ELECTRICAL SAFETY

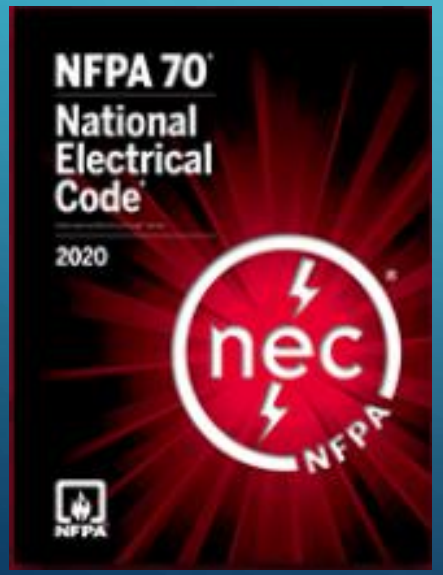
FOR SAFETY PROFESSIONALS

HEATH TAYLOR, CERTIFIED ELECTRICAL SAFETY COMPLIANCE PROFESSIONAL

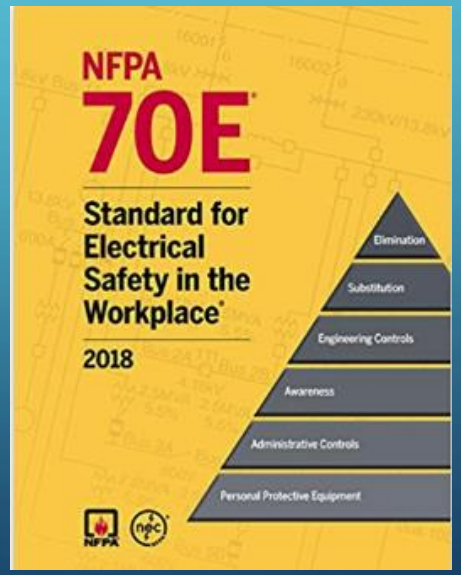
NFPA 70 E IS NOT STANDALONE

NFPA 70 E article 200 now has language that states the owner of electrical equipment is responsible for maintenance and documentation

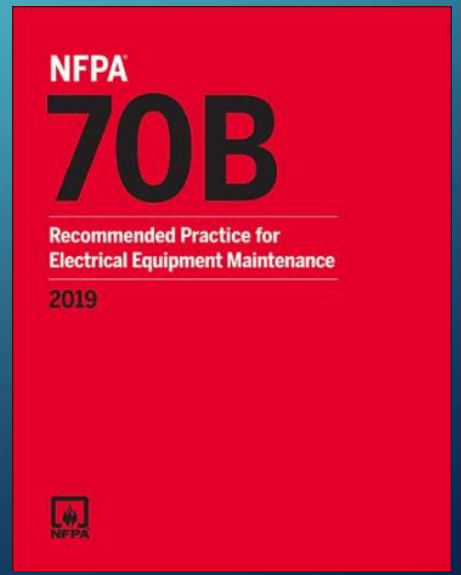
Protects the public



Protects the qualified employee



Protects the public, qualified employee, and the equipment



HISTORY OF THE NEC (OR NFPA 70)

NFPA ANNIVERSARY
1896 2021
NFPA®
125 YEARS OF SAFETY

NFPA 70 E – 105

105.3

Responsibility

- (A) The employer shall have the following responsibilities
- (1) Establish, document, and implement the safety-related work practices and procedures required by this standard
- (2) Provide employees with training in the employer's safety-related work practices and procedures.
- (B) The employee shall comply with the safety-related work practices and procedures provided by the employer.

NFPA 70 E – 110

110.1

The Priority is Hazard Elimination

110.3

- Electrically safe working condition

110.4

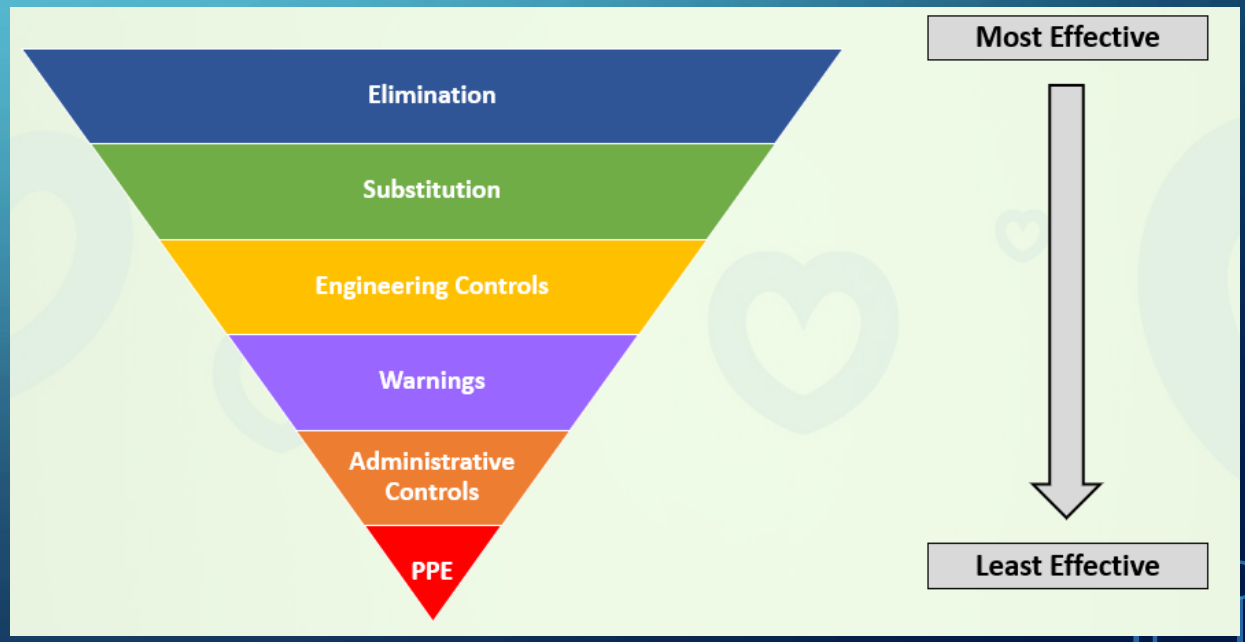
- Energized work is when the equipment can't be in an electrically safe working condition.

