Attachment No. 1, EFCOG Best Practice

Code/Standard Title: NFPA 70E® – Standard for Electrical Safety in the Workplace®

TITLE: Technical Evaluation of the Changes in NFPA 70E® between 2018 and 2021 Editions

Date: November 18, 2020

NATIONAL FIRE PROTECTION ASSOCIATION
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SENT VIA EMAIL
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October 1, 2020

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Senior Electrical Review Board (SERB)
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Re: Requests for NFPA® Material - Revised

Dear Mr. McAlhaney:

We are writing in further response to your request on behalf of Savannah River Nuclear Solutions ("**SRNS**") to use certain material which is the intellectual property of the National Fire Protection Association® ("**NFPA®**"). Specifically, SNRS has requested NFPA's permission to use excerpts from NFPA 70E®, 2018 and 2021 editions of the Standard for Electrical Safety in the Workplace® (collectively, the "**NFPA Material**") in SNRS' role as the contractor for the Department of Energy ("**DOE**") to compare the two editions, evaluate the changes and determine the impact to safety and cost to each site that is part of the DOE complex, with the ultimate goal of adopting NFPA 70E, 2021 edition, at each site.

It is our understanding that SRNS' proposed comparison and evaluation document would consist of excerpts (technical changes only) from the 2018 and 2021 editions of this standard and a commentary regarding acceptability of the individual changes for use at each site. We also understand SNRS will quote changes which are applicable to industrial uses or settings, and will exclude other changes, such as editorial changes, rearrangement of articles, changes to articles which are not applicable to the work at SRS (e.g., residential installations, carnivals, fairs, motion picture locations, pipe organs, swimming pools, etc.), and changes to certain parts of the Code, such as informational notes. Furthermore, new articles will not be quoted but will be listed by title only. For changes selected for evaluation, the exact text from the 2018 and 2021 editions will be reflected to help readers understand the nature and the impact of the specific change.

NFPA is willing to grant SNRS' request for permission to use the NFPA Material with the following terms and conditions:

1. SNRS may set forth the specific NFPA Material referenced above in its evaluation and comparison document only this one time for the goals stated above and at no other time and for no other purpose. Except as set forth herein, SNRS may not use the NFPA Material in any other manner, form or format. NFPA will provide you with the specific NFPA Material referenced herein for use as specifically identified above. SNRS may release the evaluation and comparison document to the DOE and to members of the Energy Facility Contractors Group (EFCOG). Except as set forth herein, SNRS may not reproduce, distribute, share or sell the NFPA Material.

2. SNRS agrees to include the following credit statement where the NFPA Material appears:

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3. Upon creation and prior to publication, SNRS agreed to send to NFPA a copy of SNRS' comparison and evaluation document, including the attribution statement described herein. SNRS has provided NFPA with the comparison and evaluation document, minus the cover page. As previously agreed, SNRS shall include the credit statement where the NFPA Material appears; such credit statement may appear on the cover page of SNRS' document.

4. SNRS acknowledges and agrees that, as between SNRS and NFPA, NFPA owns and has all right, title and interest to the NFPA Material, including all intellectual property rights therein, and SNRS shall not take any steps that would violate such rights.

5. All rights in the NFPA Material not expressly granted pursuant to the terms of this letter agreement are expressly reserved in their entirety to NFPA.

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7. SNRS acknowledges and agrees that nothing herein is intended or shall be construed to create a relationship of agency, partnership, distributorship, joint venture, or employee-employer.

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Sincerely,

William Mello
Director of Sales

2021 NFPA 70E® Article or Section	**Added or Deleted Text** Underlined text is added. ~~Strikethrough~~ indicates deleted text.	**Change Description** **Impact to Worker Safety**
Global	Move existing entire section of 130.6 after 130.7.	Relocating 130.6 to follow 130.7 will enhance the logical flow of requirements. Safety Impact: No negative impact.
Global	The requirements found in 120.2 Lockout/Tagout Principles (A) General are relocated to Article 110 as these requirements are general in nature and are more appropriate for this section of the document. The relocated text is placed at 110.2 so as create a logical progression of requirements. Reorganized Article 110	The requirements found in 120.2 Lockout/Tagout Principles (A) General are relocated to Article 110 as these requirements are general in nature and are more appropriate for this section of the document. The relocated text is placed at 110.2 so as create a logical progression of requirements Locating the requirement to de-energize in Article 110 prioritizes and emphasizes the requirement to de-energize is a requirement of an Electrical Safety Program; and, the requirement to de-energize should be located before lockout requirement Safety Impact: No negative impact.
Article 90 – Introduction		
Article 100 - Definitions		
	Conductor, Covered. A conductor encased within material of composition or thickness that is not recognized by ~~this *Code*~~ *NFPA 70, National Electrical Code*, as electrical insulation.	The definition is necessary to distinguish between a conductor that is covered versus a conductor that is insulated. Safety Impact: No negative impact.
	Conductor, Insulated. A conductor encased within material of composition and thickness that is recognized by ~~this *Code*~~ *NFPA 70, National Electrical Code*, as electrical insulation.	The definition is necessary to distinguish between a conductor that is covered versus a conductor that is insulated. Safety Impact: No negative impact.
	~~**Accessible (as applied to wiring methods).**~~ ~~Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building~~.	The definition is not necessary as the term is not used within the body of NFPA 70E. Safety Impact: No negative impact.
	~~**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.~~ ~~Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided in *NFPA 70, National Electrical Code*~~	The definition is not necessary as the term is not used within the body of NFPA 70E. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	Arc Flash Hazard. A source of possible injury or damage to health associated with the release of energy caused by an electric arc. Informational Note No. 1: The likelihood of occurrence of an arc flash incident increases when energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such a manner that could cause an electric arc. An arc flash incident is not likely to occur under normal operating conditions when enclosed energized equipment has been properly installed and maintained. See 110.4(D) for further information. Informational Note No. 2: See Table 130.5(C) for examples of tasks that increase the likelihood of an arc flash incident occurring.	This clarifies the informational note by adding a reference for normal operating conditions. Safety Impact: No negative impact.
	Arc Rating The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value. Informational Note No. 1: Arc-rated clothing or equipment indicates that it has been tested for exposure to an electric arc. Flame-resistant clothing without an arc rating has not been tested for exposure to an electric arc. All arc-rated clothing is also flame resistant. ~~Informational Note No. 2: *Breakopen* is a material response evidenced by the formation of one or more holes in the innermost layer of arc-rated material that would allow flame to pass through the material.~~ Informational Note No. 2: ATPV is defined in ASTM F1959/F1959M, *Standard Test Method for Determining the Arc Rating of Materials for Clothing*, as the incident energy (cal/cm2) on a material or a multilayer system of materials that results in a 50 percent probability that sufficient heat transfer through the tested	Clarifies the term “breakopen” by replacing the word “flame” with “thermal energy” to be consistent with the ASTM definition. The informational notes related to breakopen are combined into one new informational note for clarity. Safety Impact: No negative impact.

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	specimen is predicted to cause the onset of a second degree skin burn injury based on the Stoll curve. Informational Note No. 3: EBT is defined in ASTM F1959/F1959M, *Standard Test Method for Determining the Arc Rating of Materials for Clothing*, as the incident energy (cal/cm2) on a material or a material system that results in a 50 percent probability of breakopen. Breakopen is ~~defined as a hole with~~ a material response evidenced by the formation of one or more holes of a defined size [an area of 1.6 cm^2 (0.5 $in.^2$) or an opening of 2.5 cm (1.0 in.) in any dimension] in the innermost layer of arc-rated material that would allow thermal energy to pass through the material .	
	Balaclava ~~(Sock Hood)~~ An arc-rated ~~hood~~ head-protective fabric that protects the neck and head except for a small portion of the facial area ~~of the eyes and nose~~ Informational Note: Some balaclava designs protect the neck and head area except for the eyes while others leave the eyes and nose area unprotected.	Clarifies the definition of the term balaclava by removing the requirement to leave the nose exposed and eliminating the potentially confusing word “hood” from the definition. The added informational note provides clarity. Safety Impact: No negative impact.
	Barrier A physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts ~~or to prevent unauthorized access to a work area.~~	This correlates the definition of the term barrier with its use in 130.7(D)(2) and other locations in the document. This revised definition does not prohibit the construction of barricades that obstruct access to a work area Safety Impact: No negative impact.
	~~**Branch Circuit.**~~ ~~The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).~~	The definition is not necessary as the term is not used within the body of NFPA 70E. Safety Impact: No negative impact.
	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. Informational Note: An electrically safe work condition is not a procedure. it is a state wherein all hazardous electrical conductors or circuit parts to which a worker might be exposed are maintained in a de-energized state for the purpose of temporarily eliminating electrical hazards for the period of time for which the state is maintained.	The added informational note provides clarity to the definition. Safety Impact: No negative impact.

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	Fault Current, Available. The largest amount of current capable of being delivered at a point on the system during a short-circuit condition. 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. Informational Note No. 2: If the dc supply is a battery system, the term *available fault current* refers to the prospective short-circuit current. Informational Note No. 3: The available fault current varies at different locations within the system due to the location of sources and system impedances.	This new informational note clarifies that the available fault current may be different at different locations within an electrical system. Safety Impact: No negative impact.
	Ground Fault. An unintentional, electrically ~~conducting~~ conductive connection between an ungrounded conductor of an electrical circuit and the normally non–current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth.	The revision to the definition is made to be consistent with the defined term in Article 100 of the National Electrical Code. Safety Impact: No negative impact.
	Receptacle A ~~receptacle is a~~ contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.	Correlates the definition with the revised definition in the 2017 National Electrical Code, NFPA 70. Safety Impact: No negative impact.
	Shock Hazard. A source of possible injury or damage to health associated with current through the body caused by contact or approach to exposed energized electrical conductors or circuit parts. Informational Note: Injury and damage to health resulting from shock is dependent on the magnitude of the electrical current, the power source frequency (e.g., 60 Hz, 50 Hz, dc), and the path and time duration of current through the body. The physiological reaction ranges from perception, muscular contractions, inability to let go, ventricular fibrillation, tissue burns, and death.	Clarifies and correlates the definition of shock hazard with the Article 100 definition of exposed as applied to energized electrical conductors and circuit parts. Safety Impact: No negative impact.
	~~Switchgear~~ Equipment, Arc-Resistant	Other arc-resistant products beyond just switchgear are available. Informational Note No. 1 directs the user to the

