NFPA 70E®-2018... What Changed?

Keeping People Safe from Electrical Hazards for over 50 Years
Moderator

Ron Spataro
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Send us your questions and comments during the presentation.
Today’s Presenter

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Disclaimer

Although Dennis is a member of the NFPA 70E Technical Committee, his views and opinions expressed in this presentation are purely his and must not be considered an official position of the NFPA or any of its Technical Committees and must not be considered to be, nor be relied upon, as a formal interpretation or promotion of the NFPA. The audience is encouraged to refer to, and become familiar with, the entire text of NFPA 70E-2018 prior to utilizing the standard.
General

Approximately

• 430 Public Inputs – 170 First Revisions
• 170 Public Comments – 70 Second Revisions
General

▶ Shaded text  = Revisions
▶ Δ = Text deletions and figure/table revisions
▶ • = Section deletions
▶ N = New material
This webinar will primarily address the major revisions to:

• Chapter 1 Safety-Related Work Practices
• Informative Annexes
Replace the terms:

- “accident” with “incident”
- “accidental” with “unintentional”
- “accidentally” with “unintentionally”
- The 100 volt DC threshold changed to “50 volts”
- “short circuit current” with "available fault current"
Global

Mandatory References

• Changed to informational notes
  • PPE shall conform to applicable state, federal, or local codes and standards.
Covered.

• This standard addresses electrical safety-related work practices, safety-related maintenance requirements, and other administrative controls ... during activities such as the installation, removal, inspection, operation, maintenance, and demolition of ...
Article 100 Definitions
Accessible, Readily (Readily Accessible)

Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth. [70:100]
Arc Flash Hazard

A source of possible injury or damage to health associated with the release of energy caused by an electric arc.
Boundary, Arc Flash

When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm$^2$ (5 J/cm$^2$).
Identifying hazards associated with the use of electrical energy and taking precautions to reduce the risk associated with those hazards.
Electrical Safety Program

A documented system consisting of electrical safety principles, policies, procedures, and processes that directs activities appropriate for the risk associated with electrical hazards.
Electrically Safe Work Condition

A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage, and, if necessary, temporarily grounded for personnel protection.
Fault Current

▶ Fault Current.
  The amount of current delivered at a point on the system during a short-circuit condition.

▶ Fault Current, Available.
  The largest amount of current capable of being delivered at a point on the system during a short-circuit condition.
Fault Current

- **Informational Note No. 1:** A short circuit can occur during abnormal conditions such as a fault between circuit conductors or a ground fault. See Figure 100.0 Arc Fault Current.

- **Informational Note No. 2:** If the dc supply is a battery system, the term “available fault current” refers to the prospective short-circuit current.
FIGURE 100.0  Available Fault Current.
Maintenance, Condition of

The state of the electrical equipment considering the manufacturers’ instructions, manufacturers' recommendations, applicable industry codes, standards and recommended practices.
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.

(See 110.2(A)(1) for Qualified Person training requirements)
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.
Shock Hazard

▶ A source of possible injury or damage to health associated with current through the body caused by contact or approach to energized electrical conductors or circuit parts.
Working Distance

▶ The distance between a person's face and chest area and a prospective arc source.
Article 105
Application of Safety-Related Work Practices
105.3 Responsibility

105.3(A) Employer Responsibility.

• 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.
105.3 Responsibility

105.3(B) Employee Responsibility.

- The employee shall comply with the safety-related work practices and procedures provided by the employer.
Hazard elimination shall be the first priority in implementation of safety-related work practices.

Informational Note: Elimination is the first risk control method listed in the hierarchy of risk control identified in 110.1(H).
Article 110
General Requirements for Electrical Safety-Related Work Practices
110.1 Electrical Safety Program

(B) Inspection.

- The electrical safety program shall include elements to verify that newly installed or modified electrical equipment or systems have been inspected to comply with applicable installation codes and standards prior to being placed into service.
(H) Risk Assessment Procedure.

- The electrical safety program shall include a risk assessment procedure and shall comply with 110.1(H)(1) through 110.1(H)(3).
110.1 Electrical Safety Program

(H) Risk Assessment Procedure

1) Elements of a Risk Assessment Procedure.

The risk assessment procedure shall address employee exposure to electrical hazards and shall identify the process to be used by the employee before work is started to carry out the following:
1) Identify hazards
2) Assess risks
3) Implement risk control according to the hierarchy of risk control methods
(H) Risk Assessment Procedure

2) Human Error.

