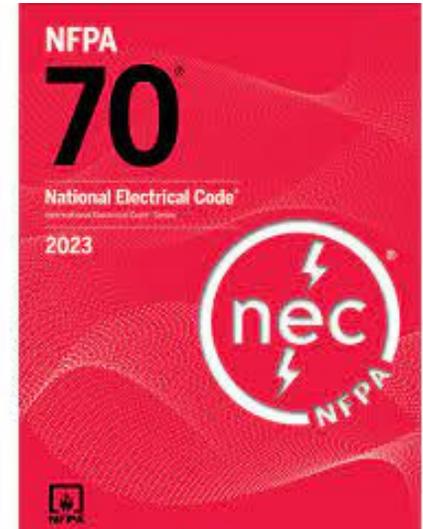
Codes & Standards

- National Electrical Code 2023 - NFPA 70 – 2023 Edition
- OSHA 1910 Subchapter S – Occupational Safety & Health Act



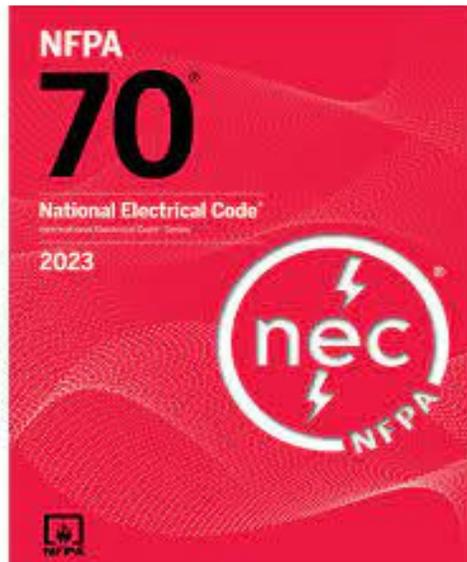
U.S. Department of Labor
Occupational Safety & Health Administration

- NFPA 70E – Standard for Electrical Safety in the Workplace - 2024



What is NFPA 70E ?

- The *Standard for Electrical Safety in the Workplace*
 - Referenced in both the NEC and OSHA regulations regarding *safe electrical work practices*



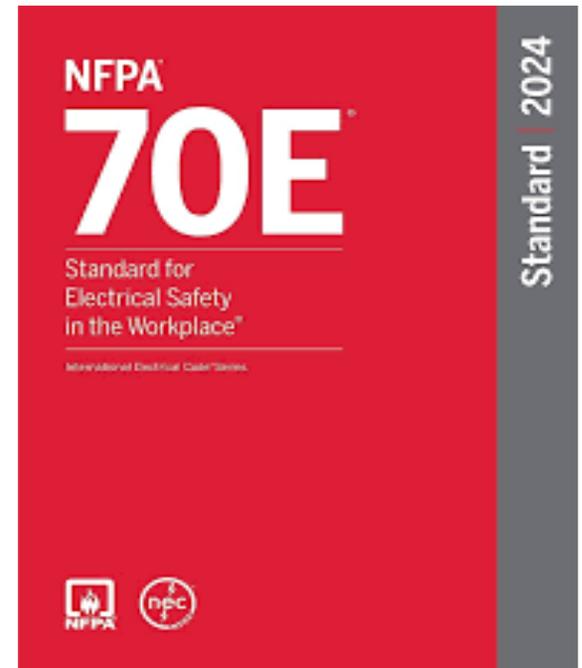
U.S. Department of Labor
Occupational Safety & Health Administration



Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



NFPA 70E Covers Electrical Safety in the Workplace

- Three Main Sections (2024):
 1. Safety-Related Work Practices
 2. Safety-Related Maintenance Requirements
 3. Safety Requirements for Special Equipment



- **Arc-Flash** is Covered in Chapter 1, Article 130 (mainly) and Annex D

Electrically Safe Work Condition

- A state in which the conductor or circuit part to be worked on or near has been:
 - Disconnected from energized parts
 - Locked/tagged in accordance with established standards
 - Tested to verify the absence of voltage
 - Temporarily grounded for personnel protection if determined necessary

NFPA 70E 2024

- Definitions and formulas to calculate Arc Flash and Electrical Shock Hazard Boundaries
- Default tables for Arc Flash levels and Personal Protective Equipment (PPE) required for specific tasks
- Includes mandates for:
 - Electrical Safety Program
 - Energized Electrical Work Permit
 - Safety-Related Maintenance/ Work Practices (including PPE)
 - Training

NFPA 70E – 2024 Changes

- **110.4 (A)(1) Qualified Person**, The word “special” was changed to (“applicable”) to make it clear that qualified persons need only be familiar with techniques they need to use.
- **120.5 (A)(1) Locating Sources**, A new informational note was added which states: “Locating sources of supply could include identifying situations where a neutral conductor continues to carry current after phase conductors have been de-energized.”
- **130.7 (C)(5) Hearing Protection**, Employees shall wear hearing protection whenever within the arc flash boundary. (**The word working inside was removed**)
- **Table 130.7 (C)(7)(a) Maximum Use Voltage for Rubber Insulating Gloves**, The word “gauntlet” was replaced with “**minimum distance between the protective cuff and rubber insulating glove cuff.**”

NFPA 70E – 2024 Changes

- **Table 130.7(C)(15)(b) Arc Flash PPE Categories for DC Systems.** A major revision was made. The upper part of the table was **deleted** that was for voltages from 100 to 250 volts DC. The new parameters for the table and arc flash PPE categories are greater than 150 volts and equal to or less than 600 volts.
- **130.8 (M) Reclosing Circuits After Protective Operation,** After a circuit is de-energized by automatic operation of a circuit protective device, the circuit shall not be **manually** re-energized until **a qualified person or persons determines** the equipment and circuit can be safely energized.

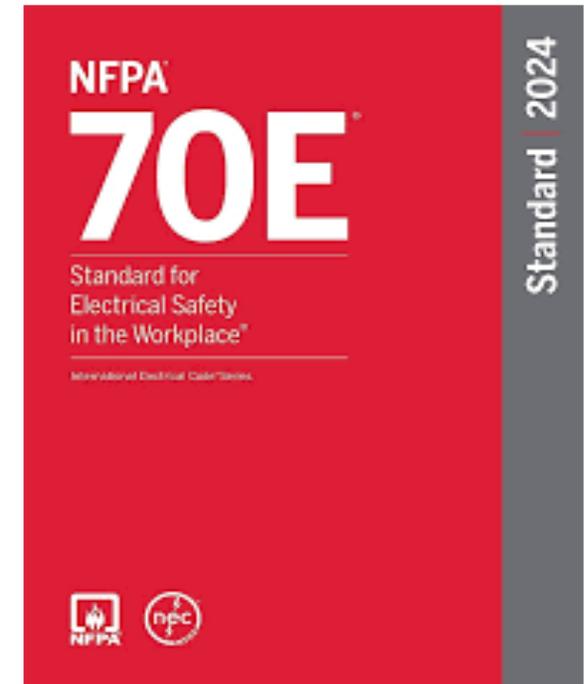
NFPA 70E – 2024 Changes

- **130.8 (M) Continued, Manually reclosing** circuit breakers or re-energizing circuits through replaced fuses shall be prohibited **until the fault has been cleared.**
- **320.1 Scope**, This article covers electrical safety requirements for the practical safeguarding of employees while working with exposed stationary storage batteries that exceed **100** volts, nominal, **or exceed a short circuit power of 1000 watts.** **320.1 Scope**, was changed from 50 volts to 100 volts.

Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

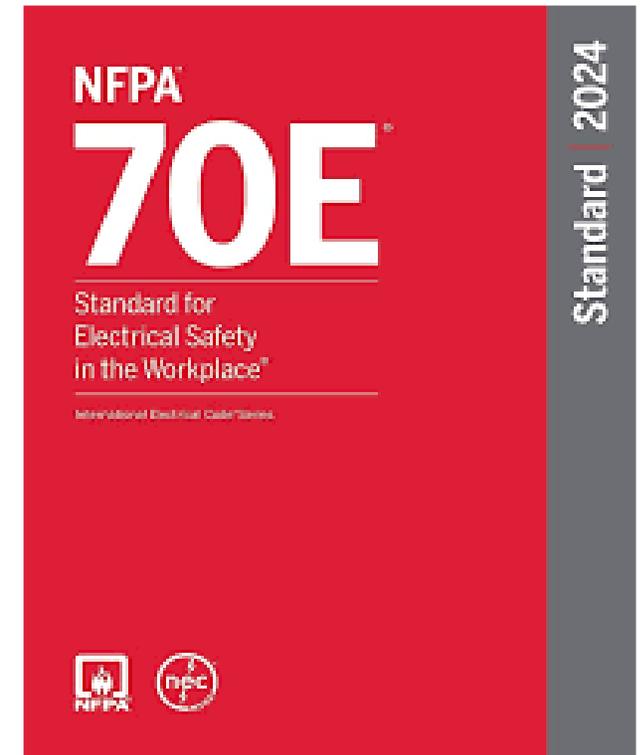
- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
 - **Minimizing Arc Flash Hazards (Risks)**



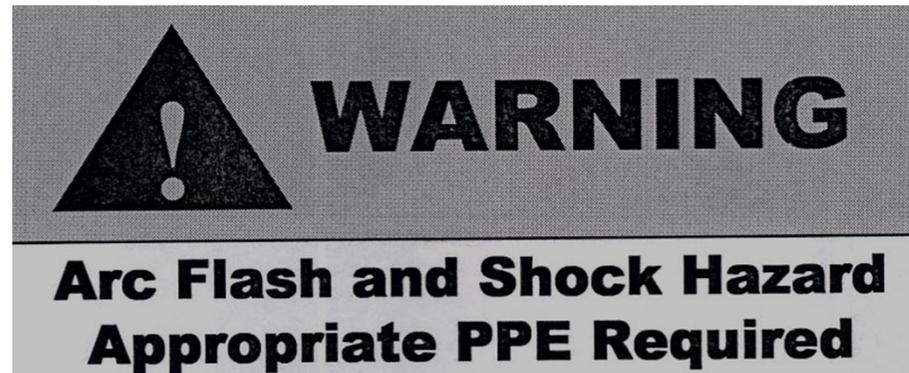
Labeling Requirement

- NFPA 70E 130.5(H) (also NEC 110.16)
Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked with a label containing all the following information:
 - (1) Nominal system voltage
 - (2) Arc flash boundary
 - (3) At least one of the following:
 - a. Available incident energy and the corresponding working distance OR the arc flash PPE category , BUT not both
 - b. Minimum arc rating of clothing
 - c. Site – specific level of PPE

Previous Labeling Example

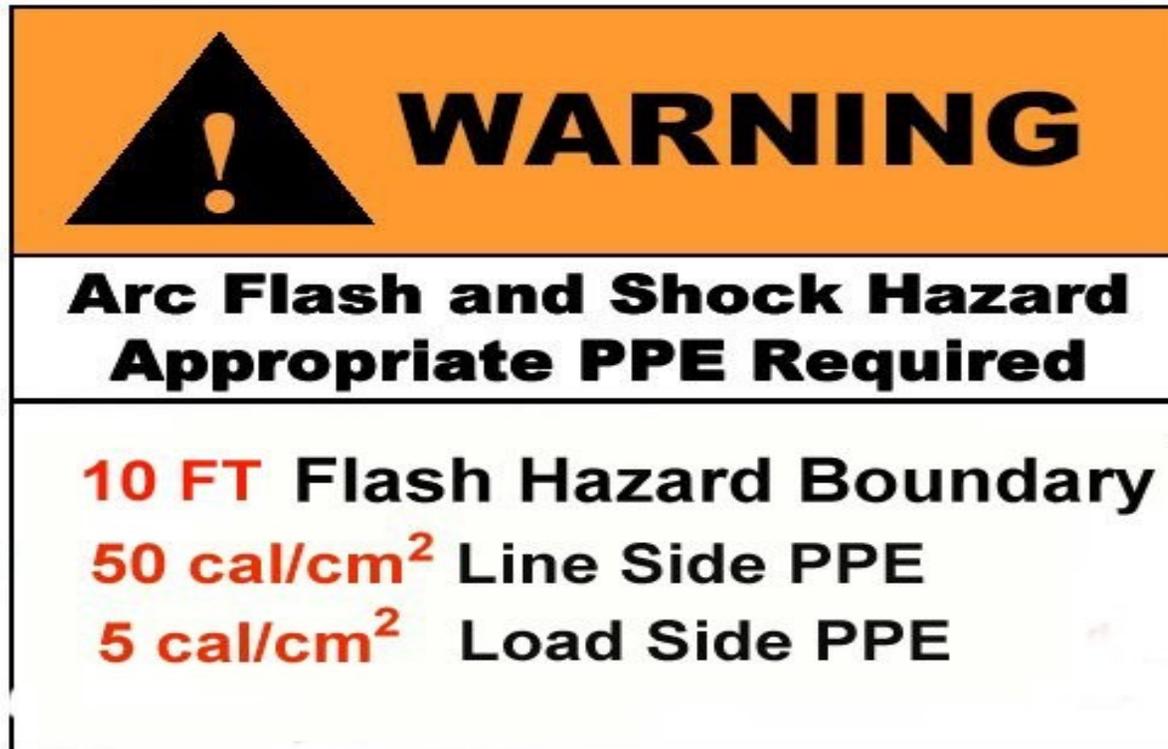
The Minimum Requirement

Under NFPA – 70E - 2009



Previous Labeling Example

Large U.S. Refining Customer



Current Labeling Example

Generating Station

WARNING			
ARC FLASH & SHOCK HAZARD APPROPRIATE PPE REQUIRED			
ARC FLASH HAZARD (CAL/CM²)	5.1	ARC FLASH BOUNDARY	48.1"
		LIMITED APPROACH BOUNDARY	42"
		RESTRICTED APPROACH BOUNDARY	12"
SHOCK PPE	CLASS	00	NOMINAL SYSTEM VOLTAGE 480V
	V-RATING	500	
EQUIPMENT ID:	MDP1		
UP-STREAM TRIP DEVICE:	MDP1 MAIN		PPE: Arc Rated (AR) Coveralls (Or Long Sleeve AR Shirt & Long AR Pants, AR Hood or AR Face Shield and AR Balaclava, Hard Hat/Safety Glasses, Hearing Protection, Heavy Duty Leather Gloves, Leather Footwear
LABEL#	RTN 140	3/20/2015	