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	Equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee. Informational Note No. 1: An example of a standard that provides information for arc-resistant equipment is IEEE C37.20.7, *Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults*. Informational Note No. 2: See O.2.4 (9) for information on arc-resistant equipment.	applicable IEEE standard. Informational Note No. 2 directs the user to informative Annex O for additional information. Safety Impact: No negative impact.
	Voltage, Nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts). Informational Note No. 1: The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment. Informational Note No. 2: See ANSI C84.1, *Electric Power Systems and Equipment — Voltage Ratings (60 Hz)*. Informational Note No. 3: Certain battery units are rated at nominal 48 volts dc but have a charging float voltage up to 58 volts. In dc applications, 60 volts is used to cover the entire range of float voltages.	New Informational Note No. 3 maintains correlation with NFPA 70, the National Electrical Code. Safety Impact: No negative impact.
	Working On (energized electrical conductors or circuit parts). Intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment (PPE) a person is wearing. There are two categories of "working on": *Diagnostic (testing)* is taking readings or measurements of electrical equipment, conductors, or circuit parts with approved test equipment that does not require making any physical change to the electrical equipment, conductors, or circuit parts. ~~*repair*~~ *Repair* is any physical alteration of electrical equipment, conductors, or circuit parts (such as making or tightening connections, removing or replacing components, etc.).	This revision adds the phrase "conductors or circuit parts" to clarify that either diagnostic tasks or repair tasks may include not only the equipment but also its internal conductors or circuit parts. The word "electrical" is added to differentiate the electrical equipment from the test equipment. Safety Impact: No negative impact.
Article 105 – Application of Safety Related Work Practices and Procedures		
Article 110 – General Requirements for Electrical Safety Related Work Practices		

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110.1	Priority. Hazard elimination shall be the first priority in the implementation of safety-related work practices. Informational Note No. 1: Elimination is the risk control method listed first in the hierarchy of risk control identified in 110.5(H) ~~110.5(I)110.1(H)~~ (3). See Annex F for examples of hazard elimination. Informational Note No. 2: An electrically safe work condition is a state wherein all hazardous electrical conductors or circuit parts to which a worker might be exposed are placed and maintained in a de-energized state, for the purpose of temporarily eliminating electrical hazards. See Article 120 for requirements to establish an electrically safe work condition for the period of time for which the state is maintained. See Informative Annex F for information regarding the hierarchy of risk control and hazard elimination.	A reference to Informative Annex F was added to Informational Note 1. The revision to the reference to the hierarchy of risk control is editorially corrected. A new informational note clarifies that an electrically safe work condition is a state wherein all hazardous electrical conductors or circuit parts to which a worker might be exposed are placed and maintained in a zero-energy state, eliminating electrical hazards. Safety Impact: No negative impact.
110.2	General. Electrical conductors and circuit parts shall not be in an electrically safe work condition until all 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 110 and Article 130 until such time that electrical conductors and circuit parts are in an electrically safe work condition.	The requirements found in 120.2 Lockout/Tagout Principles (A) General are relocated to Article 110 as these requirements are general in nature and are more appropriate for this section of the document. The relocated text is placed at 110.2 so as create a logical progression of requirements. Safety Impact: No negative impact.
110.3	~~130.2~~ 110.3 Electrically Safe Work Condition. Energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 volts shall be put into an electrically safe work condition before an employee performs work if any of the following conditions exist: (1) The employee is within the limited approach boundary. (2) The employee interacts with equipment where conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.	Move 130.2 as new 110.3 Locating the requirement to de-energize into Article 110 prioritizes and emphasizes the requirement to de-energize is a requirement of an Electrical Safety Program. The requirement to de-energize should be located before lockout requirements; and Article 130 can be focused on requirements related to work involving an electrical hazard. Safety Impact: No negative impact.
110.5(A)	**(A)** General. The employer shall implement and document an overall electrical safety program that directs activity appropriate to the risk associated with electrical hazards. ~~The electrical safety program shall be~~	All references to safety management systems and safety management standards have been removed from this section of NFPA 70E and relocated in an informative annex.

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	~~implemented as part of the employer's overall occupational health and safety management system, when one exists.~~ Informational Note No. 1: Safety-related work practices such as verification of proper maintenance and installation, alerting techniques, auditing requirements, and training requirements provided in this standard are administrative controls and part of an overall electrical safety program. Informational Note No. 2: ~~ANSI/AIHA Z10, *American National Standard for Occupational Health and Safety Management Systems*, provides a framework for establishing a comprehensive electrical safety program as a component of an employer's occupational safety and health program~~ See Informative Annex P for information on implementing an electrical safety program within an employer's occupational health and safety management system . Informational Note No. 3: IEEE 3007.1, *Recommended Practice for the Operation and Management of Industrial and Commercial Power Systems*, provides additional guidance for the implementation of the electrical safety program. Informational Note No. 4: IEEE 3007.3, *Recommended Practice for Electrical Safety in Industrial and Commercial Power Systems*, provides additional guidance for electrical safety in the workplace.	Informational Note 2 is updated to include a reference to Annex P which provides information on aligning implementation of this standard with occupational health and safety management standards. Safety Impact: No negative impact.
110.5(H)	**(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 Informational Note No. 1: The risk assessment procedure could include identifying when a second person could be required and the training	Section 110.1(H)(3) Informational Notes No. 3 & 4 are relocated to 110.5(H)(1). This requirement is about risk assessment procedure and the process to be used before work is started. There is no need to reference "the employee." Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	and equipment that person should have. Informational Note No. 2: For more information regarding risk assessment and the hierarchy of risk control, see Informative Annex F	
110.5(H)	**(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 relative to the electrical hazards in the workplace. Informational Note: The potential for human error varies with factors such as tasks and the work environment. See Informative Annex Q.	The risk assessment procedure is relative to the electrical hazards in the workplace and is consistent with the Section 90.2 Scope. The reference to consequences on processes, the work environment, and equipment is kept as they all relate to worker safety. This language is consistent with language in Annex Q.1 Safety Impact: No negative impact.
110.5(H)	**(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 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. Informational Note No. 2: See Informative Annex F ~~and ANSI/AIHA Z10, *American National Standard for Occupational Health and Safety Management Systems*,~~ for more information regarding the hierarchy of risk control methods and examples of those methods. ~~Informational Note No. 3: The risk assessment procedure could include identifying when a second person could be required and the training and equipment that person should have.~~	Section 110.1(H)(3) Informational Notes No. 3 & 4 are relocated to 110.5(H)(1) as the information that is contained in the notes pertains to 110.5(H)(1). The reference to ANSI/AIHA Z10 is deleted to clarify that it is only one example of many standards that provide information regarding the hierarchy of risk control methods Safety Impact: No negative impact.

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	~~Informational Note No. 4: For an example of a risk assessment procedure, see Informative Annex F.~~	
110.5(I)	**(1)** Job Safety Planning. The job safety plan shall be in accordance with the following: (1) Be completed by a qualified person (2) Be documented (3) Include the following information: a. A description of the job and the individual tasks b. Identification of the electrical hazards associated with each task c. A shock risk assessment in accordance with 130.4 for tasks involving a shock hazard d. An arc flash risk assessment in accordance with 130.5 for tasks involving an arc flash hazard e. Work procedures involved, special precautions, and energy source controls Informational Note: For an example of a job safety planning checklist see Figure I.2.	An informational note was added to align with new Figure I.2 in Informative Annex I. Safety Impact: No negative impact.
110.5(I)	**(3)** Change in Scope. Additional job safety planning and job briefings shall be held if changes occur during the work that might affect the safety of employees. Informational Note: For an example of a job briefing ~~form and planning~~ checklist, see ~~Informative Annex I~~, Figure I.1.	The word "planning" is deleted to correlate with changes in Informative Annex I. The word “form” is deleted in the informational note to modify the phrase to "job briefing checklist" to correlate with the title in Informative Annex I. Safety Impact: No negative impact.
110.5(L)	**(L)** Lockout/Tagout Program. The electrical safety program shall include the information required by ~~120.1(A)~~ one of the following: (1) A lockout/tagout program in accordance with 120.1(A) (2) A reference to the employer’s lockout/tagout program established in accordance with 120.1(A)	Where an employer has documented the requirements of 120.1(A) in a separate lockout/tagout program, it is redundant to require that those requirements be repeated in the employer’s electrical safety program. This revision clarifies that an employer can include the lockout/tagout program requirements of 120.1(A) in their Electrical Safety Program or document those requirements in a separate lockout/tagout program that is referenced by the employer’s Electrical Safety Program. The either/or options regarding where the employer documents the lockout/tagout requirements are separated into list items and list item one is editorially revised for clarity. Safety Impact: No negative impact.
110.5(K)	**(K)** Electrically Safe Work Condition Policy.	The new subsection requires that the employers electrically safe work program include a policy on

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	An electrical safety program shall include an electrically safe work condition policy that complies with 110.3.	establishing an electrically safe work condition. This correlates with the requirement in Article 120 and provides clarity by ensuring it becomes part of the employer's electrically safe program. Safety Impact: No negative impact.
110.6(A)	**(1)** Qualified Person. A qualified person shall be trained and knowledgeable in the construction and operation of equipment or a specific work method and be trained to identify and avoid the electrical hazards that might be present with respect to that equipment or work method. (a) Such persons shall also be familiar with the proper use of the special precautionary techniques, applicable electrical policies and procedures, PPE, insulating and shielding materials, and insulated tools and test equipment. (b) A person can be considered qualified with respect to certain equipment and tasks but still be unqualified for others. (c) Such persons permitted to work within the limited approach boundary shall, at a minimum, be additionally trained in all of the following: (1) Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment (2) Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts (3) Approach distances specified in Table 130.4(E)(a) and Table 130.4(E)(b) and the corresponding voltages to which the qualified person will be exposed (4) Decision-making process necessary to be able to do the following: a. Perform the job safety planning b. Identify electrical hazards c. Assess the associated risk d. Select the appropriate risk control methods from the hierarchy of controls identified in ~~110.5(G)~~ 110.5(H)(3), including PPE (d) An employee who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a qualified person, and who in the	This section relocated from 110.2 The section reference to the hierarchy of risk control methods is editorially revised for accuracy. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	course of such training demonstrates an ability to perform specific duties safely at his or her level of training, and who is under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those specific duties. (e) Employees shall be trained to select an appropriate test instrument and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall include information that enables the employee to understand all limitations of each test instrument that might be used. (f) The employer shall determine through regular supervision or through inspections conducted on at least an annual basis that each employee is complying with the safety-related work practices required by this standard.	
110.6(A)	**(3)** Additional Training and Retraining. ~~Retraining~~ Additional training and retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed 3 years. An employee shall receive additional training ~~(~~or retraining~~)~~ if any of the following conditions exists: (1) The supervision or annual inspections indicate the employee is not complying with the safety-related work practices. (2) New technology, new types of equipment, or changes in procedures necessitate the use of safety related work practices different from those that the employee would normally use. (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.	Adding "additional training" to the title correlates the section title with the content of the requirement since the section addresses both. The parenthesis is removed from "or retraining" as additional training and retraining are different, and both are mentioned in the requirement. Safety Impact: No negative impact.
110.6(A)	**(4)** Type of Training. The training required by 110.6(A) shall be classroom, on-the-job, or a combination of the two. The type and extent of the training provided shall be determined by the risk to the employee.	The new informational note recognizes that interactive electronic training is widely used. Safety Impact: No negative impact.

