



NFPA 70E The Right Stuff

Institute of Electrical and Electronic Engineers

IEEE

National Electrical Contractors Association

NECA

The NECA logo is located in the bottom left corner of the slide. It consists of the letters 'NECA' in a white, serif font, with a stylized graphic of three stars and a swoosh above the letters.



NFPA 70E The Right Stuff

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Objectives

- Introduction
- Enforcement
- Responsibilities
- The Hazards
- Priorities
- Hierarchy of Risk Control
- Risk Assessment Process
- Incident energy and PPE Selection
- NFPA 70E Policies and Best Practices

Introduction

- The purpose of NFPA 70E is to provide a practical safe working environment for employees relative to electrical hazards.
- NFPA 70E was developed at the request of OSHA (1976).
- Helps users avoid workplace injuries and fatalities due to shock, electrocution, and arc flash.



Courtesy of NFPA

Electrical Safety Regulations

- CFR 1910 General Industry – Mandatory Rules
- CFR 1926 Construction Industry – Mandatory Rules
- Assists in HOW to comply with OSHA 1910 Subpart S and OSHA 1926 Subpart K.

- OSHA is Shall, NFPA 70E shows How...



Enforcement

- 29 CFR 1910.333 – “Live electrical parts that an employee may be exposed shall be de-energized unless additional or greater hazards are introduced.”
- 29 CFR 1910.335 – “Employees working in areas where potential electrical hazards exist shall be provided with and shall use personal protective equipment.”

Responsibilities

- Employer – Establish, implement and document safety related work practices

- Communicate, Train, Enforce
- Provide required PPE
- Documentation



Courtesy of
Honeywell Salisbury

- Employee – comply with and implement safety-related work practices and procedures provided by the employer

Responsibilities

- Electrical Safety is a Shared Responsibility
 - Employer
 - Employee
 - Host/Owner or Designated Representative, etc.
- Company Electrical Safety Commitment is needed
- Safety Programs, Policies, Procedures
 - NECA Standing Policy 19, Safety and Health



NECA Standing Policy 19

NECA STANDING POLICY 19 Safety and Health

...NECA concludes that to achieve zero injuries in the workplace, contractors must strive for elimination of the hazards (establishing zero energy work environments) as the first priority and normal and best practice, whenever achievable.



Electrically Safe Work Condition Policy

- Section 110.5(K) requires the electrical safety program to include an electrically safe work condition (ESWC) policy.
- Section 110.3 is the general requirement mandating that an ESWC be created if an employee crosses the limited approach boundary or interacts in a manner increasing the likelihood of an arc flash.



Courtesy of Enespro PPE

Impact and Responsibility

- Electrical workers in their daily decision-making processes relative to exposure to electrical hazards covered in NFPA 70E have responsibilities to:
 - Themselves (responsible for their own personal safety)
 - Families (their family depends on them making the right safety decisions and not taking risks)
 - Employer (the company the work for depends on them making the right safety decisions and not taking risks)

Qualified Person

- One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk.
- The **Employer** determines who is/is not qualified.



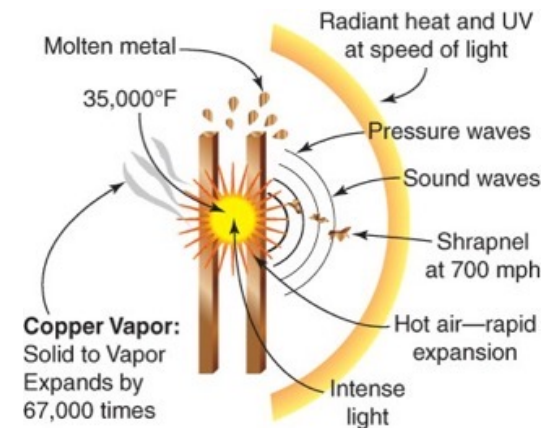
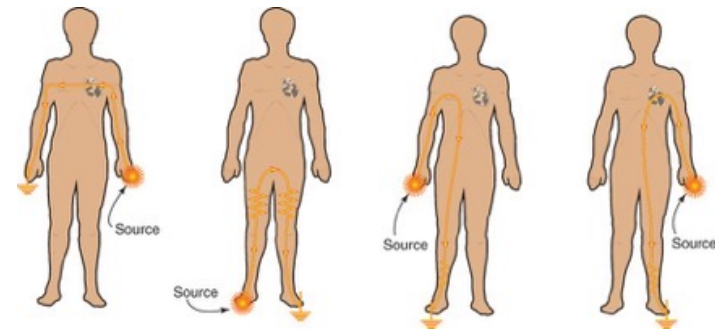
Introduction to Electrical Safety