110.5

- Risk Assessment and Hierarchy of Controls

	Severity of the injury (consequences)				
Likelihood of occurrence in period	Slight	Minor	Medium	Critical	Catastrophic
cal/cm^2	<1.2	≥1.2 to ≤8		>8 to ≤40	>40
Unlikely					
Seldom					
Occasional					
Likely					
Definite					

Notes:
1. Extreme equals 25 through 15.
2. High equals 12 through 9.
3. Moderate equals 8 through 4.
4. Low equals 3 through 1.



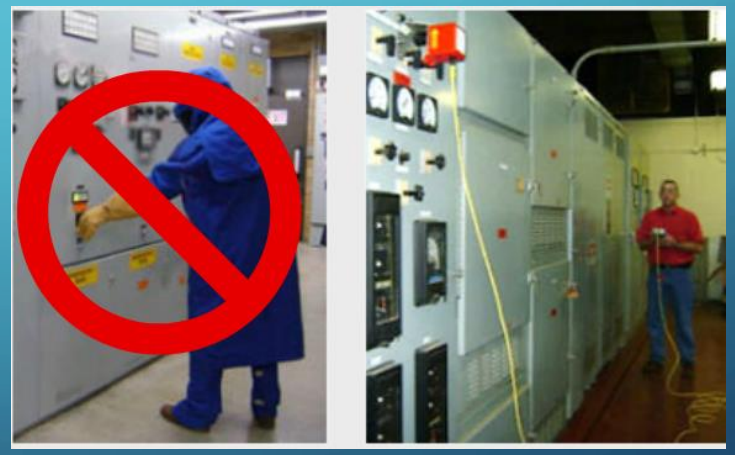
ELEMENTS OF A ENERGIZED ELECTRICAL PERMIT

Annex J - Energized electrical permit consists of:

- Description of circuit / equipment and location
- Description of work being performed
- Justification for work being performed (list in last slide)
- Description of safe work practices employed
- Voltage, Limited Approach Boundary, Restricted Approach Boundary, required PPE
- Incident energy or arc flash ppe category
- Means to restrict unqualified persons
- Documented Job briefing (JSA)
- Approval, authorized signature

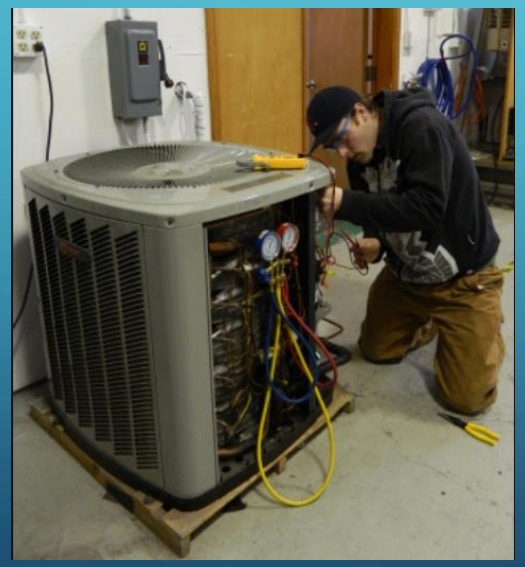
DESIGN FOR SAFETY

Nowhere in the NFPA 70E, OSHA, or any other standard does it say to design the system for employee safety.



QUALIFIED VS UNQUALIFIED

NFPA 70 E 110.2 (A) Employees who will be exposed to an electrical hazard not reduced to a safe level by the installation (i.e. opening a panel with exposed conductors)



EMPLOYEE TRAINING

110.6 (A) Employees must be trained in the following

- How to recognize hazards and when the risk is unacceptable (too high)
- How to reduce your risks
- Understand the proper sequencing or steps of how a process works
  - Not knowing this process could lead to hazardous start up or not having the energy fully neutralized
- LOTO
- How to determine electrical boundaries
- How to determine the correct PPE
- How to perform job planning
- Knowing that your skills and knowledge can be limited (no one knows everything)
- Emergency Response

EQUIPMENT LABELING

130.5 (H)

- Equipment labeling must have all of the following:
- (1) Nominal system voltage
- (2) Arc flash boundary
- (3) At least on of the following
  - Available incident energy and the corresponding working distance, or the arc flash PPE category in Table 130.7(C)(15)(a) or (b) for the equipment but not both
  - Minimum arc rating of clothing
  - Site-specific level of PPE

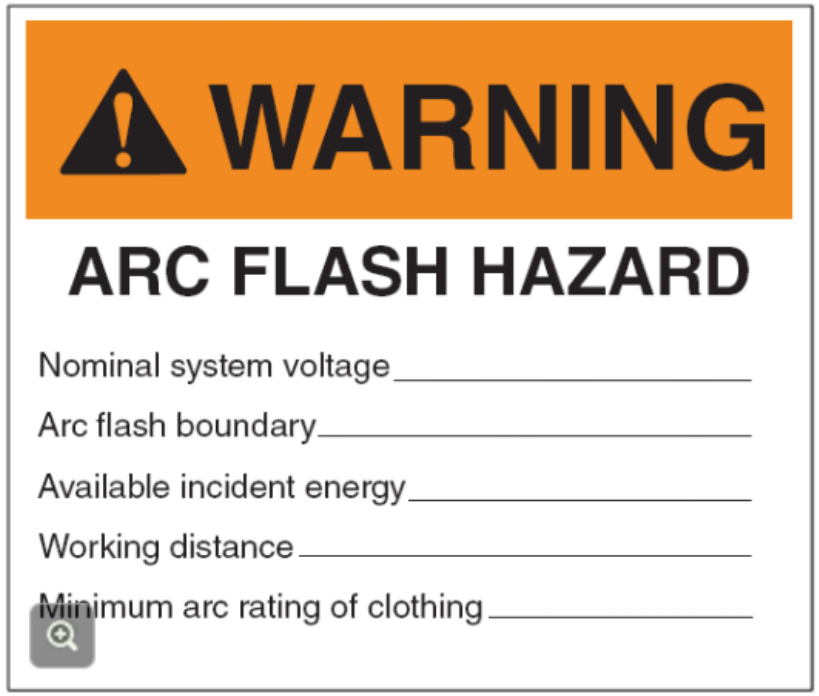
130.4 (F) ELECTRICAL BOUNDARIES

- Limited approach boundary
  - A boundary or zone in which no unqualified person may enter
- Restricted approach boundary
  - A boundary or zone where there is a hazard of incidental contact with energized electrical circuits
  - Only insulated tools and gloves may be used within this boundary
- Arc flash boundary
  - A boundary or zone in which employees are exposed to an arc flash rating listed on the panel or table 130.4

HOW DO WE KNOW WHAT PPE TO CHOOSE?