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	Informational Note: Classroom training can include interactive electronic or interactive web-based training components.	
110.6(B)	**(1)** Initial Training. Employees involved in ~~or affected by~~ the lockout/tagout procedures required by 120.2(B) shall be trained in the following: (1) The lockout/tagout procedures (2) Their responsibility in the execution of the procedures	The phrase "or affected by" is deleted. While all employees must understand the purpose of a lockout, the requirement to train employees that are involved in the lockout is consistent with the requirement in 120.2(B) Employee Involvement: "Each person who could be exposed directly or indirectly to a source of electrical energy shall be involved in the lockout/tagout process." Safety Impact: No negative impact.
110.7(C)	**(C)** Documentation. Where the host employer has knowledge of hazards covered by this standard that are related to the contract employer's work, there shall be a documented meeting between the host employer and the contract employer. Informational Note: On multi-employer work sites (in all industry sectors), more than one employer can be responsible for identifying hazardous conditions and creating safe work practices.	The new informational note provides information that more than one employer can be responsible for identifying hazardous conditions and creating safe work practices. Although the informational note is located after 110.7(C), it applies to all of 110.7, not just 110.7(C). This revision provides clarity. Safety Impact: No negative impact.
110.8(A)	**(A)** Testing. Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring on electrical equipment ~~operating at voltages equal to or greater than 50 volts~~ where an electrical hazard exists.	The requirement was revised to apply to all electrical hazards, as testing and troubleshooting that involves any electrical hazard, not just a shock hazard, should be performed by a qualified person. Safety Impact: No negative impact.
110.9	This section applies to the use of cord- and plug-connected equipment, including cord- and plug connected test instruments and cord sets (extension cords).	Section 110.9 is edited to include cord and plug connected test equipment as they can present the same shock hazard when used in wet or damp locations, therefore, the same level of personnel GFCI protection should be extended to this equipment. Safety Impact: No negative impact.
110.9(C)	**(C)** Visual Inspection and Repair of Portable Cord- and Plug-Connected Equipment and Flexible Cord Sets. (a) *Frequency of Inspection.* Before each use, portable cord- and plug-connected equipment shall be visually inspected for external defects (such as loose parts or deformed and missing pins) and for evidence of possible internal damage (such as a pinched or crushed outer jacket). *Exception: Stationary cord- and plug-connected equipment ~~and flexible cord sets (extension cords)~~ that remain connected once they are put in place and are installed such that the cord and plug are not subject to physical damage during normal use shall not*	The exception to 110.9(C) is revised to apply only to cord and plug connected equipment that remains at a designated location and that can be controlled to ensure no damage occurs to the power cord. Extension cord sets are intended for temporary use and not permitted as a substitute for permanent wiring methods as mandated by Article 400 of the NEC. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	be required to be visually inspected until they are relocated or repaired. (b) *Defective Equipment.* If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service. No employee shall use it until a person(s) qualified to perform the repairs and tests necessary to render the equipment safe has done so. (c) *Proper Mating.* When an attachment plug is to be connected to a receptacle, the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of mating configurations.	
110.9(D)	**(D)** Conductive or Wet Work Locations. Portable cord- and-plug-connected electric equipment used in ~~highly~~ conductive or wet work locations ~~(such as those inundated with water or other conductive liquids)~~ shall be approved for use in those locations. In ~~job~~ work locations where employees are likely to contact or be drenched with water or conductive liquids, ground-fault circuit-interrupter protection for personnel shall ~~also~~ be used. Informational Note: The risk assessment procedure can also include identifying when the use of portable tools and equipment powered by sources other than 120 volts ac, such as batteries, air, and hydraulics, should be used to minimize the potential for injury from electrical hazards for tasks performed in conductive or wet locations.	Section 110.9(D) is revised to clarify that the requirement for GFCI protection also applies to wet locations. Other editorial revisions are made for consistency. Safety Impact: No negative impact.
110.12	**110.12** Equipment Use. Equipment shall be used in accordance with the manufacturer's instructions.	All equipment needs to be used in accordance with instructions provided by the manufacturers. Presently NFPA 70E requires instructions to be followed only for some specific applications. Installation requirements were not included because they are within the NEC scope. The term "equipment" is used as it is defined in Article 100. Safety Impact: No negative impact.
Article 120 – Establishing an Electrically Safe Work Condition		
120.1	**(B)** Employer Responsibilities. The employer shall be responsible for the following: (1) Providing the equipment necessary to execute lockout/tagout procedures (2) Providing lockout/tagout training to workers in accordance with 110.6(B) (3) Auditing the lockout/tagout program in accordance with ~~110.5~~ 110.5(M)(3)	Editorial corrections to section references. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(4) Auditing execution of the lockout/tagout procedures in accordance with ~~110.5~~ 110.5(M)(3) Informational Note: For an example of a lockout/tagout program, see Informative Annex G.	
120.2(A)	**(A)** Employee Involvement. Each person who could be exposed directly or indirectly to a source of electrical energy shall be involved in the lockout/tagout ~~process~~ procedure	The term "process" was replaced with "procedure" as each person that can be exposed must be part of the lockout/tagout procedure. Safety Impact: No negative impact.
120.2(B)	**(B)** Lockout/Tagout Procedure. A lockout/tagout procedure shall be developed on the basis of the existing electrical equipment and system and shall use suitable documentation including up-to-date drawings and diagrams. The procedure shall meet the requirements of applicable codes, standards, and regulations for lockout and tagging of electrical sources.	The revision requires that any Article 120 compliant lockout/tagout procedure meet applicable requirements and regulations. Safety Impact: No negative impact.
120.3	**(C)** Lockout Device. The lockout device shall meet the following requirements: (1) A lockout device shall include a lock — either keyed or combination. (2) The lockout device shall include a method of identifying the individual who installed the lockout device. (3) A lockout device shall be permitted to be only a lock, if the lock is readily identifiable as a lockout device, in addition to having a means of identifying the person who installed the lock, provided that all of the following conditions exist: (a) Only one circuit or piece of equipment is de-energized. (b) The lockout period does not extend beyond the work shift. (c) Employees exposed to the hazards associated with re-energizing the circuit or equipment are familiar with this procedure. (4) Lockout devices shall be attached to prevent operation of the disconnecting means without resorting to undue force or the use of tools.	This change brings this section in alignment with OSHA 1910.333(b)(2)(iii)(E). Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(5) Where a tag is used in conjunction with a lockout device, the tag shall contain a statement prohibiting unauthorized operation of the disconnecting means or unauthorized removal of the device. (6) Lockout devices shall be suitable for the environment and for the duration of the lockout. (7) Whether keyed or combination locks are used, the key or combination shall remain in the possession of the individual installing the lock or the person in charge, when provided by the established procedure.	
120.4(B)(2)	**(2)** Stored Energy. The procedure shall include requirements for releasing stored electric or mechanical energy that might endanger personnel. All capacitors shall be discharged, and high-capacitance elements shall also be short-circuited and grounded before the associated equipment is touched or worked on. Springs shall be released or physical restraint shall be applied when necessary to immobilize mechanical equipment and pneumatic and hydraulic pressure reservoirs. Other sources of stored energy shall be blocked or otherwise relieved. Informational Note: For more information on methods and procedures to place capacitors in an electrically safe work condition, see 360.3, 360.5, and Informative Annex R, Working with Capacitors.	An informational note was added to direct users of the document to Article 360 and Informative Annex R for additional guidance for establishing an electrically safe work condition when there are hazards associated with capacitors. Safety Impact: No negative impact.
120.5	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: (1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to date drawings, diagrams, and identification tags. (2) After properly interrupting the load current, open the disconnecting device(s) for each source. (3) Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the test or fully disconnected position. (4) Release stored electrical energy.	Modified to permit racking to the test position to enable the enclosure doors to be shut for disconnection and isolation. Revised to correlate the requirements of this section with OSHA 1910.333(b)(2) Added informational note reference to the applicable product standard identified in the requirements of Exception No. 1 to Item (7). Modified the existing text to require grounding of all circuit conductors and circuit parts before touching them where the possibility of induced voltages or stored electrical energy exists. The text was revised to eliminate redundancy and to add clarity. The term “accidentally” was changed to “unintentionally” to be consistent with use of terminology. The text of the mandatory requirement and the exceptions were revised for consistent use of the terms “verified,” “deenergized” and “absence of voltage.” The use of the term “verified” will be such that it is only associated with