- Electrical workers are sometimes exposed to electrical hazards.
- NFPA 70E *Standard for Electrical Safety in the Workplace* identifies these electrical hazards.
- Annex K provides details.



Electrical Hazards

- Shock
 - Current flow through the body
- Arc-Flash and Thermal Burns
 - Tremendous heat, burns
- Arc-Blast Injury
 - Extreme pressure
 - High decibel levels (sound)
 - Flying objects, shrapnel



Electric Shock

- Approximately 30,000 nonfatal electrical shock accidents occur each year.
- The NSC estimates that about 1000 fatalities each year are due to electrocution, more than half of those while servicing energized systems of less than 600 volts.
- Electrocution is the fourth leading cause of industrial fatalities.
- The most damaging paths through the body are through the lungs, heart, and brain.

Arc Flash

- When electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors, the temperatures can reach 35,000°F.
- Exposure to these extreme temperatures both burns the skin directly and usually causes ignition of clothing, which adds to the burn injury.
- Each year more than **2000 people** are admitted to burn centers with severe arc flash burns.



Fault Current and Clearing Times

- Two factors are directly related to the amount of incident energy at a point on the system.
 - The amount of available fault current (AFC)
 - The Clearing time of the overcurrent protective device(s)
- In service equipment, the line side and load side of the main OCPD must be factored into the method of determining incident energy.
- The clearing time on the line side of the main service equipment will typically be longer.

