Best Practice #111

(10/20/2011)

Title: Adoption of NFPA 70E 2012 in place of NFPA 70E 2009

Facility: DOE Complex

Points of Contact:

Michael Hicks, DOE-ID, Working Group Chair, hicksmd@id.doe.gov, 208-526-3724

Jackie McAlhaney, EFCOG Electrical Safety Subgroup Chair, Jackie.mcalhaney@srs.gov, 803-208-3389

Brief Description of Best Practice: NFPA 70E® – 2012 is recommended for approval across the DOE Complex as an upgrade to NFPA 70E® – 2009 in 10 CFR 851 Worker Safety and Health Plans (WSHP).

Previously, EFCOG BP#71 determined that the use of the 2009 edition of NFPA 70E® is at least as protective as the 2004 edition, and even more protective in some areas, such that the new edition should be considered for DOE Complex wide acceptance.

Why the best practice was used: 10 CFR 851 lists safety and health consensus standards with which the contractor must comply when applicable with site hazards (851.23). Only the versions of consensus standards that were in effect on February 9, 2006 were promulgated pursuant to rulemaking therefore only those specifically cited versions are required by the Rule. Contractors may include successor versions of the consensus standards that provide equal or greater worker protection if included in their DOE-approved worker safety and health program.

What are the benefits of the best practice: The use of the 2012 edition of NFPA 70E® is at least as protective as the 2009 edition, and even more protective in some areas, such that the new edition should be considered for DOE Complex wide acceptance.

NFPA 70E® – 2012 is recommended for approval across the DOE Complex as an upgrade to NFPA 70E® – 2009.

What problems/issues were associated with the best practice:

Article 320 has been reworked to eliminate the installation requirements. The revised article addresses safety-related work practices. Installation requirements from the 2009 version need to be continued with new battery installations.

How the success of the Best Practice was measured:

A detailed gap analysis of NFPA 70E versions 2012 and 2009 was performed and the link to the document is provided below.

Attachment – Working Group Members & Gap Analysis of NFPA 70E

EFCOG Best Practice #111 Attachment

Working Group Members:

Grayson Hammett nardie.hammett@srs.gov
Paul Swyers swyers1@llnl.gov
Dennis Chew chew7@llnl.gov
Mark Johnson Mark-L.Johnson@srs.gov
Y. T. Wang yt.wang@nnsa.doe.gov
Richard Waters Richard.Waters@INL.gov
Troy McCuskey troy.mccuskey@nrel.gov
Max Wright mwright@pantex.com
Heath Garrison hgarriso@pantex.com
Duane Nizio nizio@lanl.gov
Mark McNellis msmcnel@sandia.gov
Dennis Neitzel dennis.neitzel@avotraining.com
Mike Utes utes@fnal.gov

Detailed Gap Analysis of NFPA 70E Versions 2012 and 2009

2012 NFPA 70E – Changes

Rev. 0, October 20, 2011

2012 NFPA 70E Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Impact on Safety
Global Changes	• arc flash ~~protection~~ boundary • ~~flame resistant (FR)~~ arc rated (AR) • ~~FPN~~ Informational Note • Informative Annex • heavy duty leather gloves • ~~grounds~~ temporary protective grounding equipment • terms such as "limited approach boundary" not capitalized	"As safe or safer"
Section 90.2(A)	**90.2 Scope.** **(A) Covered.** This standard addresses electrical safety related work practices for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. This standard also includes safe work practices for employees performing other work activities that can expose them to electrical hazards as well as safe work practices for the following: ~~(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings~~ ~~(2) Yards, lots, parking lots, carnivals, and industrial substations~~ (1) Installation of conductors and equipment that connect to the supply of electricity (2) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are not an integral part of a	"As safe or safer"

2012 NFPA 70E Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Impact on Safety
	generating plant, substation, or control center.	
Section 90.2(A)	**90.2 Scope.** **(A) Covered.** This standard addresses electrical safety related work practices for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. This standard also includes safe work practices for employees performing other work activities that can expose them to electrical hazards as well as safe work practices for the following: ~~(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings~~ ~~(2) Yards, lots, parking lots, carnivals, and industrial substations~~ (1) Installation of conductors and equipment that connect to the supply of electricity (2) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are not an integral part of a generating plant, substation, or control center.	"As safe or safer"
Section 90.2(A)(1) and (2)	**90.2 Scope.** **(A) Covered.** This standard addresses electrical safety related work practices for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. This standard also includes safe work practices for employees performing other work activities that can expose them to electrical hazards as well as safe work practices for the following: ~~(1) Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings~~ ~~(2) Yards, lots, parking lots, carnivals, and industrial substations~~ (1) Installation of conductors and equipment that connect to the supply of electricity (2) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are not an integral part of a generating plant, substation, or control center.	"As safe or safer"
Section 90.2(B)(5)d.	**(B) Not Covered.** This standard does not cover safety related work practices for the following: … (5) Installations under the exclusive control of an electric utility where such installations: a. Consist of service drops or service laterals, and associated metering, or b. Are located in legally established easements or rights-of-way designated by or recognized by public service	"As safe or safer"

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	commissions, utility commissions, or other regulatory agencies having jurisdiction for such installations, or c. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy, or d. Are located by other written agreements either designated by or recognized by public service commissions, utility commission, or other regulatory agencies having jurisdiction for such installations. These written agreements shall be limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy where legally established easements or rights-of-way cannot be obtained. These installations shall be limited to federal lands, Native American reservations through the U.S. Department of the Interior Bureau of Indian Affairs, military bases, lands controlled by port authorities and state agencies and departments, and lands owned by railroads.	
Section 90.5(C) and throughout the document	"Fine Print Notes" re-named "Informational Notes."	"As safe or safer"
	Deleted many definitions of terms no longer used in the standards, e.g. ampacity, approved, coordination, cutout box.	"As safe or safer"
	Arc Flash Suit. A complete ~~FR clothing~~ arc-rated clothing and equipment system that covers the entire body, except for the hands and feet. ~~This includes pants, jacket, and a beekeeper type hood fitted with a face shield.~~ Informational Note: An arc flash suit may include pants or overalls, a jacket or a coverall, and a beekeeper-type hood fitted with a face shield.	"As safe or safer"
	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 (E_{BT}) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or E_{BT}, 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 (FR) clothing without an arc rating has not been tested for exposure to an electric arc. 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. 3: ATPV is defined in ASTM F 1959-06 as the incident energy on a material or a multilayer system of materials that results in a 50 percent probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second degree skin burn injury based on the Stoll curve, cal/cm2.	"As safe or safer"