Equipment labels must include:

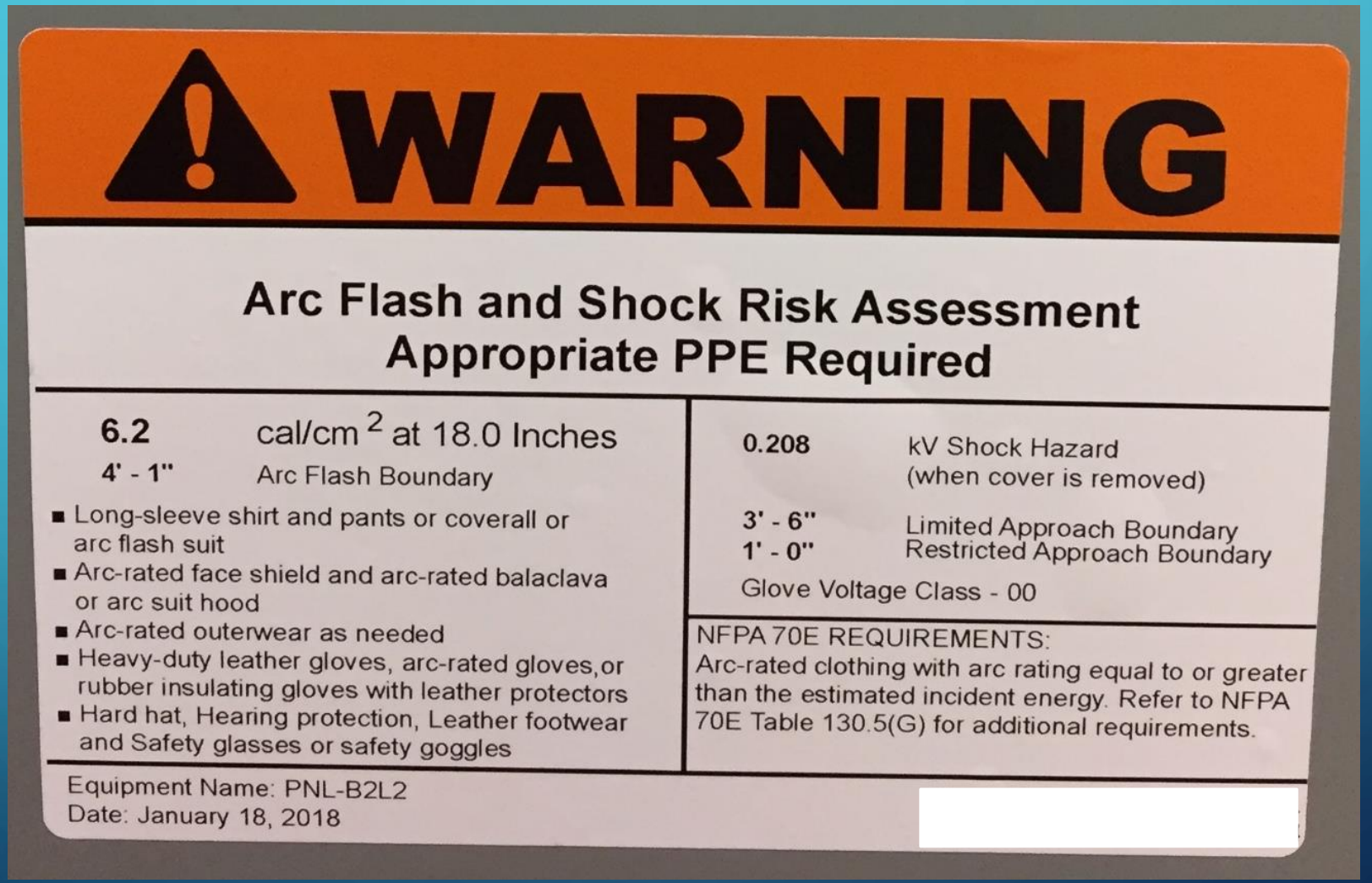
- Nominal system voltage
- Arc flash boundary