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(5) ~~Release or block stored mechanical energy~~. Block or relieve stored non-electrical energy in devices to the extent the circuit parts cannot be unintentionally energized by such devices. (6) Apply lockout/tagout devices in accordance with a documented and established procedure. (7) Use an adequately rated portable test instrument to test each phase conductor or circuit part to ~~verify it is de-energized~~ test for the absence of voltage. 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. *Exception No. 1 to 7: An adequately rated permanently mounted absence of voltage tester ~~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 testing for ~~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~~ testing for the absence of voltage.* *Exception No. 2 to 7: On electrical systems over 1000 volts, noncontact test capacitive instruments shall be permitted to be used to test each phase conductor.* Informational Note No. 1: See UL 61010-1, *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements*, for rating, overvoltage category, and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 volts and below. Informational No. 2: For additional information on rating and design requirements for permanently mounted absence of voltage testers, refer to UL 1436, *Outlet Circuit Testers and Other Similar Indicating Devices.*	determining if a test instrument or device is operating properly. This change also correlates with how it is used elsewhere within the 70E Standard. This revision also included replacing the term "verified" with "testing for" where it was used with the absence of voltage testing. In the opening sentence of the main requirement the action of "verifying" the conductors or circuit parts are "deenergized" was changed to "testing for the absence of voltage." This change is consistent with how the action is stated in the rest of this section, including the exceptions, and within the industry. The term "test device" was changed to "absence of voltage tester" to be consistent with the product standard. The term "noncontact test instrument" was changed to "noncontact capacitive test instrument"" as that is the term that is used in the product standards and therefore is the proper term for the device. The term capacitive is consistent with the technical reference to the device. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	Informational Note No. 3: For additional information on rating and design requirements for voltage detectors, refer to IEC 61243-1, *Live Working — Voltage Detectors — Part 1: Capacitive type to be used for voltages exceeding 1kV a.c.*, or IEC 61243-2, *Live Working — Voltage Detectors — Part 2: Resistive type to be used for voltages of 1kV to 36 kV a.c.*, or IEC 61243-3, *Live Working — Voltage Detectors — Part 3: Two-pole low voltage type*. (8) Where the possibility of induced voltages or stored electrical energy exists, ground ~~the phase~~ all circuit conductors ~~or~~ and circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply temporary protective grounding equipment in accordance with the following:	
Article 130 – Work Involving Electrical Hazards		
130.1	**130.1** General. Article 130 covers requirements for work involving electrical hazards such as the electrical safety-related work practices, assessments, precautions, and procedures when an electrically safe work condition cannot be established ~~the following~~: ~~(0) When an electrically safe work condition must be established~~ ~~(0) Requirements for work involving electrical hazards such as the electrical safety-related work practices, assessments, precautions, and procedures when an electrically safe work condition cannot be established~~ 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. When energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 volts are not put into an electrically safe work condition, and work is performed as permitted in accordance with 110.4, all of the following requirements shall apply: (1) Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.	Sections 130.1-130.3 are rewritten to accommodate the relocation of information from the present 130.2(A) to 110.3. This revision provides additional clarity and usability by grouping together into Article 110 the requirements for de-energizing. Relocated the concepts from the present 130.3 into a re-worded introduction in 130.1. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(2) An energized electrical work permit shall be completed as required by 110.2. (3) A shock risk assessment shall be performed as required by 130.4. (4) An arc flash risk assessment shall be performed as required by 130.5. All requirements of ~~this article~~ Article130 shall apply whether an incident energy analysis is completed or if Table 130.7(C)(15)(a), Table 130.7(C)(15)(b), and Table 130.7(C)(15)(c) are used in lieu of an incident energy analysis.	
130.2	**(B)** 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 (3) Justification for why the work must be performed in an energized condition *[see 110.4]* (4) Description of the safe work practices to be employed *(see 130.1 ~~130.3~~)* (5) Results of the shock risk assessment *[see 130.4(A)]* a. Voltage to which personnel will be exposed b. Limited approach boundary *[see ~~130.4(E)~~ 130.4(F), ~~Table 130.4(D)(a)~~ Table 130.4(E)(a), and ~~Table 130.4(D)(b)~~ Table 130.4(E)(b)]* c. Restricted approach boundary *[see ~~130.4(F)~~ 130.4(G), ~~Table 130.4(D)(a)~~ Table 130.4(E)(a), and ~~Table 130.4(D)(b)~~ Table 130.4(E)(b)]* d. Personal and other protective equipment required by this standard to safely perform the assigned task and to protect against the shock hazard *[see ~~130.4(E)~~ 130.4(F), 130.7(C)(1) through (C)(16), and 130.7(D)]* (6) Results of the arc flash risk assessment *[see 130.5]* a. Available incident energy at the working distance or arc flash PPE category *(see 130.5)* b. Personal and other protective equipment required by this standard to protect against the arc flash	Editorially corrected the reference in 130.2(B)(7) from 130.3 to 130.7(E). Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	hazard *[see 130.5(F), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(c), and 130.7(D)]* c. Arc flash boundary *[see 130.5(E)]* (7) Means employed to restrict the access of unqualified persons from the work area *[see ~~130.3~~ 130.7(E)]* (8) Evidence of completion of a job briefing, including a discussion of any job-specific hazards *[see 110.5(I) ~~110.1(I)~~]* (9) Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)	
130.3	~~**130.3** Working While Exposed to Electrical Hazards.~~ ~~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. The specific safety-related work practices shall be consistent with the electrical hazards and the associated risk. Appropriate safety-related work practices shall be determined before any person is exposed to the electrical hazards involved by using both shock risk assessment and arc flash risk assessment. Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.~~	This requirement is editorial relocated to Section 130.1 Safety Impact: No negative impact.
130.4	Shock Risk Assessment. **(A)** General. A shock risk assessment shall be performed: (1) To identify shock 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 **(B)** Estimate of Likelihood and Severity. The estimate of likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health shall take into consideration all of the following: (1) The design of the electrical equipment (2) The electrical equipment operating condition and the condition of maintenance **(C)** Additional Protective Measures. If additional protective measures are required, they shall be selected and implemented	Insert “Estimate of Likelihood and Severity” information to provide clarity and usability by aligning with 130.5. Also editorially renumber the subsequent sections (existing C, D, E and F becomes D, E, F and G). Editorially correct the reference in 130.4(B) from 110.1(H) to 110.1(H)(3). Editorially correct the reference in Table 130.4(D)(a) Note (1) from 130.5(A) to 130.5(E). The requirements for alerting the unqualified worker of the impending hazard and warning them to stay out is adequately covered in 130.7(E) and the reference is replacing existing text. The alerting techniques do not require a person in charge, but simply an attendant, if necessary, to warn unqualified persons. Consistent application of the rules will minimize confusion. Safety Impact: No negative impact.

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	according to the hierarchy of risk control identified in 110.5(H) ~~110.1(H)~~ (3). When the additional protective measures include the use of PPE, the following shall be determined: (1) The voltage to which personnel will be exposed (2) The boundary requirements (3) The personal and other protective equipment required by this standard to protect against the shock Hazard **(D)** Documentation. The results of the shock risk assessment shall be documented. **(E)** Shock Protection Boundaries. The shock protection boundaries identified as limited approach boundary and restricted approach boundary shall be applicable where personnel are approaching exposed energized electrical conductors or circuit parts. ~~Table 130.4(D)(a)~~ Table 130.4(E)(a) shall be used for the distances associated with various ac system voltages. ~~Table 130.4(D)(b)~~ Table 130.4(E)(b) shall be used for the distances associated with various dc system voltages……. **(F)** Limited Approach Boundary. **(1)** Approach by Unqualified Persons. Unless permitted by ~~130.4(E)(3)~~ 130.4(F)(3), no unqualified person shall be permitted to approach nearer than the limited approach boundary of energized conductors and circuit parts. **(2)** Working at or Close to the Limited Approach Boundary. Where one or more unqualified persons are working at or close to the limited approach boundary, ~~the designated person in charge of the work space where the electrical hazard exists shall~~ alerting methods in 130.7(E) shall be applied to advise the unqualified person(s) of the electrical hazard and warn him or her to stay outside of the limited approach boundary. **(3)** Entering the Limited Approach Boundary. Where there is a need for an unqualified person(s) to cross the limited approach boundary, a qualified person shall advise the unqualified person(s) of the possible hazards and continuously escort the unqualified person(s) while inside the limited approach boundary. Under no circumstance shall	

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	unqualified person(s) be permitted to cross the restricted approach boundary. **(G)** Restricted Approach Boundary. No qualified person shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts than the restricted approach boundary set forth in ~~Table 130.4(D)(a)~~ Table 130.4(E)(a) and ~~Table 130.4(D)(b)~~ Table 130.4(E)(b), unless one of the following conditions applies: (1) The qualified person is insulated or guarded from energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves and sleeves are considered insulation only with regard to the energized parts upon which work is performed. (2) The energized electrical conductors or circuit parts are insulated from the qualified person and from any other conductive object at a different potential.	
130.5(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 110.5(H) ~~110.1(H)~~ (3) 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	Editorially change 110.1(H) to 110.5(H)(3) for clarity. Safety Impact: No negative impact.
Table 130.5(C)	Task / Equipment Condition / Likelihood of Occurrence ~~For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack~~. Any/No For ac systems, work on energized electrical conductors and circuit parts, including ~~voltage~~ electrical testing. Any/Yes Operation of a CB or switch the first time after installation or completion of maintenance in the equipment. Any/Yes For dc systems, working on energized electrical conductors and circuit parts of series-connected battery cells, including ~~voltage~~ electrical testing. Any/Yes	The table correctly indicates that an arc flash incident is not likely to occur under normal operating conditions when operating a circuit breaker or switch. However, there is a higher likelihood of occurrence for an arc flash event the first-time equipment is energized following the initial installation. This is also true immediately after completion of maintenance activities within equipment. The standard now provides guidance for these situations. The conditions of normal (normal equipment condition) are exactly the same as the requirement in 130.2(A)(4). The redundancy is deleted and a reference to 130.2(A)(4) is added. Arc-resistant MCCs are available on the market and are evaluated against IEEE Std C37.20.7 - revision 2017 - "IEEE Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults" providing protection to contain internal arcing. The arc resistant task is expanded to cover all arc resistant equipment provided the DOORS are CLOSED and SECURED, and where the available fault current and fault clearing time does not exceed that of the

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	~~Removal~~ Insertion or removal of covers for battery ~~conductive~~ intercell connector(s) ~~covers~~ Any/Yes Arc-resistant ~~switchgear Type 1 or 2 (for clearing times of less than 0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant type construction, 1 kV through 15 kV~~ equipment with the DOORS CLOSED and SECURED, and where the available fault current and fault clearing time does not exceed that of the arc-resistant rating of the equipment in one of the following conditions:. Insertion or removal of individual starter buckets. Insertion or removal (racking) of CBs from cubicles; Insertion or removal (racking) of ground and test device; or Insertion or removal (racking) of voltage transformers on or off the bus. [a] Equipment ~~condition~~ is considered to be in a "normal operating condition" if all of the conditions in 110.4(D) are satisfied. ~~following circumstances apply~~: ~~(0) The equipment is properly installed in accordance with the manufacturer's recommendations and applicable industry codes and standards.~~ ~~(0) The equipment is properly maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards.~~ ~~(0) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions.~~ ~~(0) Equipment doors are closed and secured.~~ ~~(0) Equipment covers are in place and secured.~~ ~~(0) There is no evidence of impending failure such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.~~ *[b] As defined in this standard, the two components of risk are the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that	arc-resistant rating of the equipment. This correlates with revisions in 130.7(C)(15)(a). The revision to address all arc resistant equipment necessitated the addition of a new task to address, "Insertion or removal of individual starter buckets." Voltage testing is changed to electrical testing. There are many individual cell/unit readings performed on batteries during normal maintenance. The same revision was made for ac testing. This revision provides necessary clarity. The table note is modified to clarify that the "likelihood of occurrence must be combined with the potential severity of an arcing incident to determine if" additional protective measures are required. The title of IEEE C37.20.7 is modified to update the standard title and scope. The task for intercell battery covers is revised to delete "conductive" as they do not exist. The task is modified for clarity to include insertion. The task for insertion and removal is deleted in the "Any/No" category as it is already listed in the "Normal/Abnormal" Category The "normal operating condition" note is relocated from the table to the notes below the table as it is not a task. This requires identification in the title of the Table with a superscript a for equipment condition and a superscript b for likelihood of occurrence. Safety Impact: No negative impact.

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	results from a hazard. Risk assessment is an overall process that involves estimating both the likelihood of occurrence and severity to determine if additional protective measures are required. The estimate of the likelihood of occurrence contained in this table does not cover every possible condition or situation, nor does it address severity of injury or damage to health. Where this table identifies "No" as an estimate of likelihood of occurrence, it means that an arc flash incident is not likely to occur. Where this table identifies "Yes" as an estimate of likelihood of occurrence, it means an arc flash incident should be considered likely to occur. The likelihood of occurrence must be combined with the potential severity of the arcing incident to determine if ~~that~~ additional protective measures are required to be selected and implemented according to the hierarchy of risk control identified in 110.5(H)(3) ~~110.1(H)(3).~~ Informational Note No. 1: An example of a standard that provides information for arc-resistant ~~switchgear~~ equipment referred to in Table 130.5(C) is IEEE C37.20.7, *Guide for Testing ~~Metal-Enclosed~~ Switchgear Rated Up to ~~38~~ 52 kV for Internal Arcing Faults*. Informational Note No. 2: Improper or inadequate maintenance can result in increased fault clearing time of the overcurrent protective device, thus increasing the incident energy. Where equipment is not properly installed or maintained, PPE selection based on incident energy analysis or the PPE category method might not provide adequate protection from arc flash hazards. Informational Note No. 3: Both larger and smaller available fault currents could result in higher incident energy. If the available fault current increases without a decrease in the fault clearing time of the overcurrent protective device, the incident energy will increase. If the available fault current decreases, resulting in a longer fault clearing time for the overcurrent protective device, incident energy could also increase. Informational Note No. 4: The occurrence of an arcing fault inside an enclosure produces a variety of physical phenomena very different from a bolted fault. For example, the arc energy resulting from an arc developed in the air will cause a sudden pressure increase	