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	Informational Note No. 4: E_{BT} is defined in ASTM F 1959-06 as the incident energy on a material or a material system that results in a 50 percent probability of breakopen. Breakopen is defined as a hole with an area of 1.6 cm^2 (0.5 in^2) or an opening of 2.5 cm (1.0 in.) in any dimension.	
	Boundary, Arc Flash ~~Protection~~. When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. Informational Note: A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 5 J/cm^2 (1.2 cal/cm^2).	"As safe or safer"
	Enclosed. Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized ~~electrical conductors or circuit~~ parts.	"As safe or safer"
	Incident Energy Analysis. A component of an arc flash hazard analysis used to predict the incident energy of an arc flash for a specified set of conditions.	"As safe or safer"
	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 a person is wearing. There are two categories of "working on": *Diagnostic (testing)* is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment; *repair* is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.).	"As safe or safer"
		"As safe or safer"
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Section 110.1(C)	**(C) Documentation.** There shall be a documented meeting between the host employer and the contract employer.	"As safe or safer"
Section 110.2(C)	**(C) Emergency Procedures.** Employees exposed to shock hazards and those employees responsible for taking action in case of emergency shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Employees shall be regularly instructed in methods of first aid and emergency procedures, such as approved methods of resuscitation, if their duties warrant such training. Training of employees in approved methods of resuscitation, including cardiopulmonary resuscitation and automatic external defibrillator (AED) use, shall be certified by the employer annually.	"As safe or safer"
Section 110.2(D)(1)(c)	(c) 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 course of such training, has demonstrated 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.	"As safe or safer"

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Section 110.2(D)(1)(f)	(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.	"As safe or safer"
Section 110.2(D)(2)	**(2) Unqualified Persons.** Unqualified persons shall be trained in, and be familiar with, any ~~of the~~ electrical safety-related practices ~~that might not be addressed specifically by Chapter 1 but are~~ necessary for their safety.	"As safe or safer"
Section 110.2(D)(3)	**(3) Retraining.** An employee shall receive additional training (or retraining) under any of the following conditions: (1) If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices (2) If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use (3) If he or she must employ safety-related work practices that are not normally used during his or her regular job duties Retraining shall be performed at intervals not to exceed 3 years.	"As safe or safer"
Section 110.2(E)	**(E) Training Documentation.** The employer shall document that each employee has received the training required by 110.2 (D). This documentation shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of the training, each employee's name, and dates of training.	"As safe or safer"
Section 110.3(A)	**(A) General.** The employer shall implement and document an overall electrical safety program that directs activity appropriate for the electrical hazards, voltage, energy level, and circuit conditions.	"As safe or safer"
Section 110.3(B)	**(B) Awareness and Self-Discipline.** The electrical safety program shall be designed to provide an awareness of the potential electrical hazards to employees who ~~might from time to time~~ work in an environment with ~~influenced by~~ the presence of electrical hazards ~~energy~~. The program shall be developed to provide the required self-discipline for all employees who ~~occasionally~~ must perform work that may involve electrical hazards. The program shall instill safety principles and controls.	"As safe or safer"
Section 110.3(E)	**(E) Electrical Safety Program Procedures.** An electrical safety program shall identify the procedures for working within the limited approach boundary ~~of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists~~ and for working within the arc flash boundary before work is started.	"As safe or safer"
Section 110.3(F)	**(F) Hazard~~/~~ Identification and Risk ~~Evaluation~~ Assessment Procedure.** An electrical safety program shall ~~identify~~ include a hazard~~/~~ identification and a risk ~~evaluation~~	"As safe or safer"

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	assessment procedure to be used before work is started within the limited approach boundary or within the arc flash boundary of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists. The procedure shall identify ~~the hazard/risk process that shall~~ process to be used by the employee~~s to evaluate tasks~~ before work is started to identify hazards and assess risks, including potential risk mitigation strategies. Informational Note ~~FPN~~ No. 1: The hazard~~/~~ identification and risk ~~evaluation~~ assessment procedure may include identifying when a second person could be required and the training and equipment that person should have. Informational Note ~~FPN~~ No. 2: For an example of a hazard~~/~~ identification and risk ~~evaluation~~ assessment procedure flow chart, see Annex F. Informational Note ~~FPN~~ No. 3: For an example of a hazard~~/~~ identification and risk ~~evaluation~~ assessment procedure, see Annex F.	
Section 110.3(G)(1)	**(1) General.** Before starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, ~~and~~ personal protective equipment requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.	"As safe or safer"
Section 110.3(G)(3)	**(3) Routine Work.** Prior to starting work, a brief discussion shall be satisfactory if the work involved is routine and if the employee is qualified for the task~~, by virtue of training and experience, can reasonably be expected to recognize and avoid the hazards involved in the job~~. A more extensive discussion shall be conducted if either of the following apply: (1) The work is complicated or particularly hazardous. (2) The employee cannot be expected to recognize and avoid the hazards involved in the job.	"As safe or safer"
Section 110.3(H)	**(H) Electrical Safety Auditing.** ~~An electrical safety program shall be audited to help ensure that the principles and procedures of the electrical safety program are being followed. The frequency of audit shall be determined by the employer, based on the complexity of the procedures and the type of work being covered. Where the audit determines that the principles and procedures of the electrical safety program are not being followed, appropriate revisions shall be made.~~ **(1) Electrical Safety Program.** The electrical safety program shall be audited to verify the principles and procedures of the electrical safety program are in compliance with this standard. The frequency of the audit shall not exceed 3 years. **(2) Field Work.** Field work shall be audited to verify the requirements contained in the procedures of the electrical safety program are being followed. When the auditing determines that the principles and procedures of the electrical safety program are not being followed, the appropriate revisions to the training program or revisions to the procedures shall be made.	"As safe or safer"