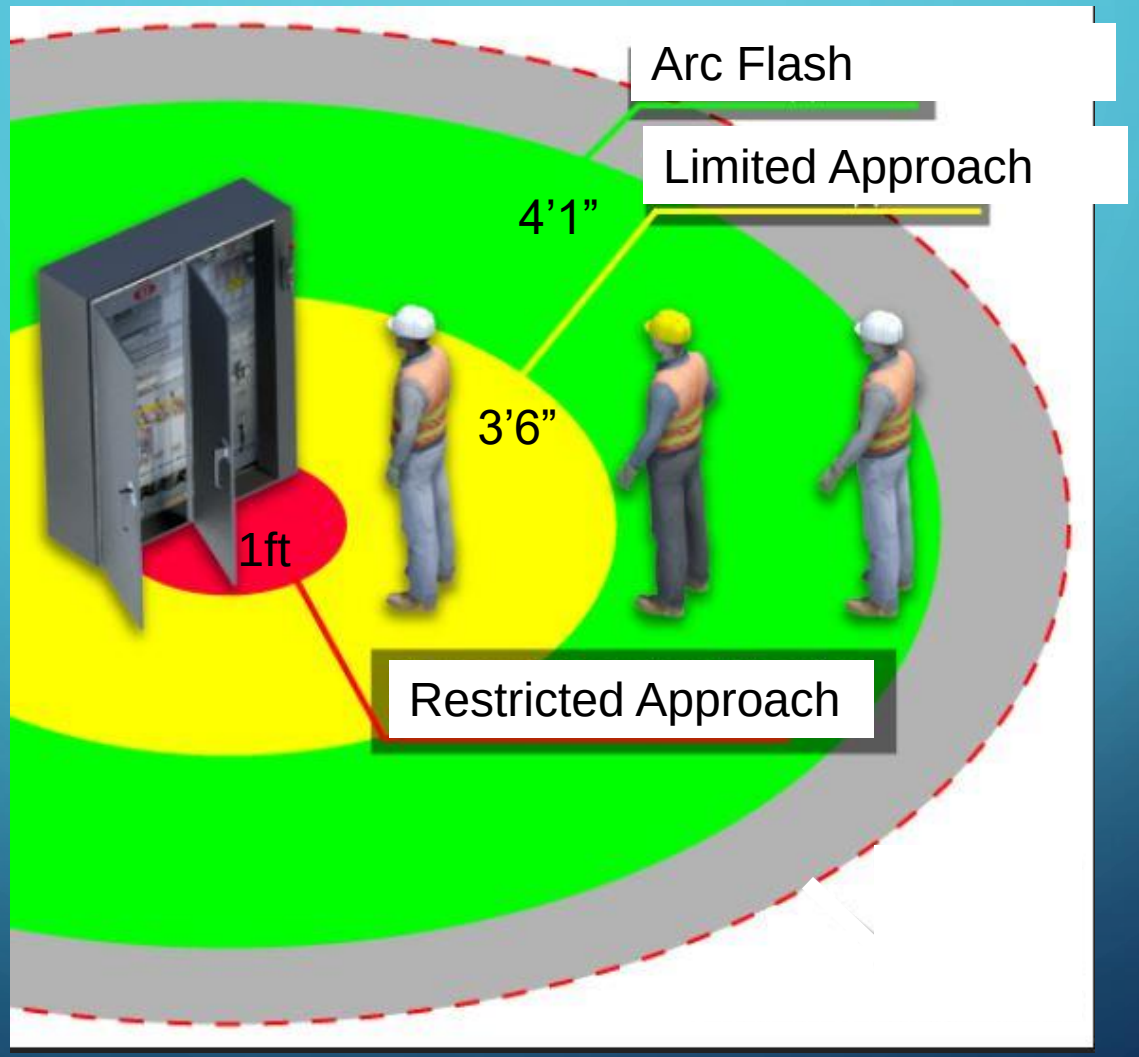
And at least one of the following:

- Incident energy and working distance or arc flash PPE category, but not both
- Minimum arc rating of clothing
- Specific level of PPE

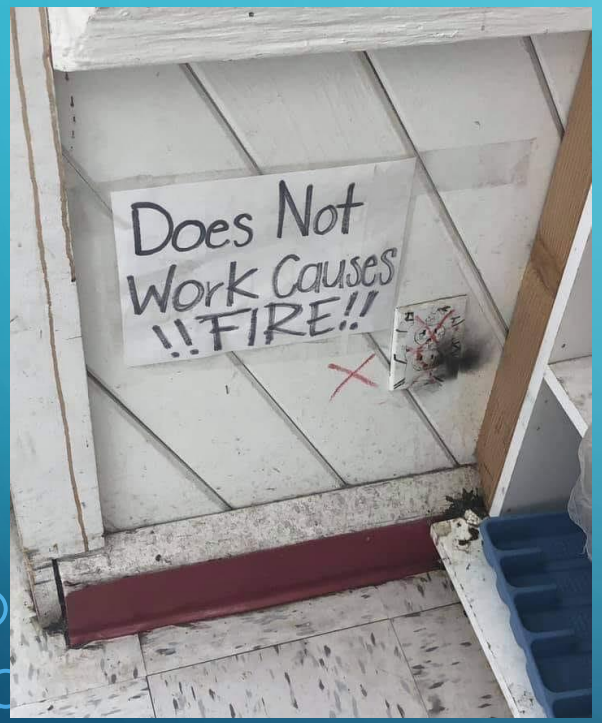
WHAT LEVEL OF PPE DO WE NEED?

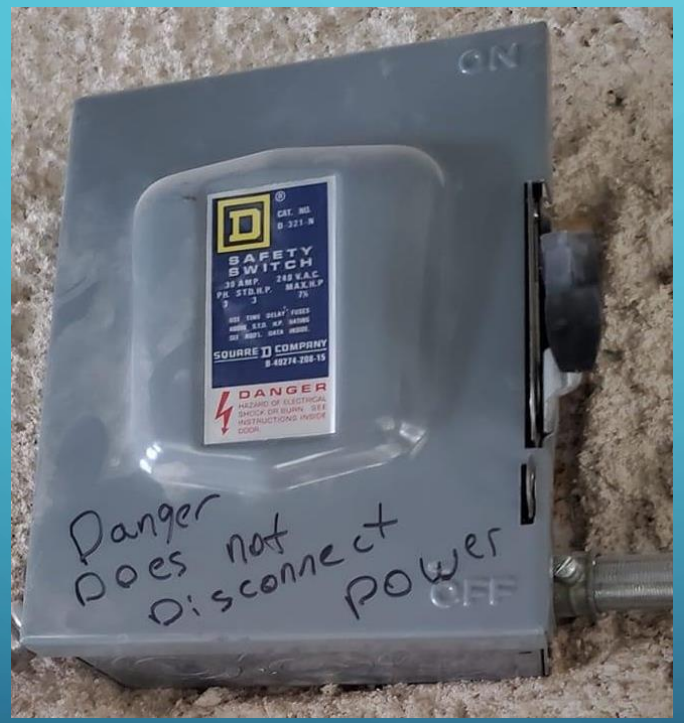


ELECTRICAL BOUNDARIES 120V – 600V



IS THIS GOOD SIGNAGE?