NFPA 70E Priorities

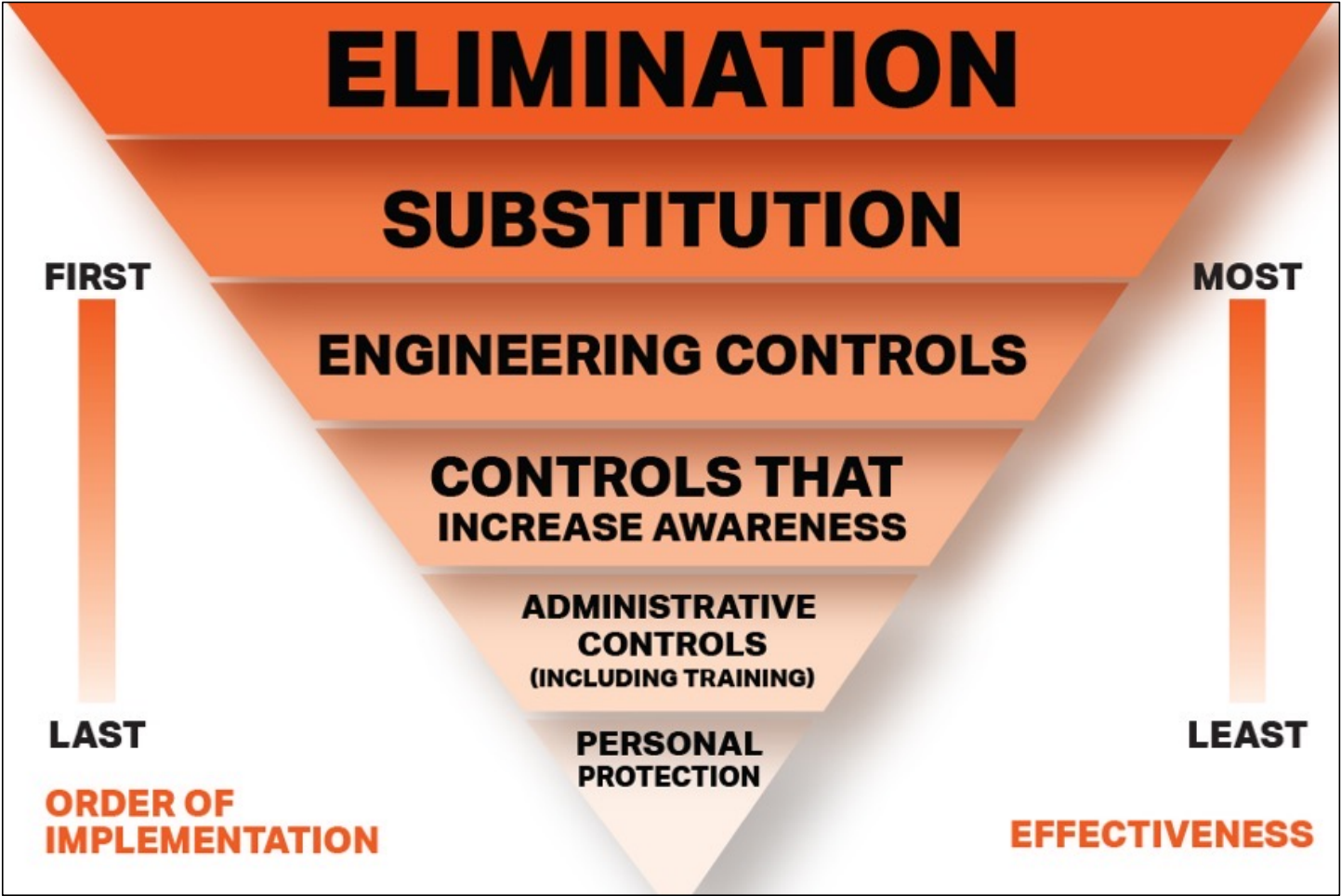
- The 2021 revision cycle of NFPA 70E shows continuous maturing of the standard through reorganization and prioritizing of requirements.
- While this reorganization seems to be primarily editorial in nature, there is a significant impact in application of general requirements.
- The first four sections in Article 110 emphasize the priorities in General Requirements for Electrical Safety-Related Work Practices.



NFPA 70E Priorities

- The requirement mandating that hazard **elimination** is always the **first priority** in the implementation of safety-related work practices is the first section in Article 110.
- *Hazard Elimination* the very first general requirement in the standard.
- This requirement was previously misplaced in Article 105 which contains administrative requirements.





NFPA 70E Priorities

- The general ESWC requirement in 120.2(A) is provided in Section 110.2.
- The process of establishing an ESWC is justified energized work.
- Electrical conductors and circuit parts are not considered to be in an electrically safe work condition until all of the requirements of Article 120 have been met.
- Hazard elimination is the first priority in the implementation of safety-related work practices.