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	(3) Documentation. The audit shall be documented.	
Section 110.8	**~~110.8 Working While Exposed to Electrical Hazards.~~**	"As safe or safer"
Section 110.4(A)(1)	**(1) Testing.** Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists.	"As safe or safer"
Section 110.4(B)(3)	(d) Conductive Work Locations. Portable electric equipment used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations. In job 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 hazard/risk evaluation procedure could 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.	"As safe or safer"
Section 110.4(C)	**(C) Ground-Fault Circuit-Interrupter (GFCI) Protection.** **(1) General.** Employees shall be provided with ground-fault circuit-interrupter (GFCI) protection where required by applicable state, federal, or local codes and standards. Listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted. **(2) Outdoors.** GFCI protection shall be provided when an employee is outdoors and operating or using cord- and plug-connected equipment supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees working outdoors operate or use equipment supplied by other than 125-volt, 15-, 20-, or 30-ampere circuits, an assured equipment grounding conductor program shall be implemented.	. "As safe or safer"
Section 110.5	**110.5 Underground Electrical Lines and Equipment.** Before excavation starts, and where there exists a reasonable possibility of contacting electrical lines or equipment, the employer shall take the necessary steps to contact the appropriate owners or authorities to identify and mark the location of the electrical lines or equipment. When it has been determined that a reasonable possibility for contacting electrical lines or equipment exists, a hazard analysis shall be performed to identify the appropriate safe work practices that shall be used during the excavation.	"As safe or safer"
Section 120.2(B)(2)	**(2) Training.** All persons who could be exposed shall be trained to understand the established procedure to control the energy and their responsibility in executing the procedure. New (or reassigned) employees shall be trained (or retrained) to understand the lockout/tagout procedure as it relates to their new assignment. Retraining shall be required as the established procedure is revised.	"As safe or safer"
Section 120.2(C)(2)	**(2) Form of Control.** Two ~~Three~~ forms of hazardous electrical energy control shall be permitted: ~~individual employee control,~~ simple lockout/tagout and complex lockout/tagout *[see 120.2(D)]*. For the ~~individual control and~~	"As safe or safer"

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	~~the~~ simple lockout/tagout, the qualified person shall be in charge. For the complex lockout/tagout, the person in charge shall have overall responsibility.	
Section 120.2(C)(3)	**(3) Audit Procedures.** An audit shall be conducted at least annually by a qualified person and shall cover at least one lockout/tagout in progress and the procedure details. The audit shall be designed to correct deficiencies in the established electrical lockout/tagout procedure or in employee understanding.	"As safe or safer"
~~Section 120.2(D)(1)~~	~~**(1) Individual Qualified Employee Control Procedure.** The individual qualified employee control procedure shall be permitted when equipment with exposed conductors and circuit parts is deenergized for minor maintenance, servicing, adjusting, cleaning, inspection, operating conditions, and the like. The work shall be permitted to be performed without the placement of lockout/tagout devices on the disconnecting means, provided the disconnecting means is adjacent to the conductor, circuit parts, and equipment on which the work is performed, the disconnecting means is clearly visible to the individual qualified employee involved in the work, and the work does not extend beyond one shift.~~	"As safe or safer"
Section 120.2(D)(1)	**(1 ~~2~~) Simple Lockout/Tagout Procedure.** ~~All lockout/ tagout procedures that are not under individual qualified employee control according to 120.2(D)(1) or complex lockout/tagout according to 120.2(D)(3) shall be considered to be simple lockout/tagout procedures.~~ All lockout/tagout procedures that involve only a qualified person(s) deenergizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards ~~performing work within the Limited Approach Boundary electrical equipment~~ shall be considered to be a simple lockout/tagout. Simple lockout/tagout plans shall not be required to be written for each application. Each worker shall be responsible for his or her own lockout/tagout.	"As safe or safer"
Section 120.2(D)(2)	**(2 ~~3~~) Complex Lockout/Tagout Procedure.** (a) A complex lockout/tagout plan shall be permitted where one or more of the following exist: (1) Multiple energy sources (2) Multiple crews (3) Multiple crafts (4) Multiple locations (5) Multiple employers (6) Multiple ~~Different~~ disconnecting means (7) Particular sequences (8) Job or task that continues for more than one work period	"As safe or safer"
Section 120.2 (E)(4)(e)	~~*Exception to (a), (b), and (c): A "hold card tagging tool" on an overhead conductor in conjunction with a hotline tool to install the tagout device safely on a disconnect that is isolated from the worker(s).*~~ (e) A hold card tagging tool on an overhead conductor in conjunction with a hotline tool to install the tagout device safely on a disconnect that is isolated from the work(s) shall be permitted.	"As safe or safer"
Section 120.2	(a) Locating Sources. Up-to-date single-line drawings shall be	"As safe or safer"

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(F)(1)(a)	considered a primary reference source for such information. When up-to-date drawings are not available, the employer shall be responsible for ensuring that an equally effective means of locating all sources of energy is employed.	
Section 120.2 (F)(1)(d)	~~(d) Individual Qualified Employee Control. Individual qualified employee control shall be in accordance with 120.2(D)(1).~~	"As safe or safer"
Section 120.2 (F)(2)(f)(2)	(2) Requirement to define the boundary of the electrically safe work condition ~~area~~	"As safe or safer"
Section 120.2 (F)(2)(g)	(g) Grounding. Grounding requirements for the circuit shall be established, including whether the temporary protective grounding equipment ~~grounds~~ shall be installed for the duration of the task or is temporarily established by the procedure. Grounding needs or requirements shall be permitted to be covered in other work rules and might not be part of the lockout/tagout procedure.	"As safe or safer"
Section 120.2 (F)(2)(m)	(m) Release for Return to Service. The procedure shall identify steps to be taken when the job or task requiring lockout/tagout is completed. Before electric circuits or equipment are reenergized, appropriate tests and visual inspections shall be conducted to verify that all tools, mechanical restraints and electrical jumpers, short circuits ~~shorts~~, and temporary protective grounding equipment ~~grounds~~ have been removed, so that the circuits and equipment are in a condition to be safely energized. Where appropriate, the employees responsible for operating the machines or process shall be notified when circuits and equipment are ready to be energized, and such employees shall provide assistance as necessary to safely energize the circuits and equipment. The procedure shall contain a statement requiring the area to be inspected to ensure that nonessential items have been removed. One such step shall ensure that all personnel are clear of exposure to dangerous conditions resulting from reenergizing the service and that blocked mechanical equipment or grounded equipment is cleared and prepared for return to service.	"As safe or safer"
Section 120.3(A)	**(A) Placement.** Temporary protective grounding equipment ~~grounds~~ shall be placed at such locations and arranged in such a manner as to prevent each employee from being exposed to hazardous differences in electrical potential.	"As safe or safer"
Section 120.3(B)	**(B) Capacity.** Temporary protective grounding equipment ~~grounds~~ shall be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault.	"As safe or safer"
Section 120.3(D)	**(D) Impedance.** Temporary protective grounding equipment ~~grounds~~ and connections shall have an impedance low enough to cause immediate operation of protective devices in case of accidental energizing of the electric conductors or circuit parts.	"As safe or safer"
Section 130.1	**130.1 General.** All requirements of this article 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)(16) are used in lieu of an incident energy analysis in accordance with 130.5, Exception.	"As safe or safer"
Section 130.2	**130.2 Electrically Safe Working Conditions.** Energized	"As safe or safer"