CATEGORY 1 AND 2 PPE

Arc-Rated PPE

electrical WORKPLACE SAFETY

Categories 1 and 2: Difference in Minimum Rating and Addition of Balaclava

52

e-Hazard

Balaclava required if back of head in AFB 130.7(C)(10)(b)(1)

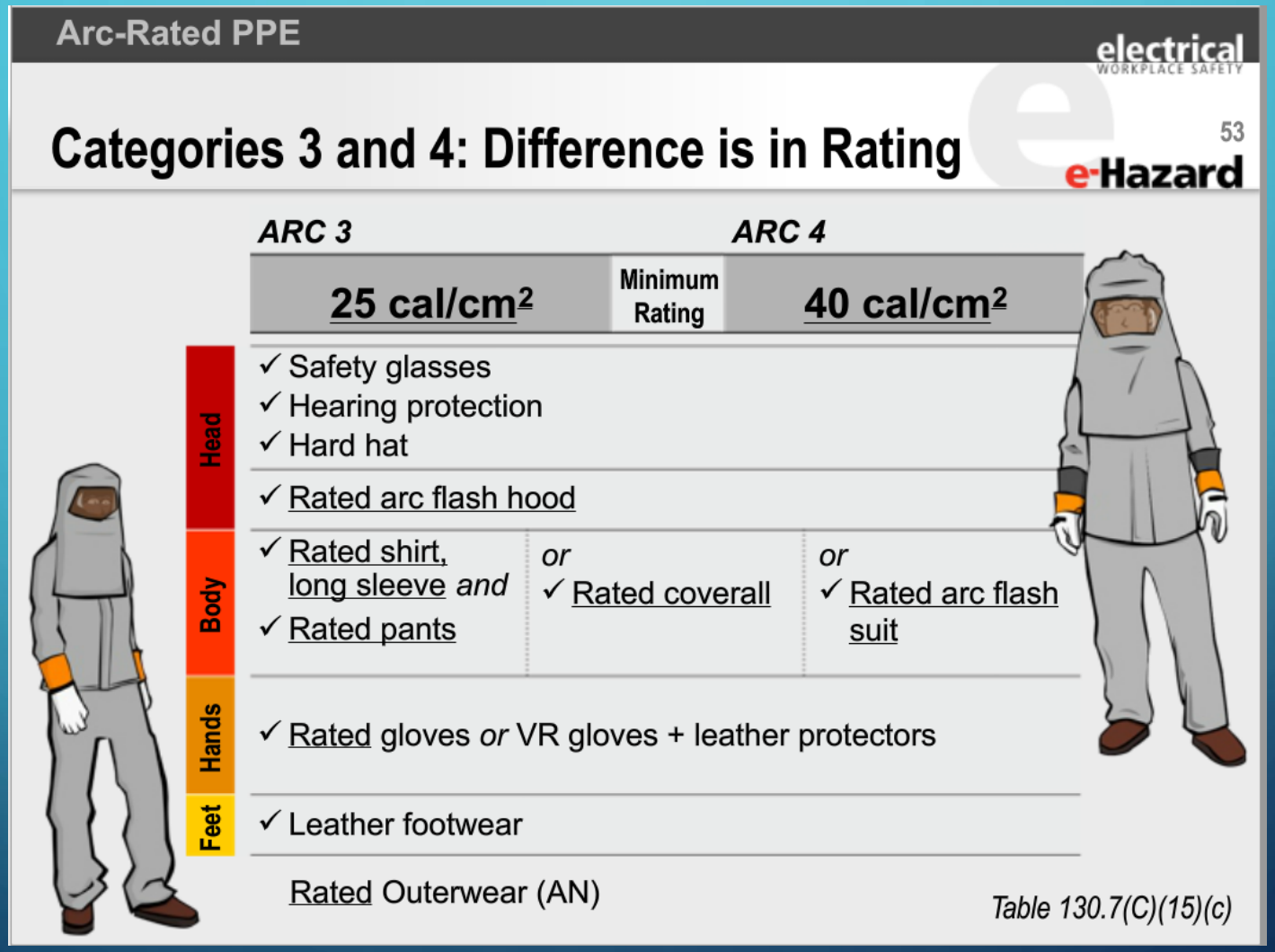
	ARC 1	Minimum Rating	ARC 2
	4 cal/cm²		8 cal/cm²
	✓ Safety glasses ✓ Hearing protection ✓ Hard hat		
Head	✓ Rated face shield *or* ✓ Rated arc flash hood	◄ARC 1 ARC 2►	✓ Rated face shield *with balaclava* *or* ✓ Rated arc flash hood
Body	✓ Rated shirt, long sleeve *and* ✓ Rated pants		*or* ✓ Rated coverall
Hands	✓ Leather gloves*		
Feet	✓ Leather footwear		
	Rated Outerwear (AN)		

* 0.7mm min. thickness if rubber insulating gloves with leather protectors are not required for shock protection

Table 130.7(C)(15)(c)

Natural fiber undergarments DO NOT automatically add PPE level (ARC 1 + cotton t-shirt ≠ to ARC 2)

CATEGORY 3 & 4 PPE



PPE IS THE LAST RESORT OF PROTECTION

130.7 PPE

- Just because you are wearing the correct PPE does not give you a license to work in a panel without caution.
- PPE Layering: Can we add garments together to achieve higher ATPV?