The risk assessment procedure shall address the potential for human error and its negative consequences on people, processes, the work environment, and equipment.

Informational Note: The potential for human error varies with factors such as tasks and the work environment. See Informative Annex Q.
3) Hierarchy of Risk Control Methods.

The risk assessment procedure shall require that preventive and protective risk control methods be implemented in accordance with the following hierarchy:

1) Elimination
2) Substitution
3) Engineering controls
4) Awareness
5) Administrative controls
6) PPE
(H) Risk Assessment Procedure

- **Informational Note No. 1:** Elimination, substitution, and engineering controls are the most effective methods to reduce risk as they are usually applied at the source of possible injury or damage to health and they are less likely to be affected by human error. Awareness, administrative controls, and PPE are the least effective methods to reduce risk as they are not applied at the source and they are more likely to be affected by human error.
110.1 Electrical Safety Program

(I) **Job Safety Planning and Job Briefing**

- Before starting each job that involves exposure to electrical hazards, the employee in charge shall complete a job safety plan and conduct a job briefing with the employees involved.
110.1 Electrical Safety Program

1) Job Safety Planning.
   • The job safety plan shall be in accordance with the following:
     1) ...by a qualified person
     2) ...documented
     3) ...Include ..:
        ‣ (a) through (e)
        ‣ [Job and task description, identify electrical hazards, shock and arc flash risk assessments, and procedures, precautions, and controls]
110.1 Electrical Safety Program

2) Job Briefing
3) Change in Scope

Also made similar changes to Informative Annex I
110.1 Electrical Safety Program

(J) Incident Investigations.

The electrical safety program shall include a requirement to investigate electrical incidents.

**Informational Note:** Electrical incidents include events or occurrences that result in, or could have resulted in, a fatality, an injury or damage to health. Incidents that do not result in fatality, injury or damage to health are commonly referred to as a “close call” or “near miss.”
110.1 Electrical Safety Program

(K) Auditing

1) Electrical Safety Program Audit
   • Not to exceed 3 years

2) Field Work Audit
   • Not to exceed 1 year

3) Lockout/Tagout Program and Procedure Audit
   • Not to exceed 1 year

4) Documentation
110.2 Training Requirements

(A) Electrical Safety Training
   (1) Qualified Person – wording moved here
   (2) Unqualified Persons
   (3) Retraining

   … conditions:
   1) … supervision or annual inspections indicate non-compliance
   2) New technology, equipment, changes different procedures than normally used
   3) The employee needs to review tasks that are performed less often than once per year.
   4) The employee needs to review safety-related work practices not normally used by the employee during regular job duties.
   5) The employee’s job duties change
110.2 Training Requirements

(A) Electrical Safety Training

(4) Type of Training

(5) Electrical Safety Training Documentation

1) Be made when the employee demonstrates proficiency in the work practices involved

2) Be retained for the duration of the employee’s employment

3) Contain the content of the training, each employee’s name, and dates of training
(B) Lockout/Tagout Procedure Training

1) Initial Training.
   • Employees that could be involved in or affected by the lockout/tagout procedures required by 120.2 shall be trained in the following:
     1) The lockout/tagout procedures
     2) Their responsibility in the execution of the procedures
(B) Lockout/Tagout Procedure Training

2) Retraining.

Retraining in the lockout/tagout procedures shall be performed as follows:

1) When the procedures are revised
2) At intervals not to exceed 3 years
3) Indications that the employee is not complying with the lockout/tagout procedures
110.2 Training Requirements

(B) Lockout/Tagout Procedure Training

2) Lockout/Tagout Training Documentation.
   a) Each employee received training
   b) When employee demonstrates proficiency
   c) Training content, employee names, dates

Informational Note: Content of the training could include: syllabus, curriculum, outline, table of contents, or objectives.
110.2 Training Requirements

(C) Emergency Response Training

1) Contact Release.

Employees exposed to shock hazards and those responsible for the safe release of victims from contact with energized electrical conductors or circuit parts shall be trained in methods of safe release. Refresher training shall occur annually.
110.2 Training Requirements

(C) Emergency Response Training

2) First Aid, Emergency Response, and Resuscitation.
   a) Trained in first aid and emergency procedures
   b) Trained in cardiopulmonary resuscitation (CPR)
   c) Trained in automated external defibrillator (AED)
   d) Training shall occur at a frequency that satisfies the requirements of the certifying body.