NFPA 70E Priorities

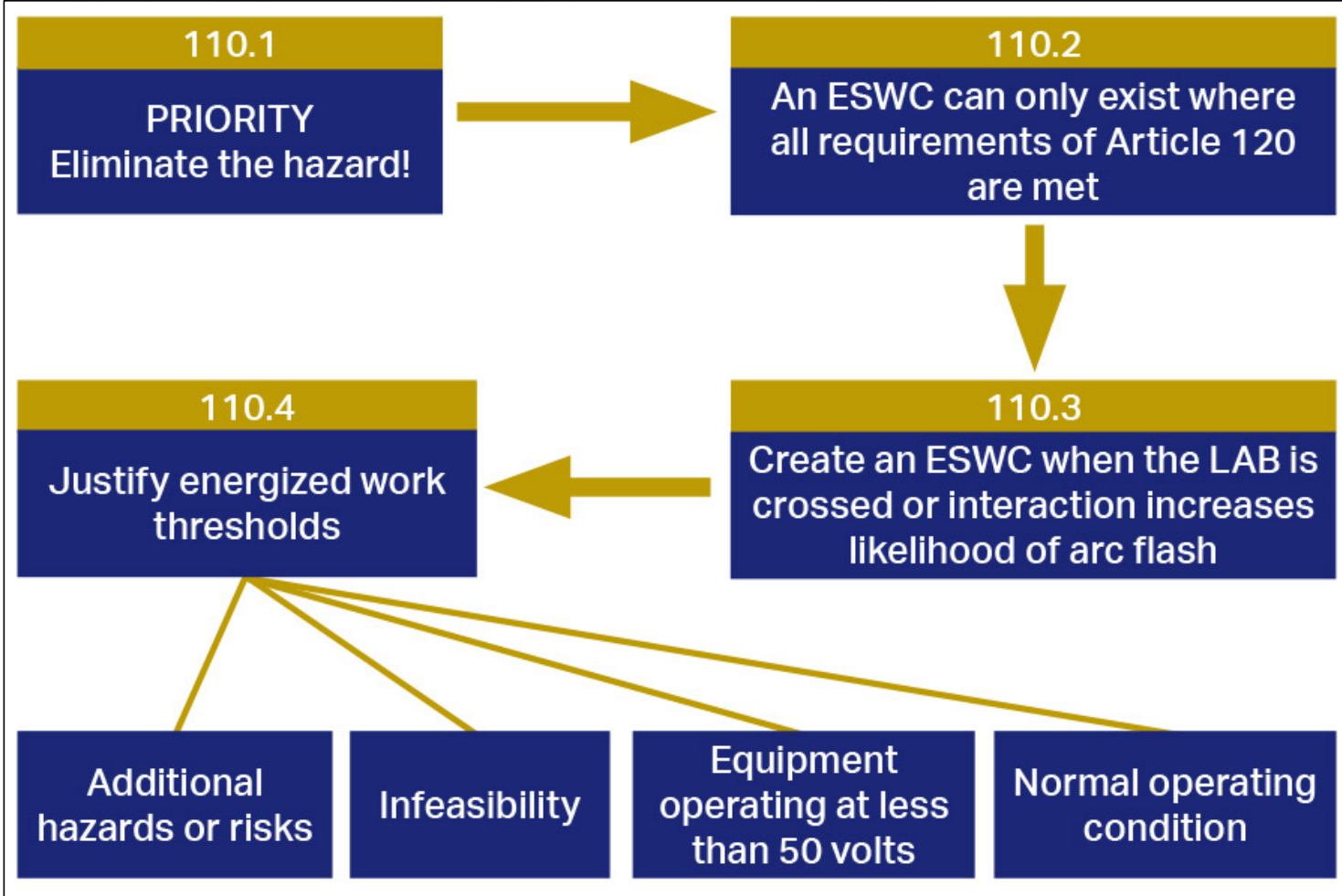
- The general rule for the creation of an Electrically Safe Work Condition (ESWC) is relocated to 110.3.
- An ESWC must be established when the LAB is crossed or there is interaction with equipment that increases the likelihood of an arc flash.



NFPA 70E Priorities

- The justification thresholds for energized work are provided in Section 110.4 which clearly provides the energized work justification thresholds.
- Sections 110.1 through 110.4 now clearly mandate elimination as the first choice (priority) and the thresholds for justified energized work.





110.4 Energized Work

- The justification thresholds for energized work are located in Section 110.4.
- This general requirement has four first level subdivisions following new section 110.3 that mandates the general rule is to create an electrically safe work condition
- Sections 110.1 through 110.4 now clearly mandate elimination as the first priority and the thresholds for justified energized work.