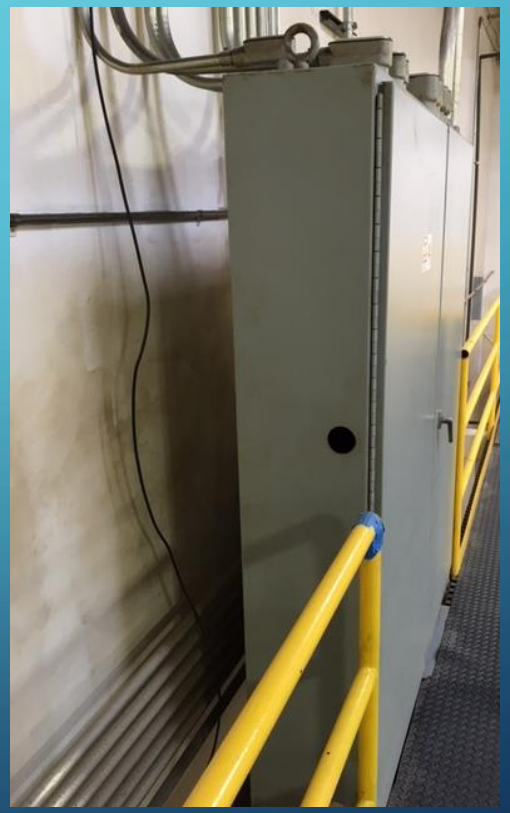
ASTM F 1959 uses the lower of:

ATPV	E_{BT}
50% probability of 2nd degree burn through the garment	50% probability of break open of the garment

110.4 (D) PANEL INSPECTIONS

Treat all panels like they are potentially energized

PANEL INSPECTIONS



COMMON ELECTRICAL VIOLATIONS

WHAT IS AN ELECTRICALLY SAFE WORK CONDITION - 110.3

Electrically safe work condition:

A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked and/or tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

Identify Sources

Determine all possible sources of electrical supply to the specific equipment.

1 2 3 4 5 6 7 8

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

Interrupt Load Current and Open Disconnects

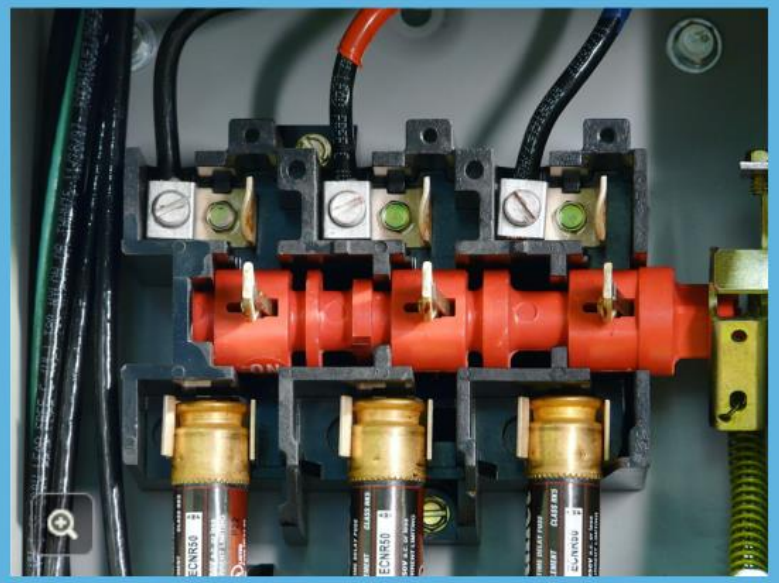
After properly interrupting the load current, open the disconnecting device(s) for each source.

1 2 3 4 5 6 7 8

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

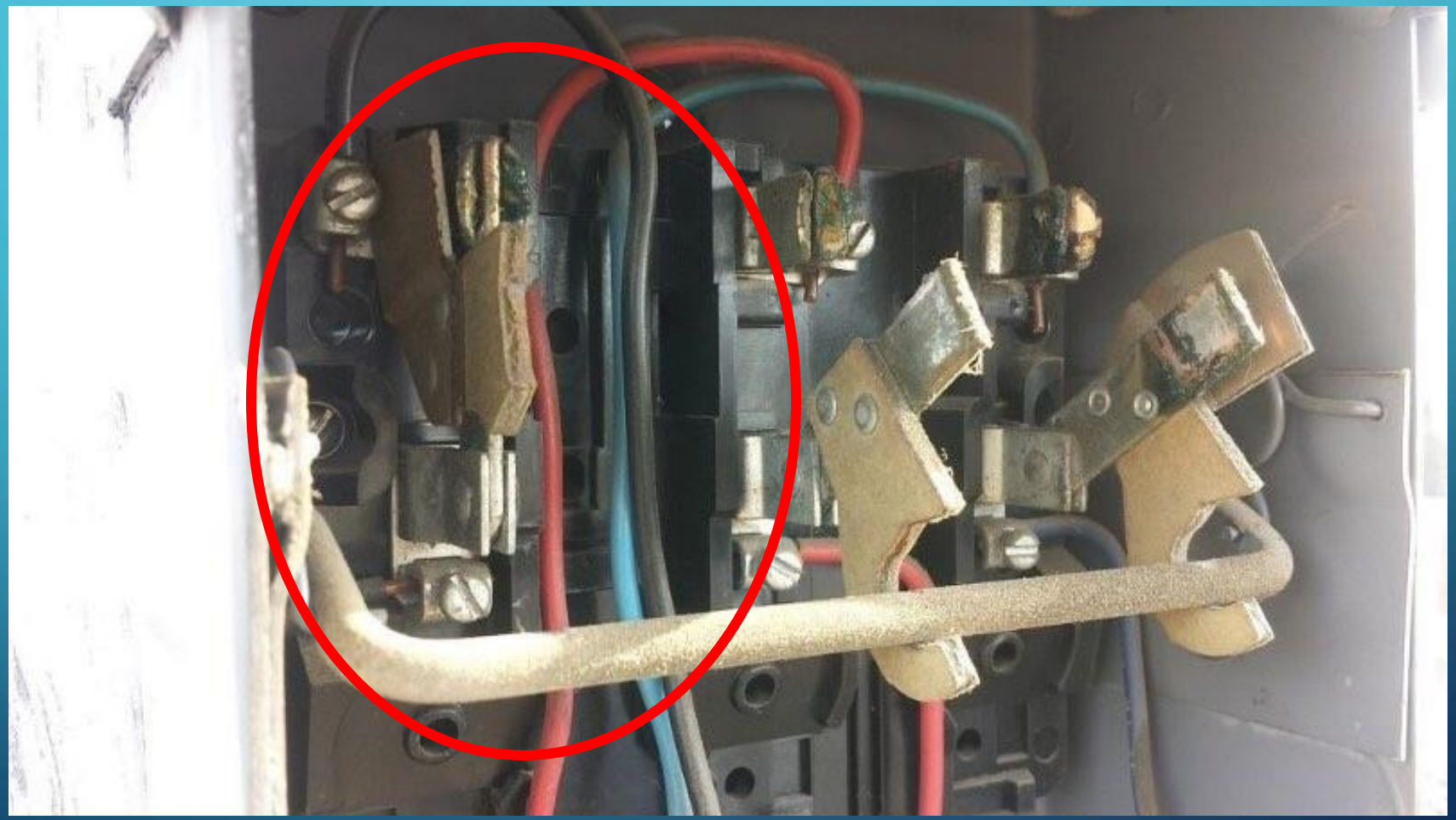
Verify Opening of Contacts

Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the fully disconnected position.