Informational Note: Employees responsible for responding to medical emergencies might not be first responders or medical professionals. Such employees could be a second person, a safety watch, or a craftsperson.
110.2 Training Requirements

(C) Emergency Response Training

3) Training Verification.
   Employers shall verify at least annually that employee training
   required by 110.2(C) is current.

4) Documentation.
110.3 Host and Contractors Employers' Responsibilities

(A) Host Employer Responsibilities

Informational Note: Examples of a host employer can include owner or their designee, construction manager, general contractor, or employer.
Article 120
Establishing an Electrically Safe Work Condition
Article 120

- Lockout/Tagout Auditing moved to 110.1(K)(3)
- Lockout/Tagout Training moved to 110.2(B)
Article 120

120.1 Lockout/Tagout Program
120.2 Lockout/Tagout Principles
120.3 Lockout/Tagout Equipment
120.4 Lockout/Tagout Procedures
120.5 Process for Establishing & Verifying an Electrically Safe Work Condition
120.1 Lockout/Tagout Program

(A) General. Employer shall establish, document, and implement and lockout/tagout program.

• ... specify LOTO procedures to safeguard workers from exposure to electrical hazards.

• Shall also incorporate the following:
  1) Be applicable to the experience and training of the workers and conditions of the workplace.
  2) Meet the requirements of Article 120.
  3) Applies to fixed, permanently installed equipment, temporarily installed equipment, and portable equipment.
120.1 Lockout/Tagout Program

(B) Employer Responsibilities. The employer shall be responsible for the following:

1) Providing the equipment
2) Providing training for workers
3) Auditing LOTO program
4) Auditing execution of LOTO procedures
120.2 Lockout/Tagout Principles

(A) General. Electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the requirements of Article 120 have been met.

Safe work practices applicable to the circuit voltage and energy level shall be used in accordance with Article 130 until such time that electrical conductors and circuit parts are in an electrically safe work condition.
Article 120

120.3 Lockout/Tagout Equipment
120.4 Lockout/Tagout Procedures

(4) Simple Lockout/Tagout Procedure.

**Exception:** Lockout/tagout is not required for work on cord- and plug-connected equipment for which exposure to the hazards of unexpected energization of the equipment is controlled by the unplugging of the equipment from the energy source, provided that the plug is under the exclusive control of the employee performing the servicing and maintenance for the duration of the work.

(OSHA states: “The plug is under the exclusive control of the employee if it is physically in the possession of the employee, or in arm's reach and in line-of-sight of the employee, or if the employee has affixed a lockout/tagout device on the plug.”)
120.5 Process for Establishing and Verifying an Electrically Safe Work Condition

Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible:

4) Release stored electrical energy.
5) Release or block stored mechanical energy.
Article 120

120.5 Process for Establishing and Verifying an Electrically Safe Work Condition

7) Use an adequately rated portable test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on any known voltage source.
Article 120

120.5(7)

- **Exception No. 1**: An adequately rated permanently mounted test device shall be permitted to be used to verify the absence of voltage of the conductors or circuit parts at the work location, provided it meets the all following requirements:
  1) It is permanently mounted and installed in accordance with the manufacturer’s instructions and tests the conductors and circuit parts at the point of work
  2) It is listed and labeled for the purpose of verifying the absence of voltage
  3) It tests each phase conductor or circuit part both phase-to-phase and phase-to-ground
  4) The test device is verified as operating satisfactorily on any known voltage source before and after verifying the absence of voltage.
Exception No. 2: On electrical systems over 1000 volts, noncontact test instruments shall be permitted to be used to test each phase conductor.
Article 130
Work Involving Electrical Hazards
130.2 Electrically Safe Work Conditions

(A) Energized Work

• (4) Normal Operating Condition. Normal operation of electric equipment shall be permitted where a normal operating condition exists. A normal operating condition exists when all of the following conditions are satisfied:
  1) ...properly installed.
  2) ...properly maintained.
  3) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer’s instructions.
  4) ...doors are closed and secured.
  5) ...covers are in place and secured.
  6) ...no evidence of impending failure.
(B) Energized Electrical Work Permit.

(1) When 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 conditions …

(2) Elements of Work Permit.