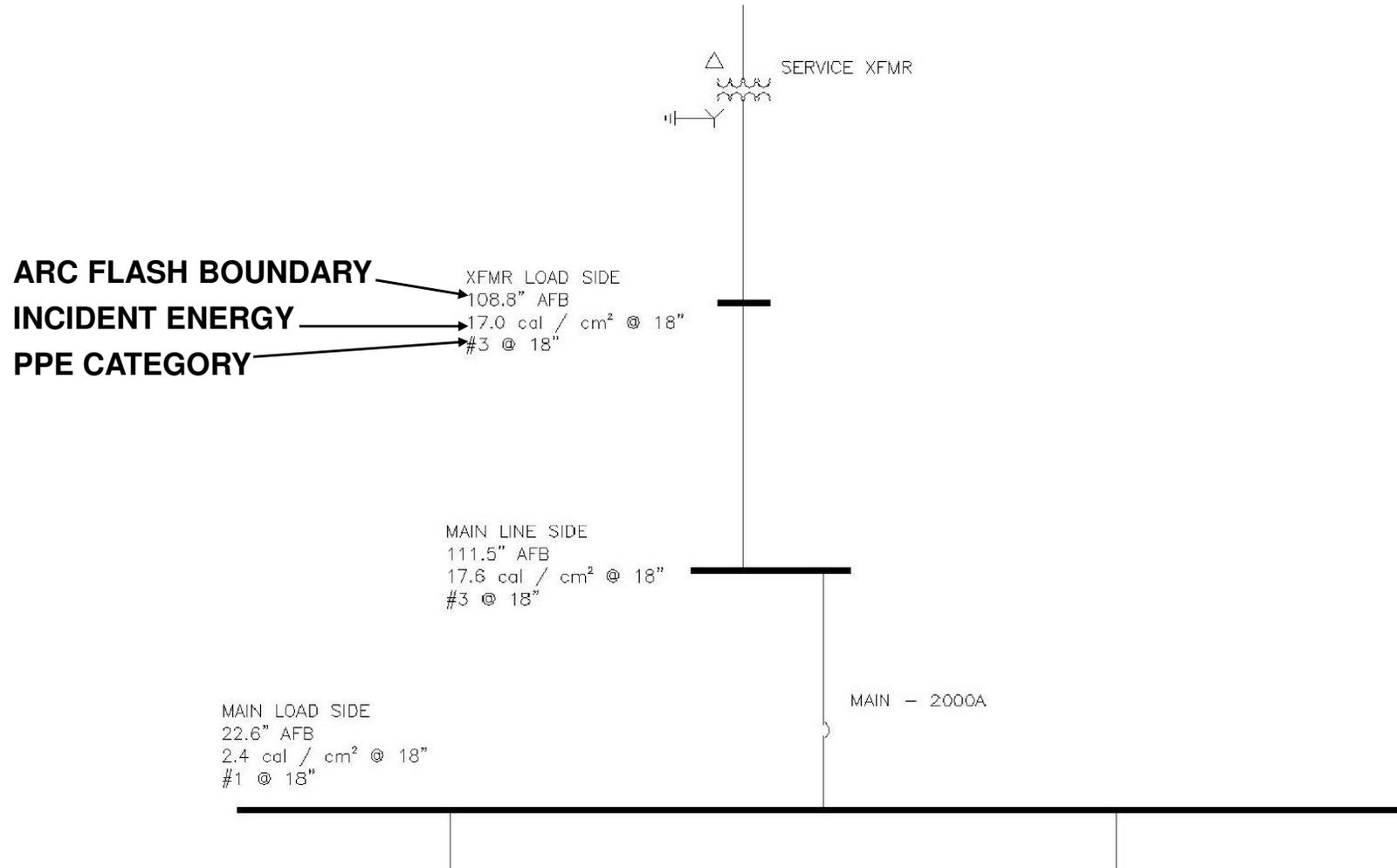
Labeling - Going Forward

The user should establish a labeling philosophy that is consistent throughout the facility and supports their Electrical Safety Program

How are Arc Flash Levels Determined?

- NFPA 70E Provides Two Methods
 - Tables in Article 130
 - These tables tend to place you in Category 2 or 4 and are not the most accurate method.
 - Calculation
 - ANNEX D provides various equations to calculate the available Arc Flash Boundaries and Levels
 - Example: ESTIMATED INCIDENT ENERGY – ARC in CUBIC BOX
 - $$E_{MB} = 1038.7D_B^{-1.4738} t_A (0.0093F^2 - 0.3453F + 5.9675)$$
 [D.3.3a]
 - E_{MB} = Maximum 20 in. cubic box Incident Energy (Cal/cm²)
 - D_B = Distance from arc electrodes, in. (for distances 18 in. and greater)
 - t_A = Arc Duration (Seconds)
 - F = Short – Circuit Current ka (16KA to 50KA)
 - Sample Calculations: $D_B = 18$ in., $t_A = 0.2$ sec (12 Cycles)
 - $E_{MB} = 8.2$ Cal/cm² for $F = 20$ KA

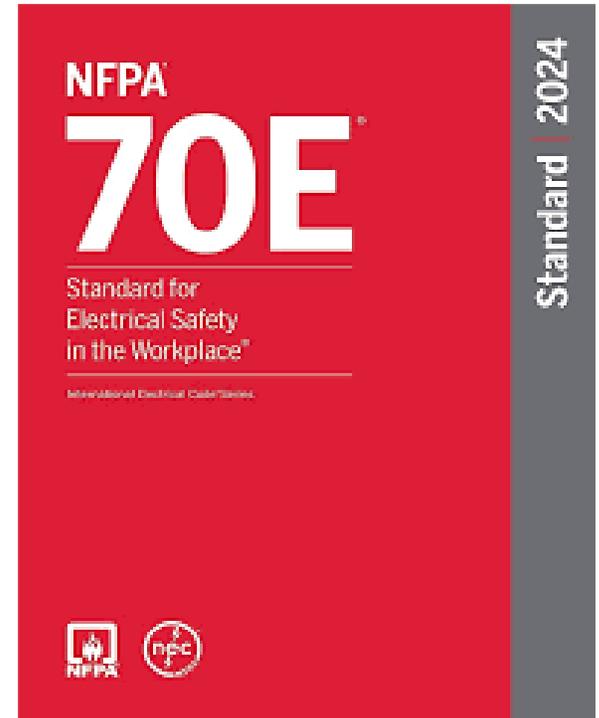
Single Line Overview



Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
- **→ Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Electrical Safety Program