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	and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of procedures that could expose an employee to high levels of incident energy. Proven designs such as arc-resistant switchgear, remote racking (insertion or removal), remote opening and closing of switching devices, high-resistance grounding of low-voltage and 5000-volt (nominal) systems, current limitation, and specification of covered bus or covered conductors within equipment are available to reduce the risk associated with an arc flash incident. See Informative Annex O for safety-related design requirements. Informational Note No. 5: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements. Informational Note No. 6: See IEEE 1584, *Guide for Performing Arc Flash Hazard Calculations*, for more information regarding incident energy and the arc flash boundary for three-phase systems.	
Table 130.5(G)	**Incident energy exposures equal to 1.2 cal/cm2 up to and including 12 cal/cm2** ~~Long~~ Arc-rated long -sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)b Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN) **Incident energy exposures greater than 12 cal/cm2** Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy ~~Long~~ Arc-rated long -sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) Arc-rated arc flash suit hood Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN) d Footwear other than leather or dielectric shall be permitted to be used provided it has been tested to demonstrate no ignition,	A new table foot note is added to include footwear that has been tested to demonstrate no ignition, melting or dripping at the estimated incident energy exposure to be used in lieu of leather or dielectric footwear. The term “arc-rated” is added for long-sleeve shirts and coveralls. The use of high visibility apparel could be a requirement for personnel exposed to arc flash hazards and is added to the list of outer garments. The addition of “and including” is editorial and clarifies that this range includes 12 calories. A new note (e) was added to outerwear to clarify that the rating of outerwear that is worn over arc rated PPE, not as part of a layered system, but as protection from the elements or for other safety purposes is not required to be equal to or greater than the estimated incident energy exposure. When outerwear is worn over arc-rated PPE that has an arc rating equal to or greater than the estimated incident energy exposure, the arc rating of the outerwear is primarily for the purposes of ensuring it has flame resistant properties if it is exposed to electrical arc discharge energy. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	melting, or dripping at the estimated incident energy exposure. [e] The arc rating of outer layers worn over arc-rated clothing as protection from the elements or for other safety purposes, and that are not used as part of a layered system, shall not be required to be equal to or greater than the estimated incident energy exposure.	
130.7(C)	Personal Protective Equipment (PPE). (1) General. When an employee is working within the restricted approach boundary, the worker shall wear PPE in accordance with 130.4. When an employee is working within the arc flash boundary, he or she shall wear protective clothing and other PPE in accordance with 130.5. All parts of the body inside the arc flash boundary shall be protected. Informational Note: ~~Although PPE is required for all parts of the body within the arc flash boundary, similar PPE can be used for parts of the body outside the arc flash boundary~~ Where the estimated incident energy exposure is greater than the arc rating of commercially available arc-rated PPE, then for the purpose of testing for the absence of voltage, the following examples of risk reduction methods could be used to reduce the likelihood of ~~injury due to sound~~ occurrence of an arcing event or the ~~expulsion of burning particles or other projectiles~~. severity of exposure: (1) Use noncontact proximity test instrument(s) or measurement of voltage on the secondary side of a low-voltage transformer (VT) mounted in the equipment before using a contact test instrument to test for the absence of voltage below 1000 volts. (2) If equipment design allows, observe visible gaps between the equipment conductors and circuit parts and the electrical source(s) of supply. (3) Increase the working distance. (4) Consider system design options to reduce the incident energy level.	The addition of the informational note to suggest the use of similar PPE when outside the arc flash boundary is unnecessary and has the potential of blurring the shock and arc flash boundaries. One can always be more conservative than the Standard. A new informational note has been added to provide guidance for specific high incident energy instances where commercially available PPE is not available to comply with the requirements of Section 130.5. By applying one or more of the suggested risk reduction methods, the likelihood of an arcing event occurring, and the severity of injury may be reduced when incident energy at the working distance exceeds the available arc rated of commercially available PPE. Safety Impact: No negative impact.
130.7(C)	**(9)** Factors in Selection of Protective Clothing. (b) *Outer Layers.* Garments worn as outer layers over arc-rated clothing, such as jackets, high visibility ~~safety~~ apparel, or	The phrase “high-visibility safety apparel” is revised to “high-visibility apparel” as the word “safety” is not necessary.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	rainwear, shall also be made from arc-rated material. The arc rating of outer layers worn over arc-rated clothing as protection from the elements or for other safety purposes, and that are not used as part of a layered system, shall not be required to be equal to or greater than the estimated incident energy exposure.	A new sentence was added to clarify that the rating of outerwear that is worn over arc-rated PPE, not as part of a layered system, but as protection from the elements or for other safety purposes is not required to be equal to or greater than the estimated incident energy exposure. When outerwear is worn over arc-rated PPE that has an arc rating equal to or greater than the estimated incident energy exposure, the arc rating of the outerwear is primarily for the purposes of ensuring it has flame resistant properties if it is exposed to electrical arc discharge energy. Safety Impact: No negative impact.
Table 130.7(C)	**(14)** Standards for PPE. Live working — Protective clothing against the thermal hazards of an electric arc — Part 1-1: Test methods — Method 1: Determination of the arc rating (ELIM, ATPV, and/or EBT) of clothing materials and of protective clothing using an open arc IEC 61482-1-1 Live working — Protective clothing against the thermal hazards of an electric arc — Part 2: Requirements IEC 61482–2	References to IEC 61482-1-1 and IEC 61482-2 are added. The test methods are similar to their corresponding ASTM standards. Safety Impact: No negative impact.
Table 130.7(C)(15)(a)	600-volt class motor control centers (MCCs)	The phrase “motor control centers” is editorially added to the second reference to “MCCs” in Table 130.7(C)(15)(a) to be consistent with the first reference. Safety Impact: No negative impact.
130.7(C)(3)	Head, Face, Neck, and Chin (Head Area) Protection. Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion. Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion. If employees use hairnets or beard nets, or both, these items ~~must~~ shall be arc rated. Informational Note: See 130.7(C)(10)(b) and (~~c~~) (C)(10(c) for arc flash protective requirements.	This revision corrects editorial errors with respect to mandatory text. Safety Impact: No negative impact.
130.7(C)(7)	Hand and Arm Protection. Hand and arm protection shall be provided in accordance with 130.7(C)(7)(a), ~~(b)~~ (C)(7)(b), and ~~(c)~~ (C) (7)(c).	A new Table 130.7(C)(7)(a) provides maximum use voltages for rubber insulating gloves. This new table is necessary to provide ready access to users of this standard and for proper application of 130.7(C)(7)(a).

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(c) *Maintenance and Use.* Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection. Maximum use voltages for rubber insulating gloves shall not exceed that specified in 130.7(C)(7)(a). The top of the cuff of the protector glove shall be shorter than the rolled top of the cuff of the insulating glove by at least the distance specified in 130.7(C)(7)(a). (d) ~~Electrical protective~~ *Periodic Electrical Tests*. Rubber insulating equipment shall be subjected to periodic electrical tests. Test voltages shall be in accordance with applicable state, federal, or local codes and standards. The maximum intervals between tests shall not exceed that specified in Table 130.7(C)(7)(b). Table 130.7(C)(7)(a) Maximum Use Voltage for Rubber Insulating Gloves **Class Designation of Glove or Sleeve (w)** **Maximum ac Use Voltage rms, volts (x)** **Maximum dc Use Voltage avg, volts (y)** **Distances Between Gauntlet and Cuff, minimum (z)** **w x y z** 00 500 750 13 mm (0.5 in.) 0 1,000 1,500 13 mm (0.5 in.) 1 7,500 11,250 25 mm (1 in.) 2 17,000 25,500 51 mm (2 in.) 3 26,500 39,750 76 mm (3 in.) 4 36,000 54,000 102 mm (4 in.)	Editorially, existing Table 130.7(C)(7) is retitled as 130.7(C)(7)(b). Editorial revisions were made in this section as necessary. Safety Impact: No negative impact.
130.7(C)(10)	Arc Flash Protective Equipment. (e) *Foot Protection.* ~~Heavy-duty leather~~ 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/cm2 (16.75 J/cm2). Footwear other than leather or dielectric shall be permitted to be used provided it has been tested to demonstrate no ignition, melting, or dripping at the estimated incident energy exposure or the minimum arc rating for the respective arc flash PPE category.	The phrase "heavy duty leather" is revised to "leather" as there is no specification as what is meant by "heavy duty." A last sentence is added to include footwear that has been tested to demonstrate no ignition, melting or dripping at the estimated incident energy exposure or the minimum arc rating for the respective for the arc-flash PPE category to be used in lieu of leather footwear or dielectric footwear. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
130.7(C)(13)	Care and Maintenance of Arc-Rated Clothing and Arc-Rated Arc Flash Suits. (d) *Cleaning, Repairing, and Affixing Items.* When arc-rated clothing is cleaned, manufacturer's instructions shall be followed ~~to avoid loss of protection~~. When arc-rated clothing is repaired, the same arc-rated materials used to manufacture the arc-rated clothing shall be used to provide repairs. Informational Note No. 1: The purpose of following manufacturer's instructions is to avoid the loss of protection and to remove contaminants such as hydrocarbons and metallic and disease-causing contaminants that could compromise safety. Informational Note No. 2: Additional guidance is provided in ASTM F1506, *Standard Performance Specification for Flame Resistant and Electric Arc Rated ~~Textile Materials for Wearing Apparel for Use by Electrical~~ Protective Clothing Worn by Workers Exposed to ~~Momentary Electric Arc and Related Thermal Hazards~~ Flames and Electric Arcs* , when trim, name tags, logos, or any combination thereof are affixed to arc-rated clothing. Informational Note No. 3: Additional guidance is provided in ASTM F1449, *Standard Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing*, and ASTM F2757, *Standard Guide for Home Laundering Care and Maintenance of Flame, Thermal, and Arc Resistant Clothing*.	The new informational note provides useful information regarding the purpose of following manufacturer's cleaning instructions. The first sentence of the requirement was revised to remove "avoid loss of protection" as it is addressed in the new informational note. Safety Impact: No negative impact.
130.7(C)(14)	Standards for ~~Personal Protective Equipment (PPE)~~ PPE (3) Certification by an accredited independent third-party certification organization Informational Note No. 1: Examples of a process for conformity assessment to an appropriate product standard can be found in ANSI/ISEA 125, *American National Standard for Conformity Assessment of Safety and Personal Protective Equipment*. See ~~Informative Annex~~ H.4 Informational Note No. 2: An example of a process to accredit independent third-party certification organizations is ISO 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*.	An informational note is added to 130.7(C)(14)(b)(3) to provide users of the document with information regarding the certification process for suppliers and manufacturers. Safety Impact: No negative impact.