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	electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition ~~before an employee works within the Limited Approach Boundary of those conductors or parts~~ before an employee performs work if either 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 risk of injury from an exposure to an arc flash hazard exists.	
Section 130.2 Exception	*Exception: Where a disconnecting means or isolating element that has been properly installed and maintained is operated, opened, closed, removed, or inserted to achieve an electrically safe work condition for connected equipment or to return connected equipment to service that has been placed in an electrically safe work condition, the equipment supplying the disconnecting means or isolating element shall not be required to be placed in an electrically safe work condition provided a risk assessment is performed and does not identify unacceptable risks for the task.*	"As safe or safer"
Section 130.2(A)	**(A) Energized Work.** **(1) Greater Hazard.** Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional ~~or increased~~ hazards or increased risk. **(2) Infeasibility.** Energized work shall be permitted where the employer can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations. **(3) Less Than 50 Volts.** Energized electrical conductors and circuit parts that operate at less than 50 volts ~~to ground~~ shall not be required to be de-energized where the capacity of the source and any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arcs.	"As safe or safer"
Section 130.2(A) FPN No 3	~~FPN No. 3: The occurrence of 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 air will cause a sudden pressure increase and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of at-risk procedures that require an employee to be exposed to high level energy sources. 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 5 kV (nominal) systems, current limitation, and specification of covered bus within equipment are techniques available to reduce the hazard of the system.~~	"As safe or safer"
Section 130.2(B)(1)	**(B) Energized Electrical Work Permit.** **(1) When Required.** When working within the limited approach boundary or the arc flash boundary of ~~When working on~~ exposed energized electrical conductors or circuit parts that are not placed in an electrically safe work condition [that is, for the reasons of increased or additional hazards or infeasibility per 130.2(A)], work to be performed shall be considered energized electrical work and shall be performed	"As safe or safer"

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	by written permit only.	
Section 130.2 (B)(2)(4)	(4) Results of the shock hazard analysis *[see 130.4(A)]* a. Limited approach boundary *[see 130.4(B) and Table 130.4(C)(a) and Table 130.4(C)(b)]* b. Restricted approach boundary *[see 130.4(B) and Table 130.4(C)(a) and Table 130.4(C)(b)]* c. Prohibited approach boundary *[see 130.4(B) and Table 130.4(C)(a) and Table 130.4(C)(b)]* d. Necessary shock personal and other protective equipment to safely perform the assigned task *[see 130.4(C), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(a), Table 130.7(C)(15)(b), and Table 130.7(C)(16), and 130.7(D)]* ~~(5) Determination of shock protection boundaries [130.2(B) and Table 130.2(C)]~~	"As safe or safer"
Section 130.2 (B)(2)(5)	(5 ~~6~~) Results of the arc flash hazard analysis *[see 130.5]* a. Available incident energy or hazard/risk category *[see 130.5]* b. Necessary personal protective equipment to safely perform the assigned task. *[see 130.5(B), 130.7(C)(1) through (C)(16), Table 130.7(C)(15)(a), Table 130.7(C)(15)(b), and Table 130.7(C)(16), and 130.7(D)]* c. Arc flash boundary *[see 130.5(A)]* ~~(7) The arc flash protection boundary [130.3(A)]~~ ~~(8) The necessary personal protective equipment to safely perform the assigned task [130.3(B), 130.7(C)(9), and Table 130.7(C)(9)]~~	"As safe or safer"
Section 130.2(B)(3)	**(3) Exemptions to Work Permit.** Work performed within the limited approach boundary of energized electrical conductors or circuit parts by qualified persons related to tasks such as testing, troubleshooting, and voltage measuring shall be permitted to be performed without an energized electrical work permit, if appropriate safe work practices and personal protective equipment in accordance with Chapter 1 are provided and used. If the purpose of crossing the limited approach boundary is only for visual inspection and the restricted approach boundary will not be crossed, then an energized electrical work permit shall not be required.	"As safe or safer" Needs to include AFB
Section 130.3	**130.3 Working While Exposed to Electrical Hazards.**	"As safe or safer"
Section 130.3(A)(1)	**(1) Energized Electrical Conductors and Circuit Parts — Safe Work Condition.** Before an employee works within the limited approach boundary, energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition ~~before an employee works within the Limited Approach Boundary of those conductors or parts~~, unless work on energized components can be justified according to 130.2(A).	"As safe or safer"
Section 130.3(B)	**(B) Working Within the Limited Approach Boundary of Exposed Electrical Conductors or Circuit Parts that Are or Might Become Energized.** ~~Prior to working within the Limited Approach Boundary of exposed electrical conductors and circuit parts operating at 50 volts or more, lockout/tagout devices shall be applied in accordance with 120.1, 120.2, and 120.3. If, for reasons indicated in 130.1, lockout/tagout~~	"As safe or safer"