- Employer shall establish, document, and implement an electrically safe work condition policy that does both of the following:
- Requires hazard elimination to be the first priority in the implementation of safety – related work practices.
- Complies with 110.2 (B)

- Use proper tools
- Assess people's abilities
- See Informative Annex F

Electrical Safety Program

- Employer shall implement an overall Electrical Safety Program
 - Provides awareness and self-discipline of the potential electrical hazards to employees
- Electrical Safety Principles, Controls and Procedures – (Sample Annex E)
- All equipment is considered energized until proven otherwise

Electrical Safety Program

- Employer shall implement an overall Electrical Safety Program
 - Provides awareness and self-discipline of the potential electrical hazards to employees
- Electrical Safety Principles, Controls and Procedures – (Sample Annex E)

- Purpose of task
- Limits of approach
- Equipment details

Electrical Safety Program

- Employer shall implement an overall Electrical Safety Program
 - Provides awareness and self-discipline of the potential electrical hazards to employees
- Electrical Safety Principles, Controls and Procedures – (Sample Annex E)
- Risk Assessment and Risk Control (Sample Annex F)

Electrical Safety Program

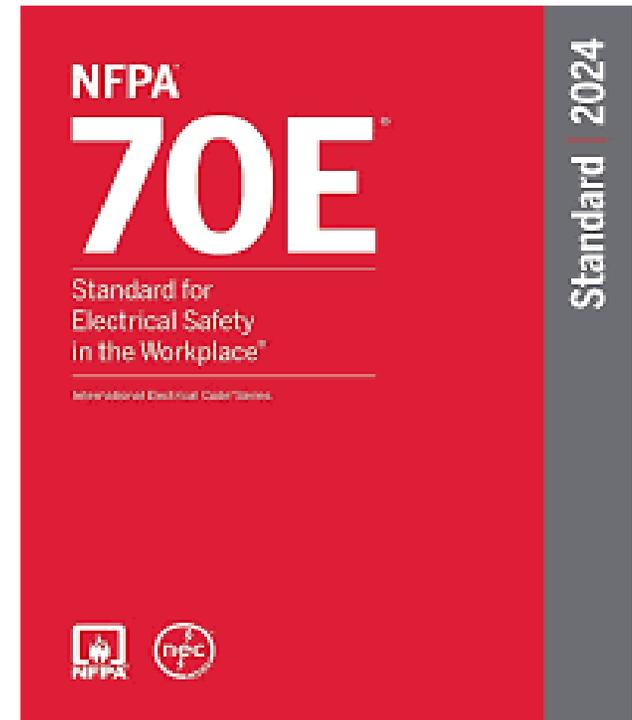
- Employer shall implement an overall Electrical Safety Program
 - Provides awareness and self-discipline of the potential electrical hazards to employees
 - Electrical Safety Principles, Controls and Procedures – (Sample Annex E)
 - Risk Assessment Procedure – (Sample Annex F)
 - Job Briefing – (Sample Annex I)
- Work procedures involved
 - Special precautions
 - PPE requirements

Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**

- **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Energized Electrical Work Permit

Definition – Electrical Safety – Related Work Practices

- Safety-related **work practices** shall be used to **safeguard employees** from injury while they are exposed to **electrical hazards** from electrical conductors or circuit parts that are or can become **energized**. (Article 130.1)
- 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. (Article 130.2)

Energized Electrical Work Permit

Energized Electrical Work

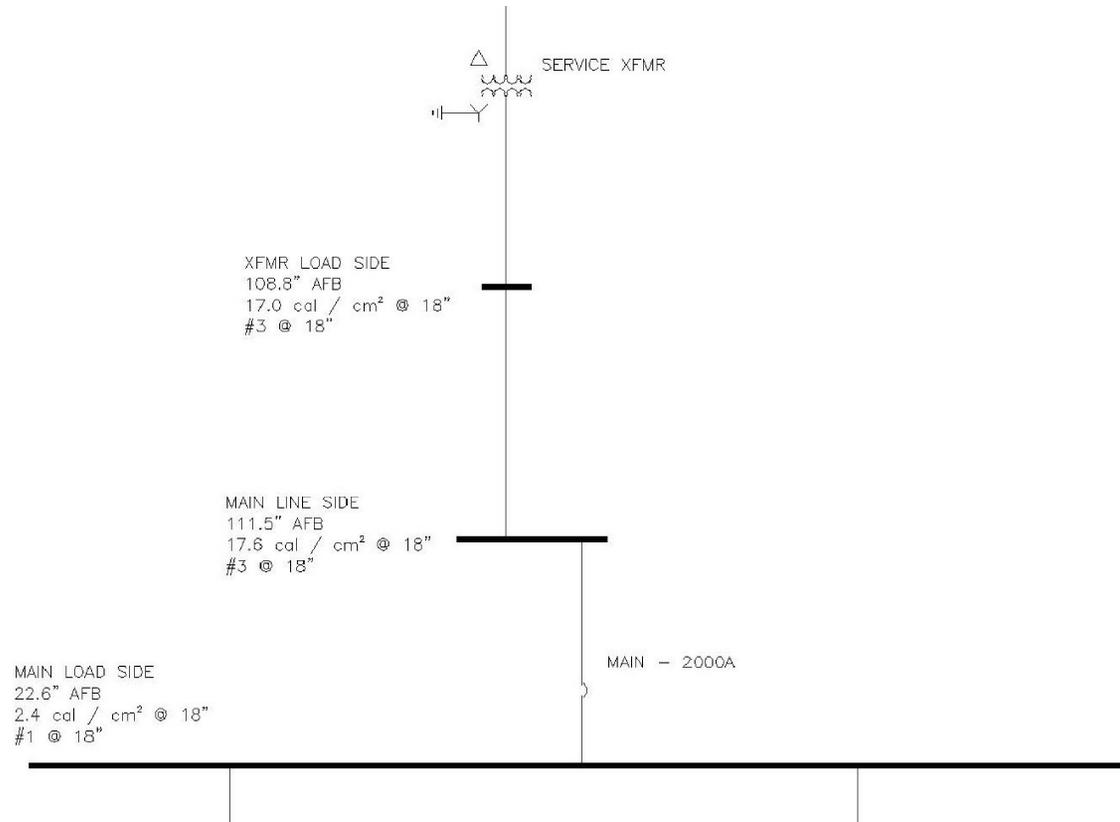
- Energized work shall be permitted where the employer can demonstrate that:
 - De-energizing introduces additional hazards or increased risk
 - Interruption of life support equipment
 - Shutdown of hazardous location ventilation equipment
 - Deactivation of emergency alarm systems
 - This includes performing diagnostics and testing (Article 130.2)

Energized Electrical Work Permit

Is an Energized Electrical Work Permit required?