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	(c) *Marking.* All suppliers or manufacturers of PPE shall provide the following information on the ~~personal protective equipment~~ PPE, on the smallest unit container, or contained within the manufacturer's instructions: (1) Name of manufacturer (2) Product performance standards to which the product conforms (3) Arc rating where appropriate for the equipment (4) One or more identifiers such as model, serial number, lot number, or traceability code (5) Care instructions	
Table 130.7(C)(14)	~~Apparel~~ Clothing — Arc Rated Standard Performance Specification for Flame Resistant and Electric Arc Rated ~~Textile Materials for Wearing Apparel for Use by Electrical~~ Protective Clothing Worn by Workers Exposed to ~~Momentary~~ Flames and Electric Arc ~~and Related Thermal Hazards ASTM~~ F1506 ~~Eye and Face Protection — General~~ American National Standard for Occupational and Educational Professional Eye and Face Protection ~~Devices ANSI~~/ISEA Z87.1 ~~Industrial~~ American National Standard for Head Protection ANSI/ISEA Z89.1	The title of the ASTM 1506, ANSI/ISEA Z87.1 and ANSI/ISEA Z89.1 document is updated in Table 130.7(C)(14) Safety Impact: No negative impact.
130.7(C)(15)	Arc Flash PPE Category Method. (c) *Protective Clothing and Personal Protective Equipment (PPE).* Once the arc flash PPE category has been identified from Table 130.7(C)(15)(a) or Table 130.7(C)(15)(b), Table 130.7(C)(15)(c) shall be used to determine the required PPE ~~for the task~~. Table 130.7(C)(15)(c) lists the requirements for PPE based on arc flash PPE categories 1 through 4. This clothing and equipment shall be used when working within the arc flash boundary. The use of PPE other than or in addition to that listed shall be permitted provided it meets 130.7(C)(7).	The phrase "for the task" was removed from 130.7(C)(15)(c) as the Arc Flash PPE Category Method is no longer a task-based method. A statement permitting the use of other or additional PPE was added 130.7(C)(15)(c) provided such PPE meets the requirements of 130.7(C). Safety Impact: No negative impact.
Table 130.7(C)(15)(a)	600-volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455 mm (18 in.) ~~Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available fault current~~	The following sections are added to Table 130.7(C)(15)(a) to update the applicability of Arc Flash PPE Category Method with changing technology: The existing "arc resistant switchgear" reference is revised to create two general "arc resistant equipment" categories. The phrase "DOORS CLOSED and SECURED" is added to the parameters of each of the arc resistant sections to clarify that each of these sections applies only when the equipment doors are closed. A note

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	~~not to exceed the arc-resistant rating of the equipment], and~~ ~~metal-enclosed interrupter switchgear, fused or unfused of arc resistant-type construction, 1 kV through 15 kV~~ ~~Parameters: Maximum of 35 kA available fault current;~~ ~~maximum of up to 0.24 sec (15 cycles) fault clearing time;~~ ~~minimum working distance 910 mm (36 in.)~~ ~~N/A (doors closed) N/A (doors closed)~~ Metal enclosed interrupter switchgear, fused or unfused type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.) 4 12m (40ft) Arc-resistant equipment up to 600-volt class Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment* N/A N/A Arc-resistant equipment 1 kV through 15 kV Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment* N/A Note: For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current limiting molded case circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1. *For DOORS OPEN refer to the corresponding non-arc-resistant equipment section of this table. Informational Note No. 1 to Table 130.7(C)(15)(a): The following are typical fault clearing times of overcurrent protective devices: (1) 0.5 cycle fault clearing time is typical for current-limiting fuses and current-limiting molded case circuit breakers when the fault current is within the current limiting range.	is added below the table to clarify how to apply a “door open” situation for these sections. A new Table Note is added to clarify that N/A means “Not Applicable” “Current limiting molded case circuit breaker” equipment type is added to Informational Table Note list item (1) to clarify that the identified typical fault clearing time is also applicable to that equipment. The words "molded case" were added to the table note for clarity. Existing Informational Note No. 1 is relocated to be part of the Informational Note to the Table, and the reference to the list in the note is editorially corrected from “Notes b through d” to “Items (2) through (4).” Existing Informational Note No. 2 is modified to address the title of IEEE C37.20.7. The informational notes are renumbered as Informational Note No. 1, 2 and 3 for clarity. A new Informational Note No. 4 is added to reference Informative Annex O, O.2.4(9) to provide clarity for the user with respect to arc resistant equipment. Safety Impact: No negative impact.

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	(2) 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with an instantaneous integral trip. (3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an instantaneous integral trip or relay operated trip. (4) 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates in the instantaneous range (i.e., "no intentional delay"). (5) 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush. (6) 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip. Informational Note No. 2 to Table 130.7(C)(15)(a): See Table 1 of IEEE 1584TM, *Guide for Performing Arc Flash Hazard Calculations*, for further information regarding ~~Notes b~~ list items (2) through ~~d~~ (4) in Informational Note No. 1. Informational Note No. 3 to Table 130.7(C)(15)(a): An example of a standard that provides information for arc-resistant ~~switchgear~~ equipment referred to in Table 130.7(C)(15)(a) is IEEE C37.20.7, *Guide for Testing ~~Metal-Enclosed~~ Switchgear Rated Up to 52 kV for Internal Arcing Faults*. Informational Note No. 4 to Table 130.7(C)(15)(a): See O.2.4(9) for information on arc-resistant equipment.	
Table 130.7(C)(15)(b)	Informational Note No. 1: When determining available fault current, the effects of cables and any other impedances in the circuit should be included. Power system modeling is the best method to determine the available short-circuit current at the point of the arc. Battery cell short-circuit current can be obtained from the battery manufacturer. See ~~Informative Annex~~ D.5 for the basis for table values and alternative methods to determine dc incident energy. Methods should be used with good engineering judgment. Informational Note No. 2: The methods for estimating the dc arc flash incident energy	Table 130.7(C)(15)(b) - The change to Informational Note No. 2 aligns with the action taken in 2018 version in Annex D.5.1. The informational note continues to suggest the consideration for additional PPE where tasks are performed within an enclosure. Safety Impact: No negative impact.

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	that were used to determine the categories for this table are based on open-air incident energy calculations. Open-air calculations were used because many battery systems and other dc process systems are in open areas or rooms. If the specific task is within an enclosure, it would be prudent to consider additional PPE protection beyond the value shown in this table. ~~Research with ac arc flash has shown a multiplier of as much as 3× for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is necessary when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.~~	
Table 130.7(C)(15)(c)	**Table 130.7(C)(15)(c) Personal Protective Equipment (PPE)** Arc Flash PPE Category PPE 1 **Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm2 (16.75 J/cm2)** Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield or arc flash suit hood Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN) **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) 2 **Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm2 (33.5 J/cm2)** 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) **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 3 **Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required**	Editorially revised the Arc Flash PPE Category 4 arc-rated glove note reference from “c” to “d.” A new table foot note includes footwear that has been tested to demonstrate no ignition, melting or dripping at the minimum arc rating in each PPE category to be used in lieu of leather or dielectric footwear. A new note (f) to Table 130.7(C)(15)(c) was added to outerwear to clarify that the rating of outerwear that is worn over arc-rated PPE, not as part of a layered system, but as protection from the elements or for other safety purposes is not required to be equal to or greater than the estimated incident energy exposure. When outerwear is worn over arc-rated PPE that has an arc rating equal to or greater than the estimated incident energy exposure, the arc rating of the outerwear is primarily for the purposes of ensuring it has flame resistant properties if it is exposed to electrical arc discharge energy. High-visibility apparel added to list of other arc-rated apparel in all Arc Flash PPE Categories. Table 130.7(C)(15)(c) glove requirements and Table Note (d) are revised to correlate with Table 130.5(G). Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text. Impact to Worker Safety	Change Description
	Minimum Arc Rating of 25 cal/cm2 (104.7 J/cm2) 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) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) c Leather footwear e 4 **Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm2 (167.5 J/cm2)** 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) cd Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN) **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. a *Arc rating* is defined in Article 100. b Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn. 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. d ~~If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not~~	

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	~~required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.~~ Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide increased arc flash protection. e Footwear other than leather or dielectric shall be permitted to be used provided it has been tested to demonstrate no ignition, melting or dripping at the minimum arc rating for the respective Arc Flash PPE Category. [f]The arc rating of outer layers worn over arc-rated clothing as protection from the elements or for other safety purposes, and that are not used as part of a layered system, shall not be required to be equal to or greater than the estimated incident energy exposure.	
130.7(D)	(1) Insulated Tools and Equipment ~~Employees shall use insulated tools or handling equipment, or both, when working inside~~ Tools and handling equipment used within the restricted approach boundary ~~of exposed energized electrical conductors or circuit parts where tools or handling equipment might make unintentional contact~~ shall be insulated. Insulated tools shall be protected from damage to the insulating material. Informational Note: See ~~130.4(D)~~ 130.4(E), Shock Protection Boundaries. (f) ~~*Protective Shields.* Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries~~ (2) *Barriers*. Exposed energized electrical conductors or circuit parts operating at 50 volts or more shall be guarded by a barrier in accordance with 130.7(D)(2) (a) through 130.7(D)(2) (c) to prevent unintentional contact while an employee is working within the ~~limited~~ restricted approach boundary of ~~energized~~ those conductors or circuit parts ~~that might be unintentionally contacted or where dangerous electric heating or arcing might occur. When normally enclosed energized conductors or circuit parts are exposed for maintenance or repair, they shall~~	The language in 130.7(D)(1) regarding the requirement to use insulated tools and equipment is simplified. 130.7(D)(1)(f) is retitled “Barriers” and the language regarding the use of barriers is simplified and the applicable boundary is changed from the limited approach boundary to the restricted approach boundary to clarify the difference between the use of barriers per 130.7(D) and barricades per 130.7(E). 130.7(D)(1)(g) and 130.7(D)(1)(h) are revised to require the rubber insulating equipment and the plastic guard equipment to be rated for the voltage. The approach boundary in 130.7(D)(1)(i) is changed from limited to restricted to clarify the difference between the use of barriers per 130.7(D) and barricades per 130.7(E). Safety Impact: No negative impact.