• The work permit shall include, but not be limited to, the following items:
  1) Description of the circuit and equipment to be worked on and their location
  2) Description of the work to be performed
(B) Energized Electrical Work Permit.

(3) Exemptions to Work Permit.

- Electrical work shall be permitted without an energized electrical work permit if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with Chapter 1 under any of the following conditions:
  1) Testing, troubleshooting, or voltage measuring
  2) Thermography, ultrasound, or visual inspections if the restricted approach boundary is not crossed
  3) Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
  4) General housekeeping and miscellaneous nonelectrical tasks if the restricted approach boundary is not crossed
130.4 **Shock Risk Assessment**

(C) **Documentation.**

The results of the shock risk assessment shall be documented.
130.5 Arc Flash Risk Assessment

(A) General.

An arc flash risk assessment shall be performed:

1) To identify arc flash hazards
2) To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
3) To determine if additional protective measures are required, including the use of PPE
130.5 Arc Flash Risk Assessment

(B) Estimate of Likelihood and Severity.

The estimate of the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health shall take into consideration the following:

1) The design of the electrical equipment, including its overcurrent protective device and its operating time
2) The electrical equipment operating condition and condition of maintenance
(C) Additional Protective Measures.

If additional protective measures are required they shall be selected and implemented according to the hierarchy of risk control identified in 110.1(H). When the additional protective measures include the use of PPE, the following shall be determined:

1) Appropriate safety-related work practices
2) The arc flash boundary
3) The PPE to be used within the arc flash boundary
130.5 Arc Flash Risk Assessment

(C) Additional Protective Measures.

Table 130.5(C) shall be permitted to be used to estimate the likelihood of occurrence of an arc flash event to determine if additional protective measures are required.

Table 130.5(C) Estimate of the Likelihood of Occurrence of an Arc Flash Incident for ac and dc Systems, was Table 130.7(C)(15)(A)(a); often referred to as the "yes" / "no" table.
130.5 Arc Flash Risk Assessment

(F) Arc Flash PPE.

One of the following methods shall be used for the selection of arc flash PPE:

1) The incident energy analysis method in accordance with 130.5(G)
2) The arc flash PPE category method in accordance with 130.7(C)

(15)

Either, **but not both** methods shall be permitted to be used on the same piece of equipment.
130.5 Arc Flash Risk Assessment

(G) Incident Energy Analysis Method.

• The incident energy analysis shall take into consideration the characteristics of the overcurrent protective device and its fault clearing time, including its condition of maintenance.

• The incident energy analysis shall be updated when changes occur in the electrical distribution system that could affect the results of the analysis. The incident energy analysis shall also be reviewed for accuracy at intervals not to exceed 5 years.
130.5 Arc Flash Risk Assessment

(G) Incident Energy Analysis Method.

- Table 130.5(G) identifies the arc-rated clothing and other PPE requirements of Article 130 and shall be permitted to be used with the incident energy analysis method of selecting arc flash PPE.
Table 130.5(G) Selection of Arc-Rated Clothing and Other PPE When the Incident Energy Analysis Method Is Used

- Incident energy exposures equal to 1.2 cal/cm² up to 12 cal/cm²
- Incident energy exposures greater than 12 cal/cm²

Formerly Informative Annex H, Table H.3(b)
130.5 Arc Flash Risk Assessment

(H) Equipment Labeling

• … shall be marked
• Ex 1. … existing accurate labels allowed to remain …
• Ex 2. in supervised industrial installations
  • qualified persons
  • label information can be documented in a readily available manner
130.5 Arc Flash Risk Assessment

(H) Equipment Labeling

The method of calculating and the data to support the information for the label shall be documented. The data shall be reviewed for accuracy at intervals not to exceed 5 years. Where the review of the data identifies a change that renders the label inaccurate, the label shall be updated.
130.7 Personal and Other Protective Equipment

(A) General.

Employees exposed to electrical hazards when the risk associated with that hazard is not adequately reduced by the applicable electrical installation requirements shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.
130.7 Personal and Other Protective Equipment

(B) Care of Equipment.

Protective equipment shall be maintained in a safe, clean, and reliable condition and in accordance with manufacturers’ instructions. The protective equipment shall be visually inspected before each use. ....
130.7 Personal and Other Protective Equipment

Table 130.7(C)(7) Rubber Insulating Equipment, Maximum Test Intervals

*New insulating equipment is not permitted to be placed into service unless it has been electrically tested within the previous 12 months. Insulating equipment that has been issued for service is not new and is required to be retested in accordance with the intervals in this table.
130.7 Personal and Other Protective Equipment

130.7(C)(10) Arc Flash Equipment.