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	~~devices cannot be applied, 130.2(A) through 130.2(D)(2) shall apply to the work.~~	
Section 130.3(B)(1) to (2)	~~(a) Shock Hazard Analysis. A shock hazard analysis shall determine the voltage to which personnel will be exposed, boundary requirements, and the personal protective equipment necessary in order to minimize the possibility of electrical shock to personnel.~~ ~~FPN: See 130.2 for the requirements of conducting a shock hazard analysis.~~ ~~(b) Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the Arc Flash Protection Boundary and the personal protective equipment that people within the Arc Flash Protection Boundary shall use.~~ ~~FPN: See 130.3 for the requirements of conducting an arc flash hazard analysis.~~ ~~**(2) Energized Electrical Work Permit.** When working on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition (i.e., for the reasons of increased or additional hazards or infeasibility per 130.1), work to be performed shall be considered energized electrical work and shall be performed by written permit only.~~ ~~FPN: See 130.1(B) for the requirements of an energized electrical work permit.~~ ~~**(3) Unqualified Persons.** Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only, unless the electric conductors and equipment involved are in an electrically safe work condition.~~	"As safe or safer"
Section 130.4	**130.4 Approach Boundaries to Energized Electrical Conductors or Circuit Parts.**	"As safe or safer"
Section 130.4(B)	**(B) Shock Protection Boundaries.** The shock protection boundaries identified as limited approach, restricted approach, and prohibited approach boundaries shall be ~~are~~ applicable where ~~to the situation in which~~ approaching personnel are exposed to energized electrical conductors or circuit parts. ~~See~~ Table 130.4(C)(a) shall be used for the distances associated with various ac system voltages. Table 130.4(C)(b) shall be used for the distances associated with various dc system voltages. Informational Note: In certain instances, the arc flash ~~Protection~~ boundary might be a greater distance from the ~~exposed~~ energized electrical conductors or circuit parts than the limited approach boundary. The shock protection boundaries and the arc flash ~~protection~~ boundary are independent of each other.	"As safe or safer"
Section 130.4(C)	**(C) Approach to Exposed Energized Electrical Conductors or Circuit Parts Operating at 50 Volts or More.** No qualified person shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts operating at 50 volts or more than the restricted approach boundary set forth in Table 130.4(C)(a) and Table 130.4(C)(b), unless any of the following apply:	"As safe or safer"
Section 130.4(C)(1)	(1) The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more ~~and no uninsulated part of the qualified person's body crosses the Prohibited Approach Boundary set forth in Table 130.2(C)~~. Insulating gloves or insulating gloves and	"As safe or safer"

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	sleeves are considered insulation only with regard to the energized parts upon which work is being performed. If there is a need for an uninsulated part of the qualified person's body to cross the prohibited approach boundary, a combination of 130.4(C)(1), 130.4(C)(2), and 130.4(C)(3) shall be used to protect the uninsulated body parts.	
Table 130.4(C)(a)	**Table 130.4(C)(a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems (All dimensions are distance from energized electrical conductor or circuit part to employee.)**	"As safe or safer"
Table 130.4(C)(a)	1.0 ~~1.07~~ m (3 ft 6 in) 0.3 m ~~314.8 mm~~ (1 ft 0 in) 25 ~~25.4~~ mm (0 ft 1 in.) etc.	"As safe or safer"
Table 130.4(C)(b)	**Table 130.4(C)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems**	"As safe or safer"
Section 130.4(D)	**(D) Approach by Unqualified Persons.** Unless permitted by 130.4(D)(2), no unqualified person shall be permitted to approach nearer than the limited approach boundary of energized conductors and circuit parts. ~~Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only, unless the electric conductors and equipment involved are in an electrically safe work condition.~~	"As safe or safer"
Section 130.5	**130.5 Arc Flash Hazard Analysis.** An arc flash hazard analysis shall determine the arc flash ~~Protection~~ boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use. The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis. The arc flash hazard analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.	"As safe or safer"
Section 130.5 Informational Note No. 5	Informational Note No. 5: See IEEE 1584 for more information regarding arc flash hazards for three-phase systems rated less than 240 volts. ~~*Exception No. 1: An arc flash hazard analysis shall not be required where all of the following conditions exist:*~~ ~~*(1) The circuit is rated 240 volts or less.*~~ ~~*(2) The circuit is supplied by one transformer.*~~ ~~*(3) The transformer supplying the circuit is rated less than 125 kVA.*~~	"As safe or safer"
Section 130.5 Exception	*Exception ~~No. 2~~: The requirements of 130.7(C)(15) and 130.7(C)(16) shall be permitted to be used in lieu of determining the incident energy at the working distance ~~a detailed incident energy analysis~~.*	"As safe or safer"
Section 130.5 Informational Note No. 2	Informational Note No. 2: Both larger and smaller available short-circuit currents could result in higher available arc flash energies. If the available short-circuit current increases without a decrease in the opening time of the overcurrent protective device, the arc flash energy will increase. If the available short-circuit current decreases, resulting in a longer opening time for the overcurrent protective device, arc flash energies could also increase.	"As safe or safer"

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Section 130.5 Informational Note No. 3	Informational Note No. 3: 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 and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of at-risk procedures that require an employee to be exposed to high-level energy sources. 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 5-kV (nominal) systems, current limitation, and specification of covered bus or covered conductors within equipment are techniques available to reduce the hazard of the system.	"As safe or safer"
Section 130.5(A)	**(A) Arc Flash ~~Protection~~ Boundary.** The arc flash boundary for systems 50 volts and greater shall be the distance at which the incident energy equals 5 J/cm2 (1.2 cal/cm^2). Informational Note: For information on estimating the arc flash ~~Protection~~ boundary, see Annex D. ~~**(1) Voltage Levels Between 50 Volts and 600 Volts.** In those cases where detailed arc flash hazard analysis calculations are not performed for systems that are between 50 volts and 600 volts, the Arc Flash Protection Boundary shall be 4.0 ft, based on the product of clearing time of 2 cycles (0.033 sec) and the available bolted fault current of 50 kA or any combination not exceeding 100 kA cycles (1667 ampere seconds). When the product of clearing times and bolted fault current exceeds 100 kA cycles, the Arc Flash Protection Boundary shall be calculated.~~ ~~**(2) Voltage Levels Above 600 Volts.** At voltage levels above 600 volts, the Arc Flash Protection Boundary shall be the distance at which the incident energy equals 5 J/cm^2 (1.2 cal/cm^2). For situations where fault-clearing time is equal to or less than 0.1 sec, the Arc Flash Protection Boundary shall be the distance at which the incident energy level equals 6.24 J/cm^2 (1.5 cal/cm^2).~~	"As safe or safer"
Section 130.5(B) Informational Note	Informational Note: For information on estimating the incident energy, see Annex D. For information on selection of arc-rated clothing and other PPE, see Table H.3(b) in Annex H.	"As safe or safer"
Section 130.5(C)	**(C) Equipment Labeling.** Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information: (1) At least one of the following: a. Available incident energy and the corresponding working distance b. Minimum arc rating of clothing c. Required level of PPE d. Highest Hazard/Risk Category (HRC) for the equipment (2) Nominal system voltage	"As safe or safer"