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	~~be guarded to protect unqualified persons from contact with the energized conductors or circuit parts.~~ Barriers shall be supported to remain in place and shall prevent contact by a person, tool, or equipment. (a) *Rubber Insulating Equipment.* Rubber insulating equipment used for protection from unintentional contact with energized conductors or circuit parts shall be rated for the voltage and shall meet the requirements of applicable state, federal, or local codes and standards. Informational Note: The standards listed in Table 130.7(G); Informational Note are examples of standards that contain information on rubber insulating equipment. (b) *Voltage-Rated Plastic Guard Equipment.* Plastic guard equipment for protection of employees from unintentional contact with energized conductors or circuit parts, or for protection of employees or energized equipment or material from contact with ground, shall be rated for the voltage and shall meet the requirements of applicable state, federal, or local codes and standards. (c) *Physical or Mechanical Barriers.* Physical or mechanical (field-fabricated) barriers shall be installed no closer than the ~~limited~~ restricted approach boundary distance given in Table ~~130.4(D)(a)~~ Table 130.4(E)(a) and ~~Table 130.4(D)(b)~~ Table 130.4(E)(b). While the barrier is being installed, the ~~limited~~ restricted approach boundary distance specified in ~~Table 130.4(D)(a)~~ Table 130.4(E)(a) and ~~Table 130.4(D)(b)~~ Table 130.4(E)(b) shall be maintained, or the energized conductors or circuit parts shall be placed in an electrically safe work condition.	
Table 130.7(G)	Arc Protective Blankets — Selection, Care, and Use - Standard Guide for Selection, Care, and Use Standard Guide for Selection, Care, and Use of Arc Protective Blankets ASTM F3272	Added ASTM F3272 Standard Guide for Selection, Care, and Use of Arc Protective Blankets. Safety Impact: No negative impact.
130.8(A)	**(A)** Alertness. **(1)** ~~When~~ Where Electrical Hazards Might Exist. Employees shall be instructed to be alert at all times ~~when they are working within the limited approach boundary of energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 volts and in work situations when~~ where electrical hazards might exist.	Simplifies the requirement by using only “electrical hazard” which is a defined term. Editorially corrected the term "when" to "where". Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	(2) When Impaired. Employees shall not be permitted to work ~~within the limited approach boundary of energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 volts, or~~ where ~~other~~ electrical hazards exist while their alertness is recognizably impaired due to illness, fatigue, or other reasons. **(3)** Changes in Scope. Employees shall be instructed to be alert for changes in the job or task that could lead the person outside of the electrically safe work condition or expose the person to additional hazards that were not part of the original plan.	
130.8(C)(2)	**(2)** Obstructed View of Work Area. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees shall not perform any task ~~within the limited approach boundary of energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 volts or~~ where an electrical hazard exists.	Simplifies the requirement by using only “electrical hazard” which is a defined term. Safety Impact: No negative impact.
130.8(E)(2)	**(2)** Approach to Energized Electrical Conductors and Circuit Parts. Means shall be employed to ensure that conductive materials approach exposed energized electrical conductors or circuit parts no closer than that permitted by ~~130.2~~ 130.4(F).	Revised editorially to provide the correct applicable reference. Safety Impact: No negative impact.
130.8(F)	**(F)** Confined or Enclosed Work Spaces. When an employee works in a confined or enclosed space (such as a manhole or vault~~)~~ ~~that contains exposed energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 volts or~~ where an electrical hazard exists, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to ~~avoid inadvertent contact with these parts and the effects of the~~ protect against electrical hazards.	Simplifies the requirement by using only “electrical hazard” which is a defined term. This change correlates with actions taken to remove the phrase “that contains exposed energized electrical conductors or circuit parts” in multiple locations of the Standard. Safety Impact: No negative impact.
130.8(G)	**(G)** Doors and Hinged Panels. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized electrical conductors or circuit parts ~~operating at voltages equal to or greater than 50 volts or~~ where an electrical hazard exists if movement	Simplifies the requirement by using only “electrical hazard” which is a defined term. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	of the door, hinged panel, and the like is likely to create a hazard.	
130.8(N)	Safety Interlocks. Only qualified persons following the requirements for working inside the restricted approach boundary as covered by ~~130.4(F)~~ 130.4(G) shall be permitted to defeat or bypass an electrical safety interlock over which the person has sole control, and then only temporarily while the qualified person is working on the equipment. The safety interlock system shall be returned to its operable condition when the work is completed.	This section was revised to correctly identify 130.4(G) which correctly references the Restricted Approach Boundary rather than 130.4(F) that incorrectly references the Limited Approach Boundary Safety Impact: No negative impact.
130.9(F)(3)	Equipment Grounding. If any vehicle or mechanical equipment is capable of having parts of its structure elevated ~~near~~ within the limited approach boundary of exposed movable conductors of energized overhead lines and is intentionally grounded, employees working on the ground near the point of grounding shall not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades, dielectric overshoe footwear, or insulation, shall be taken to protect employees from hazardous ground potentials (step and touch potential).	Provides additional clarity related to any vehicle or mechanical equipment capable of having parts of its structure elevated in the vicinity of energized overhead lines that are intentionally grounded. Safety Impact: No negative impact.
130.12	~~**130.7(E)(4)**~~ **130.12** Cutting, Removing, or Rerouting of Conductors. Where conductors are de-energized in order to cut, remove, or reroute them and the conductor terminations are not within sight from the point of work , such as where ~~they are~~ the conductors are remote from the source of supply in a junction or pull box, additional steps to verify absence of voltage or identify the conductors shall be taken prior to cutting, removing, or rerouting the conductors. Informational Note: Additional steps to be taken where conductors are de-energized in order to cut, remove, or reroute them include, but are not limited to, remotely spiking the conductors, pulling ~~the~~ conductors to visually verify movement, remotely cutting the conductors, or other approved methods. Non-shielded conductors could be additionally verified with a noncontact test instrument, and shielded conductors could be verified with devices ~~to~~ that identify the conductors.	Section 130.7(E)(4) is relocated to a NEW 130.12 as the requirements are not related to alerting techniques. Other examples of additional steps to identify conductors were added to the informational note. This revision clarifies that this rule applies where terminations for de-energized conductors to be cut, removed, or rerouted are not within sight from “the point of work”. Safety Impact: No negative impact.
Chapter 2 Safety Related Maintenance Requirements		
Article 205 – General Maintenance Requirements		

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
Article 240 – Batteries and Battery Rooms		
Article 250 – Personal Safety and Protective Equipment		
250.3	Safety Grounding Equipment. **(A)** ~~Visual~~ Inspection. Personal protective ground cable sets shall be inspected for cuts in the protective sheath and damage to the conductors. Clamps and connector strain relief devices shall be checked for tightness. These inspections shall be made at intervals thereafter as service conditions require, but in no case shall the interval exceed 1 year. **(B)** Testing. Prior to being returned to service, temporary protective grounding equipment that has been repaired or modified shall be tested. Temporary protective grounding equipment shall be tested as service conditions require. Informational Note: Guidance for inspecting and testing safety grounds is provided in ASTM F2249, *Standard Specification for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-~~Energized~~ energized Electric Power Lines and Equipment*.	250.3 (A) "Visual" changed to "Inspection" for clarity. The term aligns with language in ASTM F2249, and more closely describes the inspections contained within 250.3 (A), which contains both visual and mechanical inspections. Added statement that temporary protective grounds can experience varying levels of service conditions, and when the service level is extreme, a qualified individual, through visual inspection or other methods, identify the need for testing prior to use The term "medium voltage equipment" was removed so that all classes of equipment (low-, medium-, and high-voltage) are included. Safety Impact: No negative impact.
Chapter 3 Safety Requirements for Special Equipment		
300.3	**300.3** Organization. Chapter 3 of this standard is divided into articles. Article 300 applies generally. Article 310 applies to electrolytic cells. Article 320 applies to batteries and battery rooms. Article 330 applies to lasers. Article 340 applies to power electronic equipment. Article 350 applies to research and development (R&D) laboratories. Article 360 applies to safety-related requirements for capacitors.	Article 300.3 Organization lists all sections included in Chapter 3. Article 360 Capacitors needs to be added to make the list complete and accurate. Safety Impact: No negative impact
Article 310 – Safety Related Work Practices for Electrolytic Cells		
310.1	**310.1** Scope. The requirements of this article shall apply to the electrical safety-related work practices used in the types of electrolytic cell areas. Informational Note No. 1: See Informative Annex L for a typical application of safeguards in the cell line working zone. Informational Note No. 2: For further information about electrolytic cells, see *NFPA 70*, *National Electrical Code*, Article 668.	Added a note to reference IEEE Std 463 as a resource document related to electrolytic cell line safety. Safety Impact: No negative impact

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	Informational Note No. 3: For further information about electrical safety-related work practices in electrolytic cell lines, see IEEE 463, *Electrical Safety Practices in Electrolytic Cell Line Working Zones*	
310.5(C)	The requirements of 130.5, Arc Flash Risk Assessment, shall not ~~apply to~~ be required for electrolytic cell line ~~work~~ working zones.	This revision editorially modifies arc flash risk assessment requirements for clarity. Safety Impact: No negative impact.
Article 320 – Safety Requirements Related to Batteries and Battery Rooms		
320.3(A)(2)	**(2)** Battery Risk Assessment. Prior to any work on a battery system, a risk assessment shall be performed to identify the chemical, electrical shock, and arc flash hazards and assess the risks associated with the type of tasks to be performed. Informational Note: For an example of a risk assessment method for work on batteries, see F.7 and Figure F.7 in Informative Annex F	The standard does not provide guidance to users on how to select PPE when a risk assessment is performed on tasks involving multiple hazards. This addition to Annex F provides one method for determining appropriate PPE. Safety Impact: No negative impact.
320.3(B)(2)	**(2)** Activities That Do Not Include Handling of Electrolyte. Employees performing any activity not involving the handling of electrolyte shall wear safety glasses. Informational Note: Battery maintenance activities usually do not involve handling electrolyte. Batteries ~~with solid electrolyte~~ that are hermetically sealed (such as most lithium batteries) or immobilized electrolyte (such as valve-regulated lead acid batteries) present little or no electrolyte hazard. Most modern density meters expose a worker to a quantity of electrolyte too minute to be considered hazardous, if at all. Such work would not be considered handling electrolyte. However, if specific gravity readings are taken using a bulb hydrometer, the risk of exposure is higher — this could be considered to be handling electrolyte, and the requirements of 320.3(B)(1) would apply.	Most lithium batteries have a liquid electrolyte, but the cells are hermetically sealed and there is no exposure hazard. The change is to correct an inaccurate statement. Safety Impact: No negative impact.
320.3(C)	**(C)** ~~Testing, Maintenance, and Operation~~. Tools and Equipment **(1)** Handles. Tools and equipment for work on batteries shall be equipped with handles listed as insulated for the maximum working voltage. **(2)** Contact. Battery terminals and all electrical conductors shall be kept clear of unintended contact with	The existing information is addressing design and installation considerations. NFPA 70E is a work practice standard. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	tools, test equipment, liquid containers, and other foreign objects. **(3)** Non-sparking Tools. Non-sparking tools shall be required when the risk assessment required by 110.5(H) ~~110.1(H)~~ justifies their use. ~~**(1)** Direct-Current Ground-Fault Detection. Ground-fault detection shall be based on the type of dc grounding systems utilized.~~ ~~Informational Note: Not all battery systems have dc ground-fault detection systems. For personnel safety reasons, it is important to understand the grounding methodology being used and to determine the appropriate manner of detecting ground faults. If an unintended ground develops within the system (e.g., dirt and acid touching the battery rack), it can create a short circuit that could cause a fire. Commonly used dc grounding systems include, but are not limited to, the following:~~ ~~(0) Type 1. An ungrounded dc system, in which neither pole of the battery is connected to ground. If an unintentional ground occurs at any place in the battery, an increased potential would exist, allowing fault current to flow between the opposite end of the battery and the ground. An ungrounded dc system is typically equipped with an alarm to indicate the presence of a ground fault.~~ ~~(0) Type 2. A solidly grounded dc system, in which either the most positive or most negative pole of the battery is connected directly to ground. If an unintentional ground occurs, it introduces a path through which fault current can flow. A ground detection system is not typically used on this type of grounded system.~~ ~~(0) Type 3. A resistance grounded dc system, which is a variation of a Type 1 system, in which the battery is connected to ground through a resistance. Detection of a change in the resistance typically enables activation of a ground-fault alarm. Introducing an unintentional ground at one point of the battery could be detected and alarmed. A second unintentional ground at a different point in the battery would create a path for short-circuit current to flow.~~	