- When work is performed as permitted in accordance with 130.2 (A), an energized electrical work permit shall be required and documented under the any of following condition:
 - When work is performed within the restricted approach boundary
 - Work shall be performed by **written permit only** (Sample Annex J)

Energized Electrical Work Permit



Some software packages can automatically generate work permits by clicking on the bus you plan to work on.

In order to work on the Line Side of the 2000A breaker in this example the permit would look as follows.

Energized Electrical Work Permit (Generated by EasyPower 9.0)

ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job Work Order Number: _____

- Description of circuit/equipment/job location: **MAIN LINE SIDE**
Other
- Description of work to be done:
Work on incoming source or main protective device
- 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:

- Detailed job description procedure to be used in performing the above described work:
- Description of the Safe Work Practices to be employed:

Shock hazard: 0.48 kV	Shock Boundary: 1' - 0"	V-rated Gloves: Yes
Flash Hazard: 17.6 cal/cm2	Flash Boundary: 9' - 4"	V-rated Tools: Yes
HRC Reduction: 0	Required PPE: #3	Work Distance: 1' - 6"
Cotton underwear plus FR shirt & FR pants plus FR coverall		

- Means employed to restrict the access of unqualified persons from the work areas:
- Evidence of completion of a Job Briefing including discussion of any job-specific hazards:
See Attached Job Briefing Report
- 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.

Job Briefing and Planning Checklist

Job Briefing and Planning Checklist

Identify

- | | |
|--|---|
| <input type="checkbox"/> What are the hazards? | <input type="checkbox"/> Potential for arc flash |
| <input type="checkbox"/> What voltage levels are involved? | <input type="checkbox"/> Unusual work conditions |
| <input type="checkbox"/> What skills are required? | <input type="checkbox"/> Is this a multiple-person job? |
| <input type="checkbox"/> "Foreign" voltage source present? | |

Ask

- | | |
|--|--|
| <input type="checkbox"/> Can the equipment be de-energized? | <input type="checkbox"/> Is a "standby person" required? |
| <input type="checkbox"/> Are there possible backfeeds of the circuits to be worked on? | |

Check

- | | |
|---|--|
| <input type="checkbox"/> Job Plans | <input type="checkbox"/> Safety procedures |
| <input type="checkbox"/> One lines and vendor prints | <input type="checkbox"/> Vendor Information |
| <input type="checkbox"/> Status Board | <input type="checkbox"/> Individuals familiar with facility? |
| <input type="checkbox"/> For up-to-date information on plant and vendor resources | |

Know

- | | |
|---|--|
| <input type="checkbox"/> What is the job? | <input type="checkbox"/> EasyPower one-line has been printed, reviewed, and attached to energized work permit? |
| <input type="checkbox"/> Who is in charge? | |
| <input type="checkbox"/> Who else needs to know?.....Communicate! | |

Think

- | | |
|---|---|
| <input type="checkbox"/> About the extra event...What if? | <input type="checkbox"/> Use the right tools and equipment, including PPE |
| <input type="checkbox"/> Lock-Tag-Test-Try | <input type="checkbox"/> Install barriers and barricades |
| <input type="checkbox"/> Test for voltage – FIRST | <input type="checkbox"/> What else...? |
| <input type="checkbox"/> Install and remove grounds | |

Prepare for an emergency

- | | |
|---|---|
| <input type="checkbox"/> Standby person CPR trained | <input type="checkbox"/> What is the exact work location? |
| <input type="checkbox"/> Telephone location? | <input type="checkbox"/> How is the equipment shut off in an emergency? |
| <input type="checkbox"/> Fire alarm locations? | <input type="checkbox"/> Where is the emergency equipment? |
| <input type="checkbox"/> Confined space rescue available if required? | <input type="checkbox"/> Is the required emergency equipment available? |
| <input type="checkbox"/> Emergency phone numbers? | <input type="checkbox"/> Radio communications available? |
| <input type="checkbox"/> Extinguisher? | |

Energized Electrical Work Permit

Exemptions to Work Permit (Article 130.2)

- Electrical work performed by **qualified persons**
 - Testing
 - Troubleshooting
 - Voltage measuring
 - Thermography
 - Ultrasound



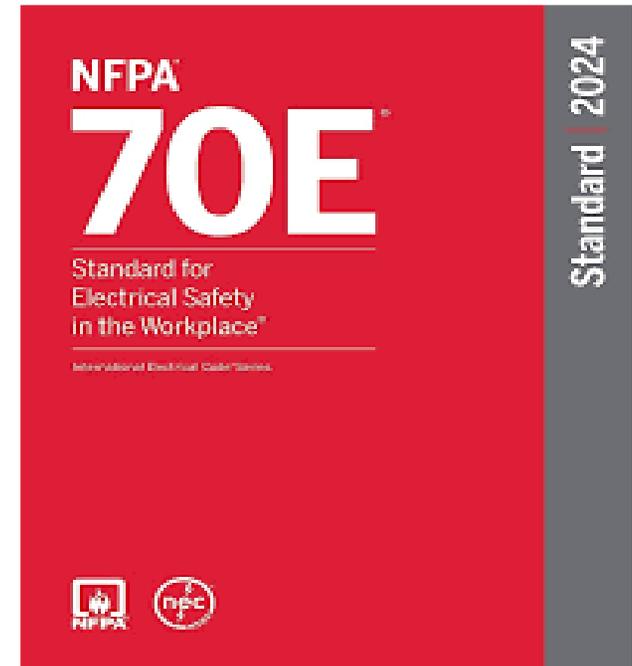
Appropriate safe work practices and PPE in accordance with Chapter 1

Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**

- **→ Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



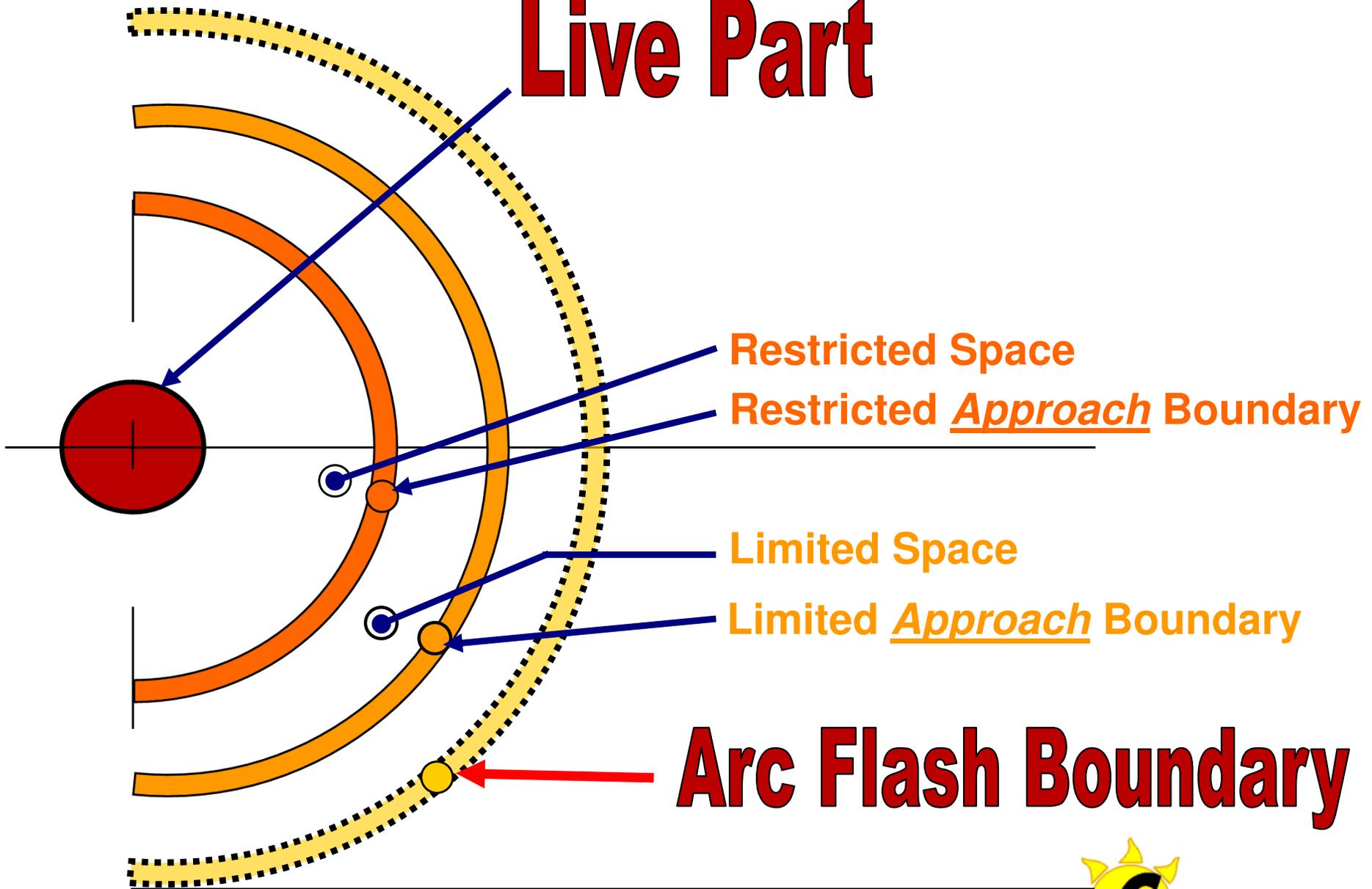
Approach Boundaries

There are three different types of approach boundaries in the standard:

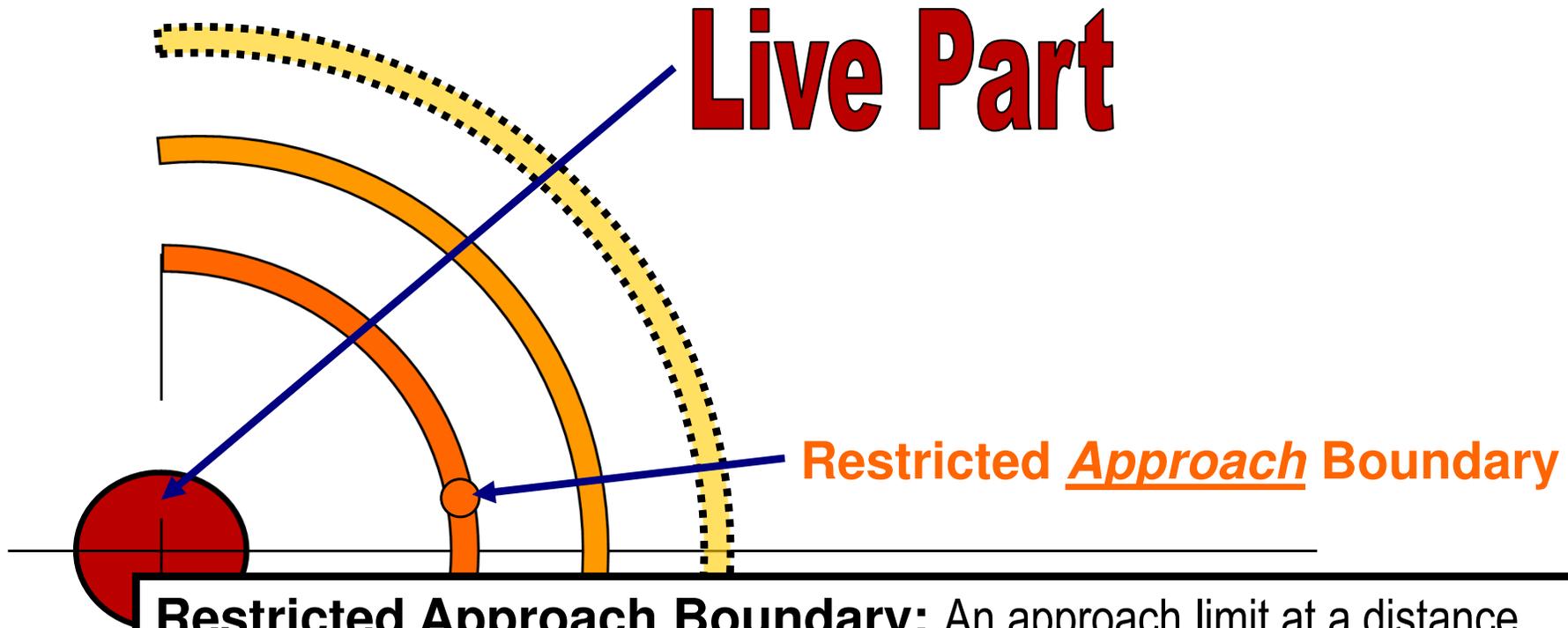
- Limited Approach Boundary (Article 130.4)
 - A qualified person shall advise the unqualified person of the possible hazards and continuously escort the unqualified person
- Restricted Approach Boundary (Article 130.4)
 - Unqualified persons not allowed
- Arc Flash Boundary
 - Must wear appropriate PPE (≥ 1.2 Cal/cm²) (Article 130.5)

Limits of Approach

Live Part



Limits of Approach



Restricted Approach Boundary: An approach limit at a distance from an exposed live part within which there is an **increased risk of shock, due to electrical arc-over and inadvertent movement**, for personnel working in close proximity to the live part.