1 2 3 4 5 6 7 8

VISUAL VERIFICATION



STEPS FOR ELECTRICAL SAFETY WORK CONDITION

Release Stored Electrical Energy

Release stored energy and verify the lack of voltage.

Photo Courtesy of Schneider Electric

1 2 3 4 5 6 7 8

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

Release or block mechanical energy that might endanger personnel.

Photo Courtesy of Metal Form Products Co. Ltd

1 2 3 4 5 6 7 8

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

Apply Lockout/Tagout Devices

Apply lockout/tagout devices in accordance with a documented and established policy.

1 2 3 4 5 6 7 8

STEPS FOR ELECTRICAL SAFETY WORK CONDITION

(a) (b) (c)

Live-Dead-Live

Before the equipment can be considered to be in an electrically safe condition, we need to verify that the circuit parts that we will be working on have been disconnected from a source of voltage.

The process for accomplishing this is:

a. to first verify your test instrument on a known source of voltage,

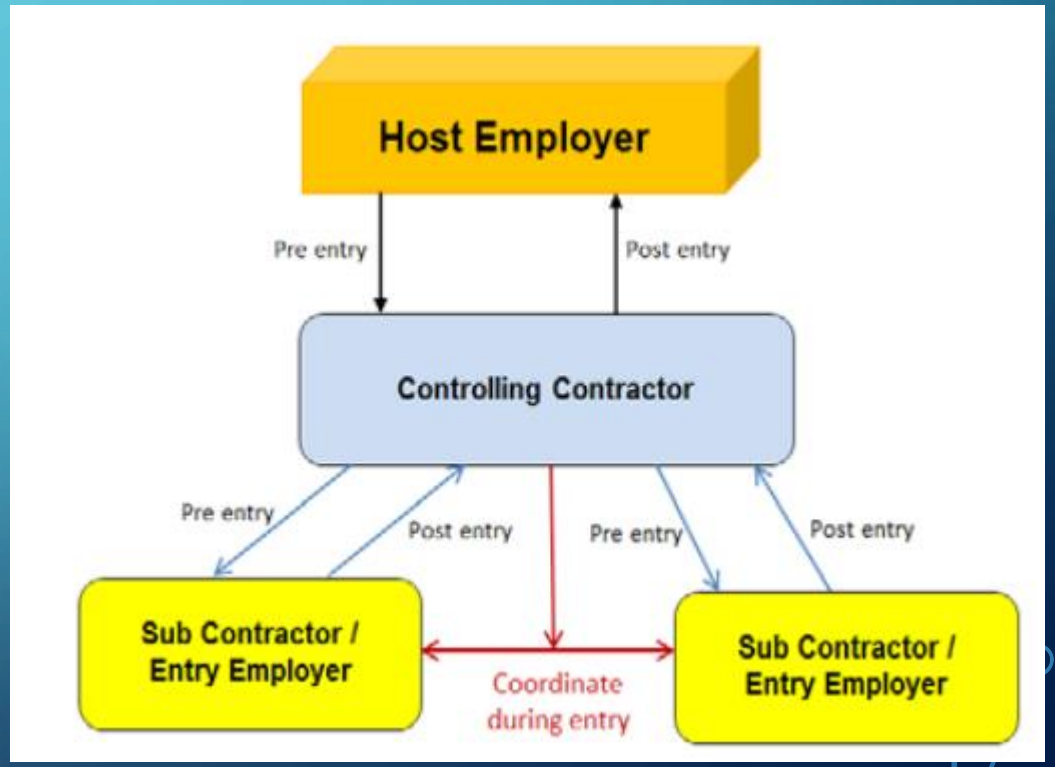
b. test the circuit parts you are placing in a de-energized state, then

c. test your meter once again on a known source of voltage to verify that it is indeed functioning properly.

CONTRACTORS AND HOST EMPLOYERS

110.7

- The host employer must inform the contractor of all of the hazards onsite, with the equipment, and that of other contractors onsite
- Inform the contractor of hazards like the risk of ammonia, overhead work in the area, or that the electrical equipment has been modified, damaged, or otherwise poses a risk to the contract employees



WHO HAS TO BE CERTIFIED

C10 - Electrical Contractor

California Code of Regulations

Title 16, Division 8, Article 3. Classifications

- An electrical contractor places, installs, erects or connects any electrical wires, fixtures, appliances, apparatus, raceways, conduits, solar photovoltaic cells or any part thereof, which generate, transmit, transform or utilize electrical energy in any form or for any purpose.

CERTIFIED ELECTRICIANS

- **DIVISION 1. DEPARTMENT OF INDUSTRIAL RELATIONS [50 - 176]**
- **CHAPTER 4.5. Electrician Certification [108.2]**
- **108.2.**
- (b) State certification is only for those persons who perform work as electricians for contractors licensed as class C-10 electrical contractors including incidental and supplemental work as defined in section 7059 of the business and professions code and regardless of the same contractor is also licensed as a class C-10 contractor

CERTIFIED ELECTRICIANS

DIVISION 1. DEPARTMENT OF INDUSTRIAL RELATIONS [50 - 176]

CHAPTER 4.5. Electrician Certification [108 - 108.5]

108.4.

- (a) An uncertified person may perform electrical work for which certification is required under Section 108 in order to acquire the necessary on-the-job experience for certification, if **all of the following requirements are met:**
- (1) The person is registered with the Labor Commissioner.
- (2) The person either has completed or is enrolled in an approved curriculum of classroom instruction.
- (3) The employer attests that the person shall be under the direct supervision of an electrician certified pursuant to Section 108 **who is responsible for supervising no more than one uncertified person**

ALL CONTRACTORS ONSITE MUST COMMUNICATE

- If a contractor is applying an aerosolized hazard and wearing respiratory protection, the contractor creating the hazard must inform the other workers onsite of this hazard
- If a contractor is working with live electrical energy, they must inform other contractors onsite.