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	~~(0) Type 4. A solidly grounded dc system, either at the center point or at another point to suit the load system. If an unintentional ground occurs on either polarity, it introduces a path through which short circuit current can flow. A ground detection system is not typically used on this type of grounded system.~~	
Article 330 – Safety Related Work Practices: Lasers		
Article 340 – Safety Related Work Practices: Power Electronic Equipment		
Article 350 – Safety Related Work Requirements: Research and Development Laboratories		
350.2	**Field Evaluated.** A thorough evaluation of nonlisted or modified equipment in the field that is performed by persons or parties acceptable to the authority having jurisdiction. The evaluation approval ensures that the equipment meets appropriate codes and standards or is similarly found suitable for a specified purpose. Informational Note: For additional information on recommended practices and procedures for the field evaluation of nonlisted equipment, see NFPA 791, *Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation*. For help in evaluating whether third-party entities are acceptable to an authority having jurisdiction, see NFPA 790, *Standard for Competency of Third-Party, Field Evaluation Bodies*.	An informational note is added to reference NFPA 790 and 791 for information on field evaluations. Safety Impact: No negative impact.
350.9	**350.9** Energy Thresholds. Energy exposure levels shall not exceed those identified in the following list unless appropriate controls are implemented as approved by the ESA: (1) AC: 50-~~Volts~~ volts and 5 milliamperes (2) DC: 100-~~Volts~~ volts and 40 milliamperes (3) ~~Capacitive systems:~~ ~~a. 100-volts and 1 joule of stored energy~~ ~~b. 400-volts and 25 joules of stored energy~~ ~~c. Less than 100 volts and 100 joules of stored energy~~ Informational Note No. 1: This information is extracted from the Department of Energy, (*DOE*) *Electrical Safety Handbook*, DOE-HDBK-1092	The deleted information is in the new Article 360. Removing it from Article 350 prevents duplication and potential confusion. An informational note is added to point the user to the information in 360.3. Safety Impact: No negative impact.

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	Informational Note No. 2: See 360.3 and Informative Annex R for information on capacitor hazards and controls.	
Article 360 Safety-Related Requirements for Capacitors		
360	**360.1 Scope.** This article covers the electrical safety-related requirements for the practical safeguarding of employees while working with capacitors that present an electrical hazard. Informational Note: For more information on working safely with capacitors, see Informative Annex R, Working with Capacitors. **360.2 Definitions.** **Arc Blast Hazard.** A source of possible injury or damage to health from the energy deposited into acoustical shock-wave and high-velocity shrapnel. **Bleed Resistor.** A resistor network connected in parallel with a capacitor's terminals that drains the charge after power has been disconnected. **Charge Transfer.** Improper discharging of capacitor networks that results in transferring from one capacitor to another charge instead of fully discharging the stored energy. **Dielectric Absorption.** The property of certain capacitors to recharge after being discharged. A voltage recharge of up to 10 percent may occur a few minutes after the grounding or shorting device has been removed. Informational Note: A voltage recharge of up to 10 percent can occur a few minutes after the grounding or shorting device has been removed. **Discharge Time.** The time required to discharge a capacitor below a stored energy hazard threshold. **Ground Stick.** A device that is used to ensure that the capacitor is discharged by applying it to all terminals of the capacitor element.	New Article 360 provides safe work practices for working with hazardous capacitors. Safety Impact: No negative impact.

2021 NFPA 70E® Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Change Description Impact to Worker Safety
	Informational Note: This is also called a ground hook and could incorporate power-rated discharge resistors for high-energy applications. **Hard Grounding (Low Z).** The practice of discharging a capacitor through a low impedance, also called Low Z (impedance) grounding. **Hearing Protection Boundary.** Worker distance at which a 1 percent probability of ear damage exists from a 20kPa (3.0 psi) shock wave. **Lung Protection Boundary.** Worker distance at which a 1 percent probability of lung damage exists from a 70 kPa (10-psi) shock wave. **Soft Grounding (Hi-Z).** The practice of connecting a capacitor to ground through a power resistor to avoid the hazards related with hard grounding. **Time Constant.** The time it takes for voltage to drop by ~63 percent (1/e) during discharge. **360.3 Stored Energy Hazard Thresholds.** Appropriate controls shall be applied where any of the following hazard thresholds are exceeded: (1) Less than 100 volts and greater than 100 joules of stored energy (2) Greater than or equal to 100 volts and greater than 1.0 joule of stored energy (3) Greater than or equal to 400 volts and greater than 0.25 joules of stored energy **360.4 Specific Measures for Personnel Safety.** **(A) Qualification and Training.** The following qualifications and training shall be required for personnel safety: (1) Employees who perform work on electrical equipment with capacitors that exceed the energy thresholds in 360.3 shall be qualified and shall be trained in, and familiar with, the specific hazards and controls required for safe work.	

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	(2) Unqualified persons who perform work on electrical equipment with capacitors shall be trained in, and familiar with, any electrical safety-related work practices necessary for their safety. **(B) Performing a Risk Assessment for Capacitors.** The risk assessment process for capacitors shall follow the overall risk assessment procedures in Chapter 1. If additional protective measures are required, they shall be selected and implemented according to the hierarchy of risk control identified in 110.5(H). When the additional protective measures include the use of PPE, the following shall be determined: (1) Capacitor voltage and stored energy for the worker exposure. An exposure shall be considered to exist when a conductor or circuit part that could potentially remain energized with hazardous stored energy is exposed. (2) Thermal hazard. The appropriate thermal PPE shall be selected and used if the stored energy of the exposed part is greater 100 joules. (3) Shock hazard. The appropriate shock PPE in accordance with 130.7 shall be selected and used if the voltage is greater than or equal to 100 volts. (4) Arc flash and arc blast hazard at the appropriate working distance. The appropriate protection for the arc flash and arc blast hazard shall be selected, as follows: (a) Arc flash PPE in accordance with 130.7 shall be selected and used if the incident energy exceeds 1.2 cal/cm 2 (5 J/cm 2) at the working distance. (b) Hearing protection shall be required where the stored energy exceeds 100 joules. (c) The lung protection boundary shall be determined if stored energy is above 122 kJ. Employees shall not enter the lung protection boundary. (d) Alerting techniques in accordance with 130.7(E) shall be used to warn employees of the hazards.	

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	(5) Required test and grounding method. Soft grounding shall be used for stored energy greater than 1000 joules. If capacitors are equipped with bleed resistors, or if using a soft grounding system, the required discharge wait time shall be determined, where applicable. (6) Develop a written procedure that captures all of the required steps to place the equipment in an electrically safe work condition. Include information about the amount of stored energy available, how long to wait after de-energization before opening the enclosure, how to test for absence of voltage, and what to do if there is still stored energy present. Informational Note No. 1: For more information on calculating capacitor stored energy, arc flash, and arc blast boundaries, see Informative Annex R, Working Safely with Capacitors. Informational Note No. 2: Heavy duty leather with a minimum thickness of 0.03 in. (0.7 mm) provides protection from thermal hazards. **360.5 Establishing an Electrically Safe Work Condition for a Capacitor.** **(A) Written Procedure.** Where a conductor or circuit part is connected to a capacitor operating at or above the thresholds in 360.3, a written procedure shall be used to document the necessary steps and sequence to discharge the capacitors and place the equipment into an electrically safe work condition. The written procedure shall incorporate the results of the risk assessment performed in 360.5(B) and specify the following at a minimum: **(B) Safe Work Practices.** In order to place the capacitor(s) into an electrically safe work condition, a qualified person shall use the appropriate safe work practices and PPE and shall apply the following process for establishing and verifying an electrically safe work condition: (1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up to- date drawings, diagrams, and identification tags.	

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	(2) After properly interrupting the load current, open the disconnecting device(s) for each source. (3) 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. (4) Apply lockout/tagout devices in accordance with a documented and established policy. (5) If bleed resistors or automatic discharge systems are applicable, wait the prescribed time for the capacitors to discharge to less than the thresholds in 360.3 and proceed to step (6). For systems without bleed resistors or automatic discharge systems, discharge the capacitors with an adequately rated grounding device (e.g., ground stick). Soft grounding is required above 1000 joules, and remote soft grounding is required above 100 kJ. (6) Verify that the capacitors are discharged. For capacitors less than 1000 joules, verification shall be permitted to be done either by testing or by grounding. For capacitors between 1000 joules and less than 100 kJ, verification shall be done using testing or soft grounding, then hard grounding. Above 100 kJ, an engineered and redundant system shall be used for remote testing and grounding. An adequately rated portable test instrument shall be used to test between each capacitor terminal and from each terminal to ground to assure that the capacitor is de-energized. (7) Before and after each verification, determine that the test instrument is operating satisfactorily through verification on a known dc voltage source. If voltage remains, determine and correct the cause and repeat step (5) to discharge the capacitors. Where recharging can occur due to dielectric absorption or induced voltages, all the capacitor terminals shall be connected together and grounded with a bare or transparent-insulated wire. (8) For series capacitors the shorting wires shall be attached across each individual capacitor, and to case. For single capacitors or for a parallel capacitor bank, the grounding device shall be	

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	permitted to be left hanging on attached to the capacitor terminals for the duration of the work (e.g., a ground stick/hook). *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.* **360.6 Grounding Sticks.** Grounding sticks shall be provided for qualified persons to safely discharge any residual stored energy contained in capacitors or to hold the capacitor potential at 0 volts. The grounding sticks shall be designed, constructed, installed, and periodically inspected so that the full energy and voltage of the capacitors can be safely discharged. **(A) Visual Inspection.** The ground stick shall be visually inspected for defects before each use. Resistors shall be visually inspected for cracks or other defects and electrically tested for proper resistance. The following shall occur if defects or contamination are found: (1) If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the ground stick is present, the tool shall be removed from service. (2) If the defect or contamination exists on the grounding stick, then it shall be replaced or repaired and tested before returning to service. (3) If the defect or contamination exists on the cable, then it shall be replaced or repaired and tested before returning to service. **(B) Electrical Testing.** All ground sticks shall be electrically tested as follows: (1) The ground stick cable shall be tested to verify that the impedance is less than 0.1 ohm to ground every 2 years. (2) The testing shall be documented.	

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	Exception: The test shall be performed annually if the ground stick is utilized outdoors or in other adverse conditions. (3) Soft grounding (High-Z) ground sticks with resistors shall be measured and compared to the specified value before each use. **(C) Storage and Disposal.** Any residual charge from capacitors shall be removed by discharging before servicing or removal. (1) All uninstalled capacitors capable of storing 10 joules or greater at their rated voltage shall be short-circuited with a conductor of appropriate size. (2) When an uninstalled capacitor is discovered without the shorting conductor attached to the terminals, it shall be treated as energized and charged to its full rated voltage until determined safe by a qualified person. Informational Note: A capacitor that develops an internal open circuit could retain substantial charge internally even though the terminals are short-circuited. Such a capacitor can be hazardous to transport, because the damaged internal wiring could reconnect and discharge the capacitor through the short-circuiting conductor. Any capacitor that shows a significant change in capacitance after a fault could have this problem. Action should be taken to reduce the risk associated with this hazard when it is discovered.	