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	(3) Arc flash boundary *Exception: Labels applied prior to September 30, 2011, are acceptable if they contain the available incident energy or required level of PPE.* The method of calculating and data to support the information for the label shall be documented. ~~Equipment shall be field marked with a label containing the available incident energy or required level of PPE.~~	
Section 130.6(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 50 volts or more 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 electrical hazards. ~~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 rating at 50 volts or more or where an electrical hazard exists.~~	"As safe or safer"
Section 130.6(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 50 volts or more or where an electrical hazard exists if movement of the door, hinged panel, and the like is likely to create a hazard.	"As safe or safer"
Section 130.6(H)	**(H ~~G~~) Housekeeping Duties.** Employees shall not perform housekeeping duties inside the limited approach boundary where there is a possibility of contact with energized electrical conductors or circuit parts, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact. ~~Where energized electrical conductors or circuit parts present an electrical contact hazard, employees shall not perform housekeeping duties inside the Limited Approach Boundary where there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact.~~ Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) shall not be used inside the limited approach boundary unless procedures to prevent electrical contact are followed.	"As safe or safer"
Section 130.6(J)	**(J ~~I~~) Anticipating Failure.** When there is evidence that electric equipment could fail and injure employees, the electric equipment shall be de-energized, unless the employer can demonstrate that de-energizing introduces additional ~~or increased~~ hazards or increased risk or is infeasible because of equipment design or operational limitation. Until the equipment is de-energized or repaired, employees shall be protected from hazards associated with the impending failure	"As safe or safer"

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	of the equipment by suitable barricades and other alerting techniques necessary for safety of the employees. Informational Note: See 130.7(E) for alerting techniques.	
Section 130.6(L)	**(L) Reclosing Circuits After Protective Device Operation.** After a circuit is de-energized by the automatic operation of a circuit protective device, the circuit shall not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses shall be prohibited. When it is determined ~~from the design of the circuit and the overcurrent devices involved~~ that the automatic operation of a device was caused by an overload rather than a fault condition, examination of the circuit or connected equipment shall not be required before the circuit is reenergized.	"As safe or safer"
Section 130.7 Informational Note No. 2	Informational Note No. 2: It is the collective experience of the Technical Committee on Electrical Safety in the Workplace that normal operation of enclosed electrical equipment, operating at 600 volts or less, that has been properly installed and maintained by qualified persons is not likely to expose the employee to an electrical hazard.	"As safe or safer"
Section 130.7(C)(1)	**(1) General.** When an employee is working within the restricted approach boundary, the worker shall wear personal protective equipment in accordance with 130.4. When an employee is working within the arc flash boundary, he or she shall wear protective clothing and other personal protective equipment in accordance with 130.5. All parts of the body inside the arc flash boundary shall be protected.	"As safe or safer"
Section 130.7(C)(2)	**(2) Movement and Visibility.** When ~~flame-resistant (FR)~~ arc-rated clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility.	"As safe or safer"
Section 130.7(C)(3)	**(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 and/or beard nets, these items must be arc-rated ~~non-melting and flame-resistant~~.	"As safe or safer"
Section 130.7(C)(5)	**(5) Hearing Protection.** Employees shall wear hearing protection whenever working within the arc flash boundary.	"As safe or safer"
Section 130.7(C)(6)	**(6 ~~5~~) Body Protection.** Employees shall wear arc-rated ~~FR~~ clothing wherever there is possible exposure to an electric arc flash above the threshold incident energy level for a second degree burn [5 J/cm2 (1.2 cal/cm2)].	"As safe or safer"
Section 130.7(C)(6) FPN	~~FPN: Such clothing can be provided as an arc flash suit jacket and arc flash suit pants, shirts and pants, or as coveralls, or as a combination of jacket and pants, or, for increased protection, as coveralls with jacket and pants. Various weight fabrics are available. Generally, the higher degree of protection is provided by heavier weight fabrics and/or by layering combinations of one or more layers~~	"As safe or safer"

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	~~of FR clothing. In some cases, one or more layers of FR clothing are worn over flammable, non-melting clothing.~~	
Section 130.7(C)(8)	**(8 ~~7~~) Foot Protection.** Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection. Informational Note: EH (Electrical Hazard) shoes meeting ASTM F 2413 can provide a secondary source of electric shock protection under dry conditions.	"As safe or safer"
Section 130.7(C)(9)	**(9 ~~12~~) Factors in Selection of Protective Clothing.** Clothing and equipment that provide worker protection from shock and arc flash hazards shall be used ~~utilized~~. ~~Clothing and equipment required for the degree of exposure shall be permitted to be worn alone or integrated with flammable, nonmelting apparel.~~ If arc-rated ~~FR~~ clothing is required, it shall cover associated parts of the body as well as all flammable apparel while allowing movement and visibility. ~~All personal protective equipment shall be maintained in a sanitary and functionally effective condition. Personal protective equipment items will normally be used in conjunction with one another as a system to provide the appropriate level of protection.~~ Clothing and equipment required for the degree of exposure shall be permitted to be worn alone or integrated with flammable, nonmelting apparel. Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of a clothing system.	"As safe or safer"
Section 130.7(C)(9)	**(9 ~~12~~) Factors in Selection of Protective Clothing.** …	"As safe or safer"
Section 130.7(C)(9)(a)	(a) Layering. Nonmelting, flammable fiber garments shall be permitted to be used as underlayers in conjunction with arc-rated ~~FR~~ garments in a layered system for added protection. If nonmelting, flammable fiber garments are used as underlayers, the system arc rating shall be sufficient to prevent breakopen of the innermost arc-rated ~~FR~~ layer at the expected arc exposure incident energy level to prevent ignition of flammable underlayers. Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of a clothing system.	"As safe or safer"
Section 130.7(C)(9)(b)	(b) Outer Layers. Garments worn as outer layers over arc-rated ~~FR~~ clothing, such as jackets or rainwear, shall also be made from arc-rated ~~FR~~ material.	"As safe or safer"
Section 130.7(C)(10)	**(10 ~~13~~) Arc-Flash Protective Equipment.**	"As safe or safer"
Section 130.7(C)(10)(b)	(b) Head Protection. (1) An arc-rated balaclava shall be used with an arc-rated faceshield when the back of the head is within the arc flash boundary. An arc-rated hood shall be permitted to be used instead of an arc-rated faceshield and balaclava. (2) An arc-rated hood shall be used when the anticipated incident energy exposure exceeds 12 cal/cm^2.	"As safe or safer"
Section	(c ~~b~~) Face Protection. Face shields shall have an arc rating	"As safe or safer"