130.7(C)(10)(e) Foot Protection.

Heavy duty leather footwear or dielectric footwear or both provide some arc flash protection to the feet and shall be used in all exposures greater than 4 cal/cm$^2$ (16.75 J/cm$^2$).
130.7 Personal and Other Protective Equipment

130.7(C)(14) Standards for Personal Protective Equipment (PPE).

- (b) *Conformity Assessment*. All PPE suppliers or manufacturers shall demonstrate conformity with the appropriate product standard by one of the following methods:
  1) Self-declaration with a Supplier’s Declaration of Conformance.
  2) Self-declaration under a registered Quality Management System and product testing by an accredited laboratory and a Supplier’s Declaration of Conformity.
  3) Certification by an accredited independent third-party certification organization.
130.7 Personal and Other Protective Equipment

Table 130.7(C)(15)(c) Personal Protective Equipment (PPE)

Note c  Other types of hearing protection are permitted to be used in lieu of or in addition to ear canal inserts provided they are worn under an arc-rated arc flash suit hood.
(E) Alerting Techniques.

(4) Cutting, Removing, or Rerouting of Conductors

Where conductors are de-energized in order to cut, remove, or reroute them and conductor terminations are not within sight, ..., additional steps to verify absence of voltage or identify the conductors shall be taken prior to …

*Informational Note: Additional steps … include, … remotely spiking the conductors and pulling the conductors to visually verify movement. Nonshielded conductors could be additionally verified with a noncontact test instrument, and shielded conductors could be verified with devices to identify the conductors.*
H.4 Conformity Assessment of Personal Protective Equipment (PPE)

H.4.2 Level of Conformity.

• Level 1 conformity - supplier or manufacturer self-declaration
• Level 2 conformity - ISO registered supplier or manufacturer self-declaration
• Level 3 conformity - ISO accredited independent third party certification - products have mark or label
• ANSI/ISEA – 125 detailed information ...on the conformity assessment levels... ISEA@Safetyequipment.org
Informative Annex  K
General Categories of Electrical Hazards

Annex K has been updated to reflect current information and data for electrical shock and arc flash injuries
O.2.3 Incident Energy Reduction Methods.

5 additional reduction methods:

4) Energy-reducing active arc flash mitigation system
5) Arc flash relay
6) High-resistance grounding
7) Current-limiting devices
8) Shunt-trip
Informative Annex O
Safety-Related Design Requirements

O.2.4 Additional Safety-by-Design Methods

1) finger-safe components - reduces exposure
2) disconnects within sight of each motor or driven machine
3) cable limiters - reduce the incident energy
4) inspection windows
5) single service disconnect – provides bus protection
Informative Annex O
Safety-Related Design Requirements

O.2.4 Additional Safety-by-Design Methods

6) remote monitoring - reduces exposure
7) current-limitation - Type 2 “no damage” protection
8) lowered adjustable instantaneous trip - inrush currents
9) arc-resistant equipment
10) remote racking - outside AFB
11) remote opening and closing - from safe distance
12) Class C, D, and E special purpose ground fault circuit interrupters
NEW

Informative Annex Q Human Performance and Workplace Electrical Safety
There are many significant revisions in the NFPA 70E-2018.

If you have additional questions or want to discuss these in more detail, please call or send an e-mail.

Thank You!
NFPA 70E® 2018 Electrical Safety Courses

 NFPA 70E-2018 Electrical Safety (2-day course)
  • Qualified Persons, as defined by the standards

 NFPA 70E-2018 Electrical Safety (1-day course)
  • Employees who may be exposed to electrical hazards, but are not qualified persons
    (examples are: safety personnel, supervisors, managers, etc.)

 NFPA 70E-2018 Electrical Safety (1/2-day seminar)
  • Unqualified Personnel
  • Persons who may work in the vicinity of electrical work or who use cord-and plug-connected equipment and extension cords
Save the Date for Our Next Webinar

Tuesday, January 30, 2018 at 1pm – 2pm CDT

“A Relay Technician’s Approach to Generator Protection”

Presented by Dennis Moon
AVO Training Senior Relay Instructor and Curriculum Advisor
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