CONTRACTORS HAVE TO FOLLOW THE SAME RULES WE DO

- They have to have their own program
- Train and qualify their employees
- Have state certified electricians (this rule only applies to contractors)
- Provide them with the proper PPE and equipment
- Perform safety meetings
- Perform Job Hazard Assessments and Risk Analysis
- Document safety infractions
- Perform accident investigations

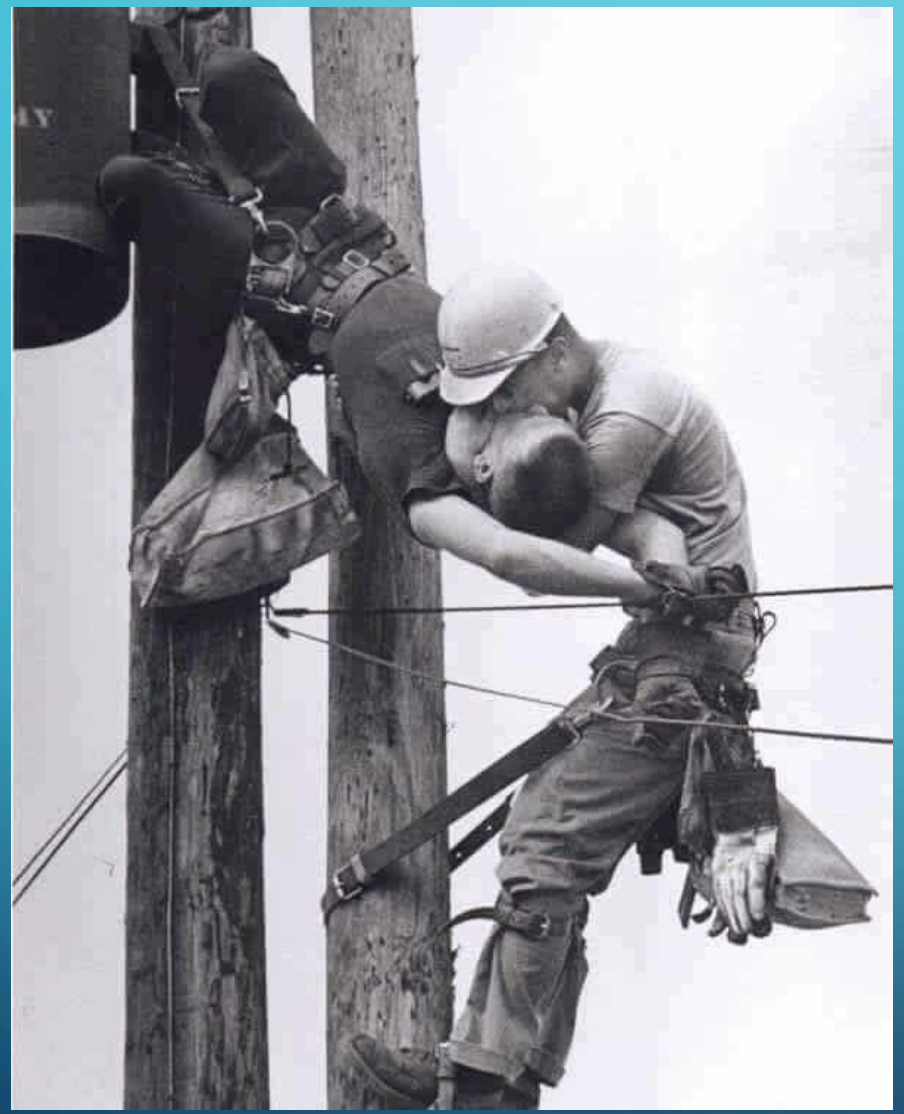
EQUIPMENT MAINTENANCE

- 110.5 (C) Maintenance
- Equipment that is not maintained may not function properly
- Breakers, fault interrupters, heaters, fuses, etc. can all fail if the equipment is not properly maintained
- Proper maintenance can be achieved utilizing the manufacturer's recommendations as well as the NFPA 70 B

EMERGENCY RESPONSE -110.6 (C)

Employees responsible for responding to a medical emergency:

- First-aid and emergency procedures
- CPR
- AED operation, if employer's response plan includes AED



A Pulitzer prize photo, and certainly worthy of that award...

This photo shows two power linemen, Randall Champion and J. D. Thompson, at the top of a utility pole. They had been performing routine maintenance when Champion brushed one of the high voltage lines at the very top. Over 4000 volts entered Champion's body and instantly stopped his heart (an electric chair uses about 2000 volts). His safety harness prevented a fall, and Thompson, who had been ascending below him, quickly reached him and performed mouth-to-mouth resuscitation. He was unable to perform CPR given the circumstances, but continued breathing into Champion's lungs until he felt a slight pulse, then unbuckled his harness and descended with him on his shoulder.

Thompson and another worker administered CPR on the ground, and Champion was moderately revived by the time paramedics arrived, eventually making a full recovery.

DON'T PUT YOURSELF IN DANGER

- The first rule of emergency response is to protect yourself
- This means wearing the correct PPE
- Use the correct tools
- Turn the power off for emergency response crews

QUESTIONS

Heath Taylor
Heathtaylor.csp@gmail.com

Reference Material:

https://www.esfi.org/

https://www.fluke.com/en-us/learn/blog/safety/safe-test-tools-real-world-use

https://www.se.com/us/en/work/services/field-services/safety-services.jsp

https://www.westex.com/hazards-standards/arc-flash?gclid=Cj0KCQjw-daUBhCIARIsALbkjSbWE3QmlKEIyZAMt4fOgSD4f0a8m_MoMGS2FJp1alw6_7eVki58nOoaAomNEALw_wcB

https://www.eaton.com/us/en-us/company/news-insights/reset-safety-arc-flash.html