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130.7(C)(10)(c)	suitable for the arc flash exposure. Face shields with a wraparound guarding to protect the face, chin, forehead, ears, and neck area shall be used. Face shields without an arc rating shall not be used. Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.	
Section 130.7(C)(10)(d)(1)	(d ~~c~~) Hand Protection. (1) Heavy-duty leather gloves or arc-rated gloves shall be worn where required for arc flash protection. Informational Note: Heavy-duty leather gloves are made entirely of leather with minimum thickness of 0.03 in. (0.7 mm), are unlined or lined with nonflammable, nonmelting fabrics. Heavy-duty leather gloves meeting this requirement have been shown to have ATPV values in excess of 10 cal/cm^2.	"As safe or safer"
Section 130.7(C)(10)(d)(2)	(2) Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves. Informational Note: The leather protectors worn over rubber insulating gloves provide additional arc flash protection for the hands for arc flash protection exposure. ~~FPN: Insulating rubber gloves and gloves made from layers of flame-resistant material provide hand protection against the arc flash hazard. Heavy-duty leather (e.g., greater than 12 oz/yd.^{2}) gloves provide protection suitable up to Hazard/Risk Category 2. The leather protectors worn over insulating rubber gloves provide additional arc flash protection for the hands. During high arc flash exposures leather can shrink and cause a decrease in protection.~~	"As safe or safer"
Section 130.7(C)(10)(e)	(e ~~d~~) Foot Protection. Heavy-duty leather work shoes provide some arc flash protection to the feet and shall be used ~~in all tasks in Hazard/Risk Category 2 and higher and~~ in all exposures greater than 4 cal/cm^2.	"As safe or safer"
Section 130.7(C)(11), (12), (13), and (14)		
Section 130.7(C)(14)	**(14 ~~8~~) Standards for Personal Protective Equipment (PPE).**	"As safe or safer"
Table 130.7(C)(14)	**Table 130.7(C)(14 ~~8~~) Standards on Protective Equipment**	"As safe or safer"
Section 130.7(C)(15)	**(15 ~~9~~) Selection of Personal Protective Equipment When Required for Various Tasks.**	"As safe or safer"
Section 130.7(C)(15)	**(15) Selection of Personal Protective Equipment When Required for Various Tasks.** Where selected in lieu of the incident energy analysis of 130.5(B)(1), Table 130.7(C)(15)(a) and Table 130.7(C)(15)(b) shall be used to determine the hazard/risk category and requirements for use of rubber insulating gloves and insulated and insulating hand tools for a task. The assumed maximum short-circuit current capacities and maximum fault clearing times for various tasks are listed in Table 130.7(C)(15)(a). For tasks not listed, or for power systems with greater than the assumed maximum short-circuit current capacity or with longer than the assumed maximum fault clearing times, an incident energy ~~arc flash hazard~~ analysis shall be required in accordance with 130.5.	"As safe or safer"
Section	Informational Note No. 1: The hazard/risk category, work tasks, and protective equipment identified in Table 130.7(C)(15)(a) were	"As safe or safer"

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130.7(C)(15) Informational Note No. 1	identified by a task group, and the hazard/risk category, protective clothing, and equipment selected were based on the collective experience of the task group. The hazard/risk category, protective clothing and equipment are generally based on determination of estimated exposure levels. In several cases, where the risk of an arc flash incident is considered low, very low, or extremely low by the task group, the hazard/risk category number has been reduced by 1, 2, or 3 numbers, respectively.	
Section 130.7(C)(15) Informational Note No. 2	Informational Note No. 2: The collective experience of the task group is that, in most cases, closed doors do not provide enough protection to eliminate the need for PPE for instances where the state of the equipment is known to readily change (for example, doors open or closed, rack in or rack out).	"As safe or safer"
Section 130.7(C)(15) FPN No. 2	~~FPN No. 2: Both larger and smaller available short-circuit currents could result in higher available arc flash energies. If the available short-circuit current increases without a decrease in the opening time of the overcurrent protective device, the arc flash energy will increase. If the available short-circuit current decreases, resulting in a longer opening time for the overcurrent protective device, arc flash energies could also increase.~~	"As safe or safer"
Section 130.7(C)(15) Informational Note No. 3	Informational Note No. 3: The premise used by the task group in developing the criteria discussed in Informational Note No. 1 and Informational Note No. 2 is considered to be reasonable, based on the consensus judgment of the full NFPA 70E Technical Committee.	"As safe or safer"
Section 130.7(C)(15) FPN No. 3	~~FPN No. 3: Energized electrical conductors or circuit parts that operate at less than 50 volts may need to be deenergized to satisfy an "electrically safe work condition." Consideration should be given to the capacity of the source, any overcurrent protection between the energy source and the worker, and whether the work task related to the source operating at less than 50 volts increases exposure to electrical burns or to explosion from an electric arc.~~	"As safe or safer"
Section 130.7(C)(15) FPN No. 4	~~FPN No. 4: See 130.1(B)(2)(6) for requirements on documenting the available short-circuit current and fault clearing time.~~	"As safe or safer"
Table 130.7(C)(15)(a)	**Panelboards or Other Equipment Rated 240 V and Below ~~Note 1~~** Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 19 in. ~~Specific Notes (as referenced in the table):~~ ~~1. Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time.~~	"As safe or safer"
Table 130.7(C)(15)(a)	**Panelboards or Other Equipment Rated 240 V and Below ~~Note 1~~** Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 19 in.	"As safe or safer"
Table 130.7(C)(15)(a)	**Hazard/Risk Category**	
Table	**Panelboards or other equipment rated > 240 V and up to 600 V**	"As safe or safer"