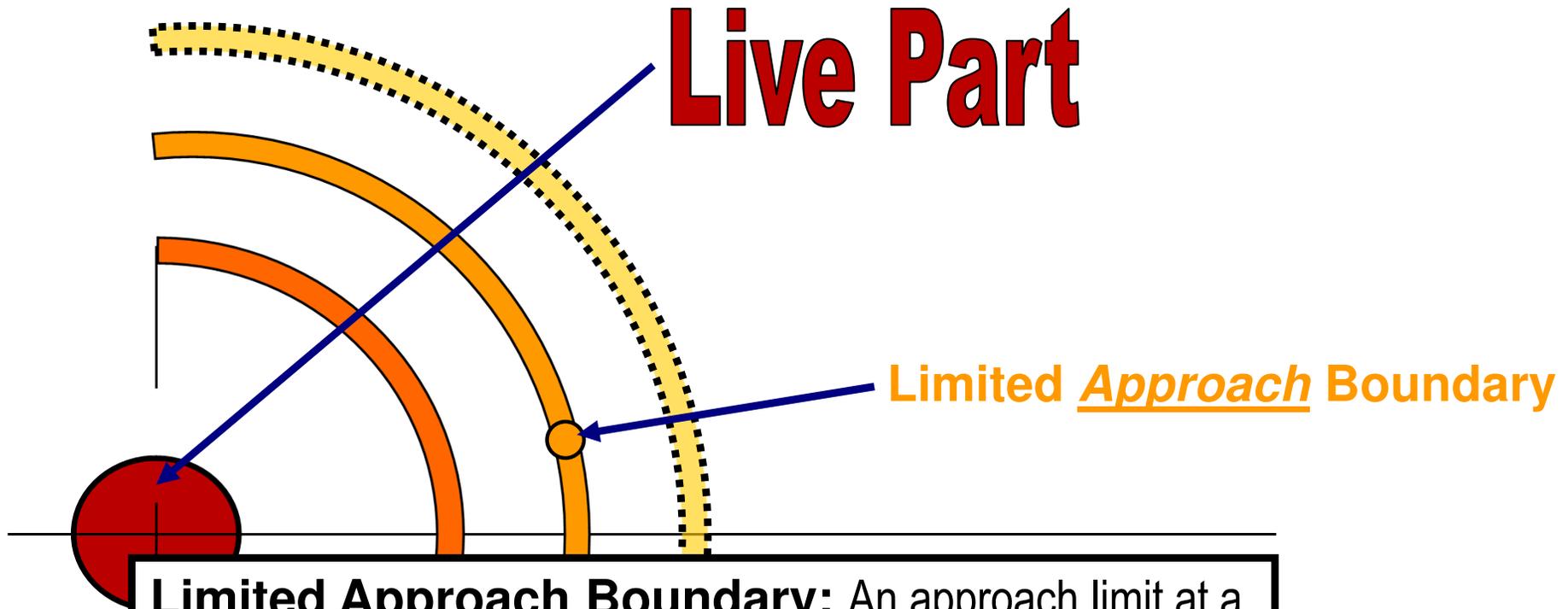
Less than 50 volts – Distance not specified

50 – 150 volts – Avoid contact

151 – 750 volts – 1 ft. 0 in. from live part

751 – 15 KV – 2 ft. 2 in. from live part

Limits of Approach



Limited Approach Boundary: An approach limit at a distance from exposed live part within **which a shock hazard exists.**

Exposed
moveable
conductor

Exposed fixed
circuit part

Less than 50 volts – **Distance not specified**

50 – 150 volts – 10 ft. 0 in. / 3 ft. 6 in.

151 – 750 volts – 10 ft. 0 in. / 3 ft. 6 in.

751 – 15 KV – 10 ft. 0 in. / 5 ft. 0 in.

Arc Flash Boundary

Definition – Arc Flash Boundary

When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm^2 (Article 100)

- **Personal Protective Equipment (PPE)** and/or **Arc Rated (AR)** clothing are required when working within the Arc Flash Boundary



Arc Flash Boundary

- The Arc Flash Boundary is the distance at which 1.2 cal/cm² incident energy is available.
- The default Tables list AFB as:
 - 19" for 240V and below equipment
 - 3' for 480V Panelboards
 - 5' for 480V MCC's with 2 cycle protection
 - 14' for 480V MCC's with 20 cycle protection
 - 40' for 6.9KV Motor Starters
 - 3' to 6' for DC equipment below 250VDC

Table 130.7(C)(15)(a)

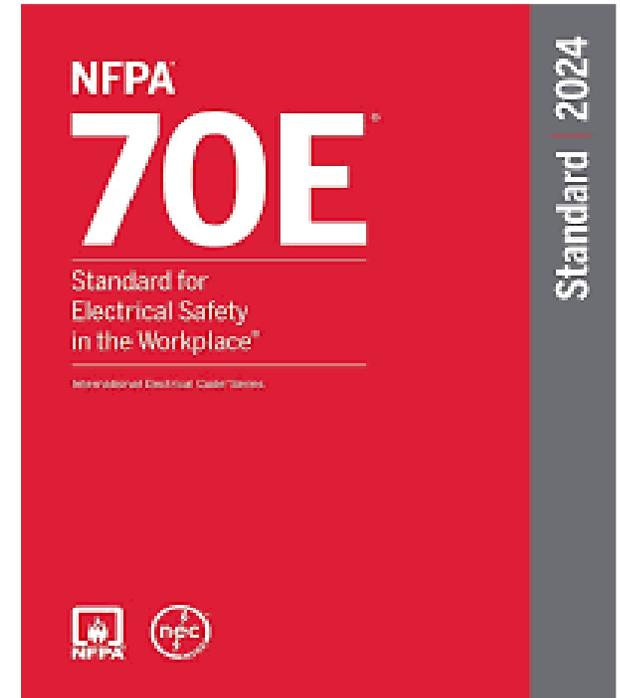
Table 130.7(C)(15)(b)

Agenda

- **Electrical Hazards**
- **Codes & Standards**
- **Introduction to NFPA 70E 2024**

- **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**

→ **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Personal Protective Equipment (PPE)

When tasks are performed within the Arc Flash Boundary:

- Use the PPE Category Form for Voltage and Task to Identify the Hazard and Risk Category based on energy calculations
 - Many good software packages are available
 - Two Step Procedure for Default Tables
 - 1) Determine need for PPE by Task
 - 2) If Task Requires PPE, use PPE Category as Listed for Voltage Level and Equipment as well as Arc Flash Boundary

Hazard Level

Hazard Level		
PPE Category	Range of Incident Energy (Cal/cm ²)	Required Minimum Arc Rating of PPE (Cal/cm ²)
0 - REMOVED	0 – 1.2 - REMOVED	N/A - REMOVED
1	1.2 - 4	4
2	4 - 8	8
3	8 - 25	25
4	25 - 40	40