Courtesy of Enespro PPE

Risk and Risk Assessment

- Definition of “Risk”
 - It is a combination of the **likelihood of occurrence** of injury or damage to health and the **severity of injury or damage to health** that results from a hazard.
- Definition of “Risk Assessment”
 - An overall process that identifies hazards, estimates the likelihood of occurrence of injury or damage to health, estimates the potential severity of injury or damage to health, and determines if protective measures are required.
 - The risk of “**Human Error**” is often overlooked but needs to part of the overall risk assessment process per Section 110.5(H)(2).

Risk and Risk Assessment

- NFPA 70E requires two types of risk assessments
 - Shock Risk Assessments – NFPA 70E Section 130.4
 - Arc Flash Risk Assessments – NFPA 70E Section 130.5
- Assessments are required to be documented.

Shock Risk Assessment

- Step 1
 - Identify shock hazards
- Step 2
 - Estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
- Step 3
 - Determine if additional measures are needed

Shock Risk Assessment

- Considerations include:
 - (1) The design of the Electrical Equipment
 - (2) The equipment operating condition and the condition of maintenance
- Additional protective measures include:
 - (1) Voltage that personnel will be exposed to
 - (2) Boundary Requirements
 - (3) Required personal and protective equipment

- NFPA 70E Section 130.4
- Triggers
 - Limited Approach Boundary
 - Restricted Approach Boundary



Protective Rubber Equipment Labeling Chart for Salisbury Linemen's Natural Rubber and SALCOR® Rubber Protective Equipment					
Class Color	Proof Test Voltage AC / DC	Max. Use Voltage* AC / DC	Rubber Molded Products Label	Glove Label	Rubber Dipped Sleeve Label
00 Beige	2,500 / 10,000	500 / 750			
0 Red	5,000 / 20,000	1,000 / 1,500			
1 White	10,000 / 40,000	7,500 / 11,250			
2 Yellow	20,000 / 50,000	17,000 / 25,500			
3 Green	30,000 / 60,000	26,500 / 39,750			
4 Orange	40,000 / 70,000	36,000 / 54,000			

Insulating Gloves and Sleeves must have a color coded label to meet appropriate ASTM Specifications.
* Max. Use Voltage when worn with leather protectors.



Arc Flash Risk Assessment

- Step 1
 - Identify arc flash hazards
- Step 2
 - Estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
- Step 3
 - Determine if additional measures are needed

Arc Flash Risk Assessment

- Considerations include:
 - (1) The design of the electrical equipment including overcurrent protection and operating time
 - (2) The equipment operating condition and the condition of maintenance
- Additional protective measures include:
 - (1) Appropriate safety-related work practices
 - (2) Arc flash Boundary
 - (3) Required personal and protective equipment

Table 130.5(C) Estimate Likelihood

- Use Table 130.5(C) to estimate **likelihood** of occurrence of an arc flash event and to determine if additional protective measures are required.
- Risk is defined as a combination of the **likelihood** of occurrence of injury or damage to health and the **severity** of injury or damage to health that results from a hazard.

Table 130.5(C) [in part]


Task	Equipment Condition	Likelihood of Occurance
<p>Reading a panel meter while operating a meter switch.</p> <p>Performing infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.</p> <p>Working on control circuits with exposed energized electrical conductors and circuit parts, nominal 125 volts ac or dc, or below without any other exposed energized equipment over nominal 125 volts ac or dc, including opening of hinged covers to gain access.</p> <p>Examination of insulated cable with no manipulation of cable.</p> <p>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack.</p> <p>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack.</p>	Any	No

Determining Normal Operation

- The equipment is properly installed.
- The equipment is properly maintained.
- The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions.
- The equipment doors are closed and secured.
- All equipment covers are in place and secured.
- There is no evidence of impending failure.