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130.7(C)(15)(a)	Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 30 in. Perform infrared thermography and other non-contact inspections outside the restricted approach boundary Circuit breaker (CB) or fused switch operation with covers on CB or fused switch operation with covers off Work on energized electrical conductors and circuit parts, including voltage testing Remove/install CBs or fused switches Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts) Opening hinged covers (to expose bare, energized electrical conductors and circuit parts) Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	
Table 130.7(C)(15)(a) Notes	~~General Notes (applicable to the entire table):~~ Y = Yes (required). N: No (not required). Notes: (1 ~~a~~) Rubber insulating gloves are gloves rated for the maximum line-to-line voltage upon which work will be done. (2 b) Insulated and insulating hand tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done, and are manufactured and tested in accordance with ASTM F 1505, *Standard Specification for Insulated and Insulating Hand Tools*. ~~(c) Y = yes (required), N = no (not required).~~ (3) The use of "N" does not indicate that rubber insulating gloves and insulated and insulating hand tools are not required in all cases. Rubber insulating gloves and insulated and insulating hand tools may be required by 130.4, 130.8 (C) (7), and 130.8(D). ~~(d) For systems rated less than 1000 volts, the fault currents and upstream protective device clearing times are based on an 18 in. working distance.~~ ~~(e) For systems rated 1 kV and greater, the Hazard/Risk Categories are based on a 36 in. working distance.~~ (4 ~~f~~) For equipment protected by upstream current limiting fuses with arcing fault current in their current limiting range (½ cycle fault clearing time or less), the hazard/risk category required may be reduced by one number. (5) For power systems up to 600 V the arc flash boundary was determined by using the following information: When 0.03 second trip time was used, that indicated MCC or panelboard equipment protected by a molded-case circuit breaker. Working distance used was 18 in. (455 mm). Arc gap used was 32 mm for switchgear and 25 mm for MCC and protective device type 0 for all. When 0.33 or 0.5 second trip time was used, that indicated a LVPCB (drawout circuit breaker) in switchgear. Working distance was 24 in. (610 mm). Arc gap used was 32 mm and protective device type 0 for all. All numbers were rounded up or down depending on closest multiple of 5. (6) For power systems from 1 kV to 38 kV the arc flash boundary was determined by using the following information: No maximum values were given in the 2009 edition of NFPA 70E for short-circuit current or operating time. Two sets of equations were performed: 35 kA AIC and 0.2 second operating time and 26 kA AIC and 0.2 second operating time. 0.2 seconds was used by adding the typical maximum total clearing time	"As safe or safer"

2012 NFPA 70E Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Impact on Safety
	of the circuit breaker to an estimated value for relay operation. This coincides with the IEEE 1584 values of 0.18 second operating time and 0.08 tripping time rounded off. A short-circuit current of 35 kA was used as a maximum (HRC-4 @ ~ 40 cal/cm2) and 26 kA was used to compare the effects of lowering the short circuit current (HRC-4 @ ~ 30 cal/cm2). Working distance used was 36 in. (909 mm), arc gap was 6 in. (455 mm), and protective device type 0 for all. ~~Specific Notes (as referenced in the table):~~ ~~1. Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time.~~ ~~2. Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time.~~ ~~3. Maximum of 42 kA short circuit current available; maximum of 0.33 sec (20 cycle) fault clearing time.~~ ~~4. Maximum of 35 kA short circuit current available; maximum of up to 0.5 sec (30 cycle) fault clearing time.~~	
Table 130.7(C)(15)(b)	**Table 130.7(C)(15)(b) Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated and Insulating Hand Tools — Direct Current Equipment**	"As safe or safer"
Table 130.7(C)(16)	**Table 130.7(C)(16) Protective Clothing and Personal Protective Equipment (PPE)**	"As safe or safer"
Section 200.1(3)	(3) For the purpose of Chapter 2, maintenance shall be defined as preserving or restoring the condition of electrical equipment and installations, or parts of either, for the safety of employees who work ~~on, near, or with electrical such equipment~~ where exposed to electrical hazards. Repair or replacement of individual portions or parts of equipment shall be permitted without requiring modification or replacement of other portions or parts that are in a safe condition.	"As safe or safer"
Section 205.2	**205.2 Single-Line Diagram.** A single-line diagram, where provided for the electrical system, shall be maintained in a legible condition and shall be kept current.	"As safe or safer"
Section 205.3	**205.3 General Maintenance Requirements.** Electrical equipment shall be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.	"As safe or safer"
Section 205.4	**205.4 Overcurrent Protective Devices.** Overcurrent protective devices shall be maintained in accordance with the manufacturers' instructions or industry consensus standards. Maintenance, tests, and inspections shall be documented.	"As safe or safer"
Section 240.3	~~**240.3 Cell Flame Arresters and Cell Ventilation.** Battery cell ventilation openings shall be unobstructed, and cell flame arresters shall be maintained.~~	"As safe or safer"
Article 320	Article 320 has been reworked to eliminate the installation requirements. Article reduced from 5¾ pages to 2 1/8 pages.	Revised Article addresses safety-related work practices. Installation requirements from 2009 need to be continued.
340.5 (1) a	5mA to 0.5mA	"As safe or safer"
Section 340.7(B)	**B) Employee Responsibility.** The employee is responsible for the following: (1) Understanding the hazards associated with the work (2) Being continuously alert and aware of the possible hazards (3) Using the proper tools and procedures for the work (4) Informing the employer of malfunctioning protective measures, such as faulty or inoperable enclosures and locking	"As safe or safer"

2012 NFPA 70E Article or Section	Added or Deleted Text Underlined text is added. ~~Strikethrough~~ indicates deleted text.	Impact on Safety
	schemes (5) Examining all documents provided by the employer relevant to the work, especially those documents indicating the hazardous components location (6) Maintaining good housekeeping around the equipment and work space (7) Reporting any hazardous incident (8) Using and appropriately maintaining the PPE and tools required to perform the work safely.	
§**M.1.1**	**M.1.1** Layering of arc-rated clothing is an effective approach to achieving the required arc rating. The use of all arc-rated clothing layers will result in achieving the required arc rating with the lowest number of layers and lowest clothing system weight. Garments that are not arc-rated should not be used to increase the arc rating of a garment or of a clothing system.	"As safe or safer"
§O.2.3.	**O.2.3 Arc Energy Reduction.** Where a circuit breaker that is rated for, or can be adjusted to, 1000 amperes or more is used, one of the following or equivalent means have proven to be effective in reducing arc flash energy: (1) Zone-selective interlocking (2) Differential relaying (3) Energy-reducing maintenance switching with a local status indicator An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to operate faster while the worker is working within an arc flash boundary, as defined in *NFPA 70E*, and then to set the circuit breaker back to a normal setting after the potentially hazardous work is complete.	"As safe or safer"
P	New informative annex.	"As safe or safer"