Guidelines based on NFPA 70E 2024

Table 130.7(C)(15)(c)



Personal Protective Equipment (PPE)

Arc Rated (AR) Clothing

ATPV= Arc Thermal Performance Value (cal/cm²)



Personal Protective Equipment (PPE)

Headgear



w/

Bacaclava

Or

“Hoody”



Personal Protective Equipment (PPE)

Gloves and Boots



<1.2 Cal/cm²

Per Informative Annex H – Guidance

- Protective Clothing, Nonmelting or Untreated Natural Fiber
 - Shirt (long sleeve)
 - Pants (long)
- Protective Equipment
 - Safety glasses or safety goggles
 - Hearing protection (ear canal inserts)^c
 - Heavy duty leather gloves

PPE Category 1

- Arc-Rated Clothing, Minimum Rating 4 cal/cm²
 - Arc-rated Long sleeve shirt and pants or arc-rated coverall
 - Arc-rated face shield or arc flash suit hood
- Protective Equipment
 - Hard hat
 - Safety glasses or safety goggles
 - Hearing protection (ear canal inserts)^c
 - Heavy duty leather gloves
 - Leather footwear

Table 130.7(C)(15)(c)

PPE Category 2

- Arc-Rated Clothing, Minimum Rating 8 cal/cm²
 - Arc-rated Long sleeve shirt and pants or arc-rated coverall
 - Arc-rated face shield and arc-rated balaclava or arc-rated arc-rated flash suit hood
- Protective Equipment
 - Hard hat
 - Safety glasses or safety goggles
 - Hearing protection (ear canal inserts)^c
 - Heavy duty leather gloves
 - Leather footwear

Table 130.7(C)(15)(c)

PPE Category 3

- Arc-Rated Clothing Selected so That the System meets Minimum Rating 25 cal/cm²
 - Arc-rated Long sleeve shirt and pants or arc-rated coverall
 - Arc-rated arc flash suit and hood
 - Arc-rated gloves
- Protective Equipment
 - Hard hat
 - Safety glasses or safety goggles
 - Hearing protection (ear canal inserts)^c
 - Leather footwear

Table 130.7(C)(15)(c)

PPE Category 4

- Arc-Rated Clothing Selected so That the System meets Minimum Rating 40 cal/cm²
 - Arc-rated Long sleeve shirt and pants or arc-rated coverall
 - Arc-rated arc flash suit and hood
 - Arc-rated gloves
- Protective Equipment
 - Hard hat
 - Safety glasses or safety goggles
 - Hearing protection (ear canal inserts)^c
 - Leather footwear

Table 130.7(C)(15)(c)

Personal Protective Equipment (PPE)

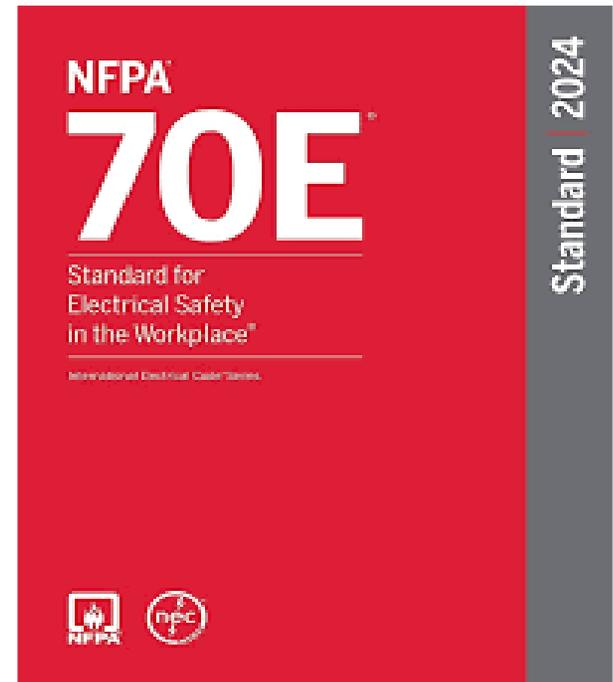
Steps need to be taken regarding PPE

- Select PPE based on arc flash risk assessment
- Provide information/labels on PPE on ATPV rating
- Train employees on use and selection of PPE
- Provide regular inspection, care and maintenance of PPE
- Document use and maintenance of PPE
- Dispose of PPE after useful life has ended

Agenda

- **Electrical Hazards**
 - **Codes & Standards**
 - **Introduction to NFPA 70E 2024**

 - **NFPA 70E 2024**
 - **Labeling**
 - **Safety Program**
 - **Energized Electrical Work Permit**
 - **Approach and Arc Flash Boundaries**
 - **Personal Protective Equipment (PPE)**
- **Minimizing Arc Flash Hazards (Risks)**



Risk Reduction Techniques

Guidelines for **reducing** the risk of arc flash

- Ongoing safety training
- Identify all possible sources of electrical energy
- Maintenance program
- Remote monitoring/operation
- When possible, visually verify device is open
- Perform lock out/tag out
- Test voltage on each conductor for verification
- Ensure workers are appropriately protected with suitable PPE

Avoid Arc Flash incidents with PREVENTION



Going Forward

NFPA 70E compliance steps

- Perform arc flash risk assessment on all electrical equipment
- Label electrical equipment to notify of the arc flash hazard (cal/cm²)
- Obtain the proper tools and PPE
- Provide employee/contractor training
- Develop and implement the proper work place policies, procedures and methods
- Maintenance

SUMMARY

What is the purpose of all of these regulations?

SAFETY!

- Create a safe work environment
- Ultimately reduce the number of injuries and fatalities caused by electrical hazards
(Electric Shock, Arc Flash and Arc Blast Injury)

TEST

ABC Company Arc Flash Hazard Training

1. The Standard for Electrical Safety in the Workplace is NFPA 70E-2024 – (p3)
True False
2. An electrical hazard is defined as a dangerous condition such that contact or equipment failure can result in electrical shock, arc flash burn, thermal burn or arc blast injury. (p4)
True False
3. To create an electrically safe work condition, the lock- out/tag-out procedure must be followed and equipment tested to ensure the absence of voltage. (p25)
True False
4. The Arc Flash warning labels on electrical equipment list the incident energy (cal/cm²), Arc Flash Boundary and required PPE. (p32)
True False

TEST

5. Everyone entering an Arc Flash Boundary must wear appropriate PPE. (p53)
True False
6. PPE stands for Personal Protection Equipment and AR stands for Arc Rated .
(p57)
True False
7. There are four (4) PPE Categories: 1 = lowest, 4 = highest. (p66-69)
True False
8. The PPE Categories are assigned by the range of incident energy (cal/cm²).
(p66-69)
True False