Energy Levels Determine Required PPE

- Determine appropriate personal Protective equipment (PPE) using one of two methods
 - Calculation of incident energy levels (see Annex D)
 - Arc-Flash PPE Category Method (Use of Tables)

		
Arc Flash and Shock Hazard Appropriate PPE Required		
5 ft. 0 in. 240	Arc Flash Boundary Volts Shock Hazard	12 Cal/cm ² at 18 In.
3 ft. 6 in.	Limited Approach	
1 ft. 0 in.	Restricted Approach	
 STARK SAFETY CONSULTANTS (866) 923-7922 2020-11-09	Equipment ID: MCC5-31A33A Equipment Name: UPS BYPASS SWITCH	1528  DWG: 5.5.1

PPE Selection Tables

- Use Table 130.7(C)(15)(a) for alternating current (ac) to determine arc flash PPE category.
- Use Table 130.7 (C)(15)(b) for direct current (dc) to determine arc flash PPE category.
- Rating listed under the Arc Flash PPE Category column, Table 130.7(C)(15)(c) for required arc flash PPE.
- Reference to Table Notes and Informational Notes.

RISK ASSESSMENT & PPE SELECTION

ARC FLASH PPE CATEGORY 1 PPE

- Arc-Rated Clothing, Minimum Arc Rating of 4cal/cm²^a
- Arc-rated long-sleeve shirt and pants or arc-rated coverall
- Arc-rated face shield^b or arc flash suit hood
- Arc rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f

PROTECTIVE EQUIPMENT

- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection (ear canal inserts^c)
- Heavy duty leather gloves, arc-rated gloves, or rubber
- insulating gloves with leather protectors (SR)^d
- Leather footwear (AN)^e

AN: as needed (optional). AR: as required. SR: selection required.

Notes: See Page 26.



RISK ASSESSMENT & PPE SELECTION

ARC FLASH PPE CATEGORY 2 PPE

- Arc-Rated Clothing, Minimum Arc Rating of 8cal/cm²^a
- Arc-rated long-sleeve shirt and pants or arc-rated coverall
- Arc-rated flash suit hood or arc-rated face shield^b and arc-rated balaclava
- Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f

PROTECTIVE EQUIPMENT

- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection (ear canal inserts^c)
- Heavy duty leather gloves, arc-rated gloves, or rubber
- insulating gloves with leather protectors (SR)^d
- Leather footwear^e

AN: as needed (optional). AR: as required. SR: selection required.

Notes: See Page 26.



RISK ASSESSMENT & PPE SELECTION

ARC FLASH PPE CATEGORY 3 PPE

Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm^{2a}

- Arc-rated long-sleeve shirt (AR)
- Arc-rated pants (AR) Arc-rated coverall (AR)
- Arc-rated arc flash suit jacket (AR)
- Arc-rated arc flash suit pants (AR)
- Arc-rated arc flash suit hood
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)^d
- Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f

PROTECTIVE EQUIPMENT

- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection (ear canal inserts^c)
- Leather footwear^e

AN: as needed (optional). AR: as required. SR: selection required.

Notes: See Page 26.



RISK ASSESSMENT & PPE SELECTION

ARC FLASH PPE CATEGORY 4 PPE

Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm^{2a}

- Arc-rated long-sleeve shirt (AR)
- Arc-rated pants (AR)
- Arc-rated coverall (AR)
- Arc-rated arc flash suit jacket (AR)
- Arc-rated arc flash suit pants (AR)
- Arc-rated arc flash suit hood
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)^d
- Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f

PROTECTIVE EQUIPMENT

- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection (ear canal inserts^c)
- Leather footwear^e



AN: as needed (optional). AR: as required. SR: selection required.

Summary

- Introduction and Enforcement
- The Hazards covered by NFPA 70E
- Employer and Employee Responsibilities
- Priorities Established in NFPA 70E
- Hierarchy of Risk Control – Elimination
- Risk Assessment Process
- Incident Energy and PPE Selection
- NECA Guide on 70E Policies and Best Practices



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